International Civil Aviation Organization
North American, Central American and Caribbean Office

WORKING PAPER

AIM/TF/7 — WP/04
24/07/24

**Seventh Meeting of the Task Force for the Implementation of Aeronautical Information Management of the North American, Central American and Caribbean Working Group (NACC/WG/AIM/TF/7)**

(Willemstad, Curaçao, July 30 – August 02 - 2024)

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**Agenda Item 3:** **Review of the AIM's Work Programme, Terms of Reference (ToRs) related to AIM implementation, System Wide Information Management (SWIM) and the incorporation of the Procedures for Air Navigation Services – Information Management (PANS IM)**

# TOWARDS THE IMPLEMENTATION OF SWIM AND THE PRESENTATION OF THE NEW PANS IM

(Presented by the Secretariat)


| **EXECUTIVE SUMMARY** | |
|---|---|
| This Working Paper on System-Wide Information Management (SWIM) presents a basic concept consisting of standards, infrastructure and governance that enable States to plan the management of ATM-related information and data and their exchange between aeronautical parties. qualified through interoperable services (ICAO Doc. 10039). | |
| Action: | Suggested actions are presented in Section 4. |
| *Strategic Objectives:* | • Strategic objective 1 – Safety<br>• Strategic objective 2 – Air navigation capacity and efficiency |
| *References:* | • States Letter Ref.: AN 2/36.1-24/39<br>• System-Wide Information Management Concept Manual (Doc 10039)<br>• Procedures for air navigation services — Information management (PANS-IM, Doc 10199, SL Ref.: AN 2/36.1-24/39)<br>• System-Wide Information Management Implementation Manual (Doc 10203), Unedited<br>• Information Security Manual (Doc. 10204), Unedited |


## 1. Introduction

1.1 SWIM (Doc 10039, **Appendix A**) enables seamless access and exchange of information between all providers and users of ATM information and services. Some information management business practices have been taken from the Information Technology (IT) sector, such as Service-Oriented Architecture (SOA) and the use of open standards and web technologies, and applied to ATM.

1.2 The SOA approach guarantees air traffic management and operation and the availability of interoperable, reusable and user-directed information services. The use of open standards and conventional web technologies reduces interoperability costs and makes the aviation data marketplace more efficient, ensuring that aviation stakeholders have access to the necessary information in the required format.

1.3 The information will be provided to users of the SWIM service through IP-VPN or the Internet basically even when other means could be used, so security devices were implemented and used as security measures for the Internet connection, network segmentation. and intrusion prevention. For the initial provision of the SWIM service, this system has been proposed to connect to the current system that centrally manages flight plan information, aeronautical information and data, MET information, etc.

**2. Discussion**

2.1 Recently, in April 2024, the first edition of the PANS-IM (Doc. 10199, **Appendix B**) was released, which comes from recommendations formulated by the second meeting of the Information Management Panel (IMP/2) and relates to system-wide information management (SWIM) and information security.

2.2 The ICAO has provided in the communication to the States AN 2/36.1-24/39, a list of tasks for the application and review of the guidance texts related to the First Edition of the PANS-IM (DOC 10199) and that Includes below as the measures to consider for implementation in relation to SWIM:

| Essential steps to be followed by a State to implement the first edition of the Procedures for Air Navigation Services — Information Management (PANS-IM, Doc 10199) |
|---|
| a) conduct a SWIM needs assessment; |
| b) conduct a gap analysis between the new ICAO provisions and the national regulatory framework; |
| c) identify the rule-making process necessary to transpose the new ICAO provisions into the national regulations, where necessary, taking into consideration the applicability date; |
| d) draft of the necessary modifications to the national regulations and means of compliance; |
| e) adopt the national regulations and means of compliance; |
| f) establish a national implementation plan that takes into account the new ICAO provisions; |
| g) train relevant personnel prior to implementation of the new provisions; |
| h) communicate the changes to impacted industry stakeholders and airspace users; |
| i) introduce new or amended regulations, as appropriate, to implement the new provisions; |
| j) modify the oversight framework according to the new and modified national regulations; |
| k) oversee the implementation of the regulation; and |
| l) publish differences in the Aeronautical Information Publication (AIP), if necessary |

**3. Conclusion**

3.1 The introduction of Internet-based technologies for information exchange (AIXM) could increase the possibility of cyber threats. However, PANS-IM reinforces the principle of secure exchange of properly validated information as a basis for SWIM. Additionally, the implementation support material provides an appropriate information security framework for critical infrastructure. It is therefore expected that the proper implementation of the provisions of the PANS-IM and the supporting guidance material will ensure reliable and organized exchanges of information, regardless of the technology used.

3.2 On the other hand, compliance with the provisions of the PANS-IM guarantees the interoperability of the various systems implemented. Furthermore, the introduction of new information into aviation systems is simplified when based on service-oriented (SOA) principles. New information supports better decision making, which in turn translates into a more efficient ATM system.

3.3 It is important to have a global mechanism for information management (IM), which is essential to achieve interoperability and harmonization in all areas of information, and to facilitate activities such as flight and flow information for the cooperative environment (FF-ICE) and the evolution of meteorological services towards the exchange of AIP digital information, and to respond to the need for aeronautical information and including aeronautical charts, the distribution of digital data sets (DDS) through information services/ data and reassessment of the NOTAM system.

**4. Suggested actions**

4.1 The meeting is invited to:

a) note the information contained in this document;

b) review the material proposed by ICAO in **Appendixes A** and **B;**

c) present as soon as possible the differences that the States may have to the documents mentioned above in References of this note; and

d) provide any other comments to the Secretariat about this matter

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**APPÉNDIX A**

ICAO

# Doc 10039

# Manual on the System-wide Information Management (SWIM) Concept

First Edition, 2024

Approved by and published under the authority of the Secretary General

INTERNATIONAL CIVIL AVIATION ORGANIZATION

ICAO

# Doc 10039

## Manual on the System-wide Information Management (SWIM) Concept

First Edition, 2024

Approved by and published under the authority of the Secretary General

INTERNATIONAL CIVIL AVIATION ORGANIZATION

Published in separate English, Arabic, Chinese, French, Russian
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and booksellers, please go to the ICAO website at www.icao.int

*First Edition, 2024*

**Doc 10039, *Manual on the System-wide Information Management Concept***
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# AMENDMENTS

Amendments are announced in the supplements to the *Products and Services Catalogue;* the Catalogue and its supplements are available on the ICAO website at www.icao.int. The space below is provided to keep a record of such amendments.

## RECORD OF AMENDMENTS AND CORRIGENDA

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# FOREWORD

Today's air traffic management (ATM) system comprises a wide variety of applications. The system is characterized by many custom communication protocols, each with their own self-contained information systems on board the aircraft or in the air traffic services units, among others. Each interface is custom designed, developed, managed and maintained individually at a significant cost. The ways in which ATM information is defined, structured, provided and used are specific to ATM-related systems.

Considering the expected growth and diversity in aviation demand, economic pressures and environmental factors, the ATM system increasingly relies on accurate and timely information. This information must be organized and provided by systems that support global interoperability, while its access and exchange should be seamless and secure.

Global improvements in information management are needed to integrate ATM supporting systems in a performance-enhancing manner. These improvements are envisioned to be applied system-wide. System-wide information management (SWIM) supporting provisions should be aligned with a globally accepted operational concept that articulates the expected benefits, enablers, features and principles for the development of, and transition to, a SWIM operational scenario.

The SWIM concept presented in this manual describes the aspects of stakeholder participation, as well as governance and operation at the technical development and implementation levels (for businesses and institutions) for SWIM. The concept provides the foundation for further developments in information management and was developed by the Information Management Panel (IMP) based on an initial draft provided by the Air Traffic Management Requirements and Performance Panel (ATMRPP).

Additional technical details and implementation guidance regarding the transition to SWIM is contained in the *Manual on System Wide Information Management Implementation* (Doc 10203).

Comments on this manual are appreciated, particularly with respect to its application and usefulness. These comments will be taken into consideration in the preparation of subsequent editions. Comments concerning the manual should be addressed to:

The Secretary General
International Civil Aviation Organization
999 Robert-Bourassa Boulevard
Montréal, Québec, Canada H3C 5H7

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# GLOSSARY

## LIST OF ACRONYMS

| | |
|---|---|
| AFTN | Aeronautical fixed telecommunication network |
| AIRM | ATM information reference model |
| AIXM | Aeronautical information exchange model |
| AMQP | Advanced message queuing protocol |
| ASP | ATM service provider |
| ASTERIX | All-purpose structured EUROCONTROL surveillance information exchange |
| ATFM | Air traffic flow management |
| ATM | Air traffic management |
| CARATS | Collaborative Action for Renovation of Air Traffic Systems |
| CNAS | China New Generation ATM System |
| FF-ICE | Flight and flow information for a collaborative environment |
| FIR | Flight information region |
| FIXM | Flight information exchange model |
| FOC | Flight operations centres |
| GANP | Global air navigation plan |
| GATMOC | Global air traffic management operational concept |
| GIF | Global interoperability framework |
| GNSS | Global navigation satellite system |
| HTTP | Hypertext transfer protocol |
| ICAO | International Civil Aviation Organization |
| ICT | Information and communication technology |
| IP | Internet protocol |
| IT | Information technology |
| IWXXM | ICAO meteorological information exchange model |
| JSON | Javascript object notation |
| METAR | Aerodrome routine meteorological report (in meteorological code) |
| OASIS | Organization for the Advancement of Structured Information Standards |
| OSI | Open system interconnection |
| PKI | Public key infrastructure |
| SDM | Service delivery management |
| SESAR | Single European Sky ATM Research |
| SIGMET | Significant meteorological information |
| SOA | Service-oriented architecture |
| SOAP | Simple object access protocol |
| SWIM | System-wide information management |
| TBO | Trajectory-based operations |
| WFS-T | Transactional web feature service |
| WMS | Web map service |
| XML | Extensible markup language |

## DEFINITIONS

***Authoritative source.*** A State authority organization or an organization formally recognized by State authority that originates or publishes data meeting the data quality requirements.

***Availability (of a service).*** The degree to which a service is operational and accessible when required for use.

***Capability.*** The ability of a system to provide a service or perform a function that, either on its own or with other services or functions, can deliver a definable level of performance.

***Capacity (of a service).*** The maximum rate at which a service can process transactions and the maximum message size of responses.

*Note.— Measurements can include the number of items that can be stored, the number of concurrent users, communication bandwidth, throughput of transactions and size of messages*.

***Collaborative validation.*** A validation of service jointly carried out by the service provider together with service users.

***Community of interest.*** A collaborative group of users who exchange information in pursuit of shared goals, interests, missions or business processes.

*Note.— Communities of interest are established in a variety of ways and may be composed of members from one or more functions and organizations, as needed, for a shared mission.*

***Confidentiality (of a service).*** The degree to which a service ensures that data are accessible only to those authorized to have access.

***Data.*** A representation of facts, concepts or instructions in a formalized manner suitable for communication, interpretation or processing.

***Data link.*** A means of digital communication between the ground and the airborne platform.

***Governance.*** The set of bodies, standards, policies and processes that ensure globally interoperable information is provided by reliable, trusted services.

***Independent validation.*** A validation of information service carried out by an independent authority.

***Information.*** The result of the assembly, analysis, formatting and documenting of data, to make the data useful in an air traffic management (ATM) context.

***Information domain.*** The scope of the integrated data for a distinct set of business activities that produce a set of unique information products and services.

***Information exchange model.*** A formal description of the information that is agreed to be shared between two or more organizations or groups and includes at least one exchange schema for the associated data.

*Note.— An information exchange model is normally defined for a specific information domain, such as aeronautical information, meteorological information or flight information. This typically includes the definition of information entities and their relationships.*

***Information quality.*** The degree or level of confidence for which the data quality, and the process used to convert data into information, meet user requirements.

***Information service.*** A type of service in a service-oriented architecture that provides an ATM-related information -sharing capability.

***Information service overview.*** A set of information service metadata intended to promote service discovery and an initial evaluation of information service characteristics.

***Information service payload.*** The assembly of information exchanged using an information service.

*Note.— Information service payloads support a specified function(s) or purpose, independent of overhead required to enable the information exchange, such as headers, and security requirements.*

***Infrastructure service.*** A service providing system-wide information management (SWIM) infrastructure capabilities such as interface management, request-reply and publish-subscribe messaging, service security and enterprise service management.

***Integrity (of a service).*** An expression of the assurance that a system, product or component prevents unauthorized access to, or modification of, an information service interface or information.

***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.

***Loose coupling.*** A characteristic in which dependencies among a system's constituting parts are minimal.

***Message exchange pattern.*** A template that describes relationships of multiple messages exchanged between interacting components to accomplish a single complete information exchange.

***Messaging capability.*** The technical infrastructure capability enabling the delivery of messages.

***Open standard.*** A standard available to the general public which is developed (or approved) and maintained via a collaborative and consensus driven process.

***Quality of service.*** The degree or level of confidence that the performance of a service meets a user’s requirements.

***Recoverability (of a service).*** The degree to which, in the event of an interruption or a failure, the desired state of the service can be re-established.

***Reliability (of a service).*** The degree to which a service performs specified functions under specified conditions for a specified period.

***Security capability.*** The technical infrastructure capability enabling secured information exchange.

***Self-validation.*** A validation of information service carried out by the service provider.

***Semantic interoperability.*** The ability of systems and organizations to exchange information with unambiguous, shared meaning.

*Note.— Syntactic interoperability is a prerequisite for semantic interoperability.*

***Service.*** A mechanism to enable access to one or more capabilities using a prescribed interface.

***Service consumer.*** An entity which seeks to satisfy a particular need with capabilities offered by means of a service.

***Service interface.*** The means by which the underlying capabilities of a service are accessed.

***Service orientation.*** The designing of systems in terms of services and service-based development.

***Service-oriented architecture (SOA).*** Architectural style that supports service orientation.

***Service provider.*** An entity (person or organization) offering the use of capabilities by means of a service.

***System-wide information management (SWIM).*** Standards, infrastructure and governance enabling the management of ATM-related information and its exchange between qualified parties via interoperable information services.

***SWIM region.*** A geographical area in which a group of States and/or ATM stakeholders have agreed upon common regional governance in support of SWIM implementation.

*Note.— A SWIM region can be an International Civil Aviation Organization (ICAO) region or any other area in which a community of interest has agreed on common governance. Communities of interest are established in a variety of ways and may be composed of members from one or more functions and organizations as needed for a shared mission.*

***SWIM registry.*** A directory containing entries with the information necessary to discover and access information services.

***Technical infrastructure.*** The assembly of software and hardware used to enable the provision of information services.

***Time behaviour (of a service).*** A measurement of the processing times of a service.

*Note.— This parameter may be expressed as an indication of the maximum time needed for a service provider to complete the request, measured from the time instant the service provider receives the request to the time instant the service provider sends the response or makes it available.*

***User validation.*** A validation of information service carried out by service users.

***Validation of service.*** An activity whereby a service is checked for conformance with service objectives and requirements.

*Note.— The service objectives and requirements are captured in the service overview and technical specifications.*

## REFERENCE DOCUMENTS

Annex 3 — *Meteorological Service for International Air Navigation*

Annex 10 — *Aeronautical Telecommunications,* Volume II – *Communication Procedures Including Those with PANS Status*

Annex 11 — *Air Traffic Services*

Annex 15 — *Aeronautical Information Services*

*Procedures for Air Navigation Services — Air Traffic Management* (PANS-ATM, Doc 4444)

*Convention on International Civil Aviation (Doc 7300)*

*Global Air Navigation Plan* (GANP, Doc 9750)

*Global Air Traffic Management (ATM) Operational Concept* (Doc 9854)

*Manual on Air Traffic Management System Requirements* (Doc 9882)

*Manual on Global Performance of the Air Navigation System* (Doc 9883)

*Manual on Flight and Flow — Information for a Collaborative Environment (FF-ICE)* (Doc 9965)

*Manual on Collaborative Air Traffic Flow Management* (Doc 9971)

*Manual on the ICAO Meteorological Information Exchange Model* (Doc 10003)

*Procedures for Air Navigation Services — Aeronautical Information Management* (PANS-AIM) (Doc 10066)

*Air Traffic Management Service Delivery Management* (ATM SDM) (Cir 335)

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# Chapter 1

# GENERAL

## 1.1 PURPOSE AND SCOPE OF THE DOCUMENT

1.1.1 The *Global Air Traffic Management (ATM) Operational Concept* (Doc 9854) envisions the application of system-wide information management (SWIM), or simply put, information management, to integrate the ATM network in an information sense, not just in a system sense. This paradigm shift is the basis for migrating the previous one-to-one message exchange concept to the future many-to-many information distribution model. In this new scenario, many geographically dispersed sources collaboratively update the same piece of information, with many geographically dispersed destinations maintaining situational awareness regarding changes to that piece of information. The *Manual on Air Traffic Management System Requirements* (Doc 9882) reinforces the need for this paradigm shift.

1.1.2 In order to meet this vision and its subsequent requirements, information management solutions need to:

a) be defined at the overall system level, rather than individually at each major subsystem (programme, project, process or function) and interface levels, which was previously the case;

b) provide validated, quality-assured and timely information to support ATM operations. The quality of shared information will be monitored and controlled, and information-sharing mechanisms to support the ATM community will be provided; and

c) enable the seamless transfer of relevant information between parties in a flexible, adaptable and scalable information environment.

1.1.3 For this paradigm shift to happen, global interoperability must be achieved, and SWIM must be developed and deployed in a harmonized manner. The global SWIM concept starts with a common understanding of what it is and a description of the operations under a SWIM environment. To this end, this document:

a) provides a common understanding of the SWIM concept at a global level;

b) facilitates the communication between States or communities trying to coordinate efforts on related topics; and

c) establishes guidelines for providing information services based on a service-oriented architecture (SOA) that enables information service providers to deliver global interoperability by applying SWIM principles.

1.1.4 The principles listed in 1.1.3 will be achieved by:

a) defining terms relevant to SWIM to enable international discourse;

b) describing the SWIM concept and key principles;

c) introducing SWIM components (information, information services, technical infrastructure and governance);

d) introducing the SWIM global interoperability framework (GIF) layers (information services, information exchange models, technical infrastructure) and detailing their relationship with applications and the underlying network; and

e) describing how information is exchanged, both ground-ground and air-ground, using information exchange standards, information services and technical infrastructure.

1.1.5 The SWIM concept applies to users and stakeholders who exchange ground-ground as well as air-ground information. For the purposes of this manual, SWIM refers to the capabilities and components required to enable information exchange both on the ground and with airborne platforms.

1.1.6 Since SWIM concepts were researched and developed at varying times, implementation stages may differ in several States. With the advent of modernization programmes such as the Collaborative Action for Renovation of Air Traffic Systems (CARATS) in Japan, the China New Generation ATM System (CNAS), the Next Generation Air Transportation System (NextGen) in the United States, and the Single European Sky ATM Research (SESAR) in Europe, stakeholders consider the implementation of SWIM as a fundamental requirement for future ATM operations.

1.1.7 SWIM implementation falls under the International Civil Aviation Organization (ICAO) strategic objective of increasing capacity and efficiency. As such, it supports a global air transport network with growing social, economic and connectivity needs of global businesses and the traveling public.

## 1.2 ORGANIZATION OF THE DOCUMENT

The document is organized as follows:

Chapter 1 provides the purpose, scope and organization of the document as well as its relationship to other publications.

Chapter 2 introduces the SWIM paradigm shift, the need for SWIM, SWIM and SOA, along with their principles, benefits and other aspects.

Chapter 3 describes the SWIM concept, including its components, scope, stakeholders and roles, information domains, global interoperability, quality management and performance improvement, to name a few.

Chapter 4 to Chapter 7 describes the four SWIM components: governance, information, information services and technical infrastructure.

## 1.3 RELATIONSHIP TO OTHER PUBLICATIONS

1.3.1 The *Global ATM Operational Concept* (Doc 9854) describes a future concept in which information is managed system-wide. Based upon this concept, the *Manual on Air Traffic Management System Requirements* (Doc 9882) explicitly identifies the implementation of SWIM as a requirement for the future ATM system.

1.3.2 The *Manual on Flight and Flow — Information for a Collaborative Environment* (FF-ICE) (Doc 9965) explains flow management, flight planning and trajectory management associated with the ATM operational concept components. FF-ICE relies on SWIM as a mechanism to exchange flight information while managing the consistency and timeliness of that information. Flight and flow information for a collaborative environment (FF-ICE) was developed to support the vision outlined in the Global ATM Operational Concept and to meet the requirements outlined in Doc 9882. SWIM serves as the basis for information management and sharing, as described in Doc 9965. The *Manual on Collaborative Air Traffic Flow Management* (Doc 9971) describes the importance of information exchange for establishing a collaborative environment.

1.3.3 The concept of trajectory-based operations (TBO) for sharing and managing trajectories and associated information is also fundamental to realizing the vison outlined in the Global ATM Operational Concept. TBO affects many processes, procedures and information flows.

1.3.4 The standards that define the content, format and rules for exchanging information also relate to the management of that information. Examples of information exchange models are the aeronautical information exchange model (AIXM), flight information exchange model (FIXM) and the ICAO meteorological information exchange model (IWXXM).

1.3.5 Standards are to be applied at all layers of SWIM; information technology (IT) standards will be adopted for SWIM implementations. Since the associated technologies and technical standards are evolving at a rapid pace, this manual provides representative examples only with regard to the types of standards and technologies necessary for global harmonization.

1.3.6 Provisions regarding the management and exchange of information within the ATM system can be found in the following ICAO documents:

Annex 3 — *Meteorological Service for International Air Navigation*;

Annex 10 — *Aeronautical Telecommunications*;

Annex 15 — *Aeronautical Information Services*;

*Procedures for Air Navigation Services — Aeronautical Information Management* (PANS-AIM) (Doc 10066);

*Procedures for Air Navigation Services — Air Traffic Management* (PANS-ATM) (Doc 4444); and

*Manual on the ICAO Meteorological Information Exchange Model* (Doc 10003).

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# Chapter 2

# SWIM PARADIGM SHIFT

## 2.1 THE NEED FOR SWIM

2.1.1 The drive towards information services was triggered by advancements in the information and communication technology (ICT) sector over the past years. Airline and air traffic management systems increasingly rely on automated systems, which in turn rely on accurate data. For example, air navigation techniques such as global navigation satellite system (GNSS)-based approaches require that digital data be transmitted with accuracy and integrity from the originator to the users. Hence, there is a need to standardize the distribution of digital data.

2.1.2 Historically, data have been made available in paper format using graphics and textual messages. Aeronautical charts, NOTAM, meteorological messages and non-standardized digital data are a few examples. However, this format no longer meets the needs of the users. Considering that data is often digitized in the later stages of the data chain and acknowledging the risk of misinterpretation or duplication of effort, the ATM community recognized that data must originate in a digital format and be available through interoperable information services.

2.1.3 The current communication infrastructure is built around point-to-point connections between systems as depicted in Figure 2-1. This infrastructure requires dedicated systems to connect to networks and the messages exchanged therein between targeted (fixed) addresses. Each time a new information exchange need arises between two systems, a new connection must be set up. Each connection usually has its own interface that is implemented through dedicated interface control documents in the systems that are either producing or consuming the information. This requires additional system procurements, or modifications to existing systems, to establish the required connection. Traditionally, these interfaces were frequently designed for aeronautical fixed telecommunication network (AFTN) low speed links. The result is an architecture that is costly to maintain, expand and lacks the required agility.

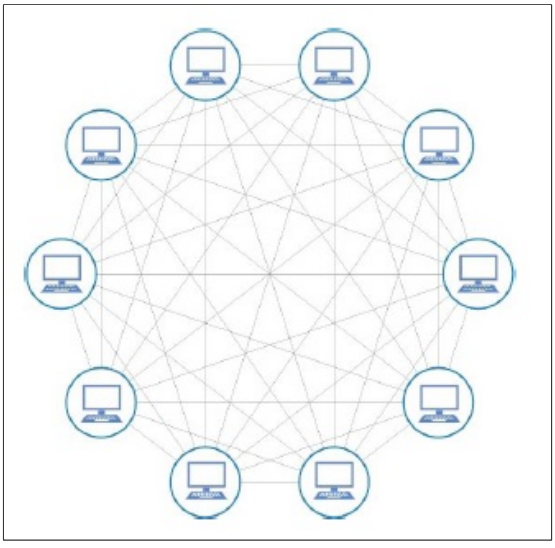

**Figure 2-1. Point-to-point connections between systems**

2.1.4 In brief, current information exchange techniques are constrained by:

a) a lack of understanding of global ATM information management. Systems have not been designed and implemented to be interoperable within globally agreed-upon parameters. This has led to:

1) a lack of semantic interoperability due to key ATM concepts having different meanings across different areas of ATM and across various standards published by different standards-making organizations;

2) system complexity, high maintenance costs and undue operational difficulties for ATM personnel;

3) inconsistent definitions, code-lists, ranges of values, units of measurement, formatting (date and time, latitude/longitude, etc.), identifiers, etc.;

4) uncertain quality of information; and

5) uncertain quality of data (accuracy, resolution, integrity and timeliness);

b) interfaces designed to support point-to-point or application-to-application exchanges, with limited flexibility to accommodate new users, additional systems, and new content or changed formats;

c) legacy information products, such as NOTAMs, that are limited in functionality and usability due to their textual nature. Paper-based aeronautical information products are also limited in usability and interoperability because they lack a digital format. Flight plan data is distributed without standardized methods for referencing the required information for flight planning. Meteorological messages are delivered using different formats and standards and have focussed on legacy products (such as, significant meteorological information (SIGMET) and aerodrome routine meteorological report (in meteorological code form) (METAR));

d) message-size limitations and a non-scalable approach;

e) an infrastructure that makes it difficult and costly for one stakeholder to have timely access to the information originated by another stakeholder; that is, lack of global interoperability prevents collaboration among stakeholders;

f) a plethora of systems that make it challenging to devise security frameworks to support the increasing need for open and timely data exchange while concurrently addressing the security concerns of all stakeholders;

g) information inconsistencies and duplication of efforts due to organizations managing ATM information in partial isolation. This implies that significant time and effort is spent on aligning standards across communities and lifecycles;

h) limited focus on ground-based ATM service providers (ASPs) and flight operations centres (FOCs) with restricted opportunity for flight deck involvement in the collaboration process. Inadequate processes to collaborate with airspace users, especially those without dispatch support, which do not accommodate the full range of benefits defined in the Global Air Navigation Plan (GANP), including air traffic flow management (ATFM);

i) inadequate methods for exchanging digital information between the ASP and the aircraft in support of the collaborative environment envisaged by the TBO concept;

j) lack of flight crew access to a shared information platform to fulfil advisory needs in-flight or on the ground. Airspace users without dispatch support may not have access to relevant information, whether on demand or in near real-time, preventing them from making collaborative decisions or participating in ATFM initiatives; and

k) a lack of collaboration mechanisms, which decreases the effectiveness of ATFM continuous planning that enables incremental updates for airborne flights.

## 2.2 SWIM AND SERVICE ORIENTATION

2.2.1 Service-oriented architecture de-couples the information service providers from the consumers (see Figure 2-2). Information becomes available through standard interfaces to a wide range of users without the need for dedicated connections between the providers and the consumers. New information service consumers can be readily added because the number of interfaces has been reduced. Since the dependencies are easier to manage through the standard interfaces, users become actively involved consumers with associated responsibilities. This means that information providers no longer make implementation decisions for the consumers.

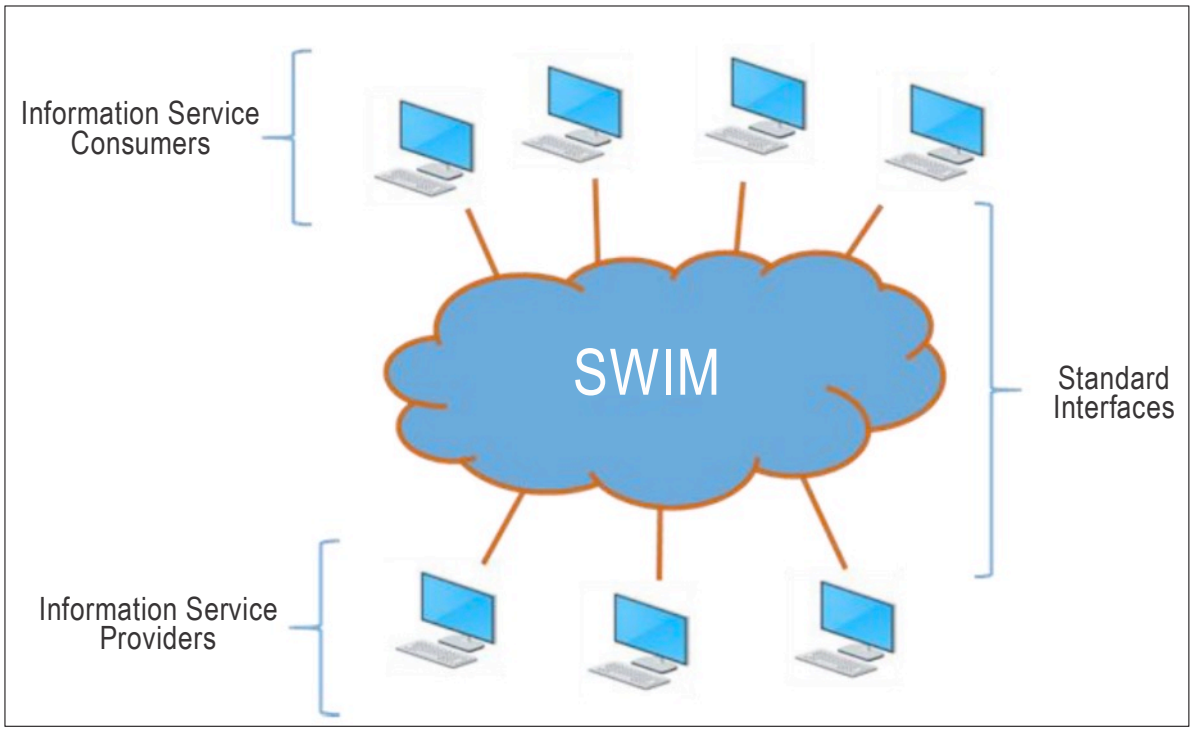


**Figure 2-2. SOA de-couples information service providers from the consumers**

2.2.2 When transitioning to SWIM, there are two key activities that support modernization: becoming data centric and becoming network centric. The second activity builds upon the first by making information services available and sharable with consumers. Together, these activities make ATM information more readily available, however, they require a unified approach to SWIM.

2.2.3 SWIM builds upon the notion of service within the ICT community. A single service can then be implemented as a web service using open standards. Typically, web services enable Internet applications such as banking, e-government and e-commerce to conduct the necessary information exchanges.

2.2.4 Defining a single service can be a straightforward task, however, creating an ecosystem of interoperable services that work together, are re-usable and respond to actual operational needs may become a complex endeavour. A solution for the development of this ecosystem is provided by the notions of service orientation and SOA, which have been successfully applied in other industries, like manufacturing, banking, health care and retail.

2.2.5 According to the Organization for the Advancement of Structured Information Standards (OASIS), SOA is a paradigm for organizing and utilizing distributed capabilities that may be under the control of different owners[1]. While there is no formally agreed-upon definition of SOA, it is considered that partitioning functionality into un-associated, self-contained, reusable services, that can be discovered by potential consumers, is a key feature that discriminates SOA from more traditional architectural paradigms.

2.2.6 Based on ISO 18384-1:2016:

a) an SOA is defined within the context of SWIM as an architectural style that supports service orientation; and

b) service orientation is at the centre of this paradigm and is defined as the designing of systems in terms of services and service-based development.

While individual services are used as the means to realize information exchanges, a service is a way to combine business and ICT viewpoints when building information systems. The following perspectives can be observed:

a) from a business perspective, a service is used to capture expected business outcomes in relation to business processes, such as collaborative ATM processes and information exchange requirements;

b) from an ICT perspective, a service enables access to one or more capabilities using technology; and

c) from an organizational perspective, service orientation increases the efficiency of information system development, integration and resource re-use. This increases the agility of organizations to better respond to changing operational needs in a digitally connected environment. Service orientation may also be part of an organization’s strategic objective to manage technology provider dependencies.

2.2.7 Applying service orientation to SWIM enables stakeholders to collaboratively define information exchanges by means of information services. An *information service provider* publishes and exposes information as *information services* for use by *information service consumers*. These consumers find the required information and the relevant information service providers by using a registry that makes information service overviews available. Information service overviews contain metadata to ensure the proper use of the information service.

2.2.8 A key principle of service orientation is loose coupling between service providers and consumers. That is, reliance on other components or services is minimized, allowing components and services to operate with as little knowledge as possible of other components or services (that is, a consumer needs to understand only what is absolutely required to invoke a service).

2.2.9 While service orientation is envisaged for a global information exchange, the benefits of a service-oriented architecture for stakeholders should be balanced with implementation costs. ASPs that have a large number of interdependent ATM systems (with unique interface requirements) may pursue service orientation internally in order to

1. Reference Architecture Foundation for Service Oriented Architecture Version 1.0 (oasis-open.org)

provide ATM functions. ASPs and other stakeholders that have fewer systems may opt to retain their current architectures, as long as the information services to be provided and consumed follow the established standards.

2.2.10 SWIM enables stakeholders to draw upon industry best practices to capitalize on new opportunities, services and capabilities through service orientation. Industry best practices in service orientation are known to provide the following benefits:

a) *More agile service delivery.* Service orientation enables organizations to respond efficiently to new business imperatives, develop distinctive new capabilities and leverage existing services for responsiveness. It does this by delivering information services to the aviation industry.

b) *Cost reductions*. Service orientation promotes the reuse of existing assets, increasing efficiency and reducing application development costs by sharing available code bases and services between ASPs. An integrated SWIM implementation can improve coordination across all ATM system components by reducing costly and time-consuming data conversion.

c) *Return on investment.* Service orientation enables operational improvements to the ATM system and provides a higher return on investment to projects that implement SWIM and to other projects enabled by SWIM.

d) *Meeting IT goals.* The technological value of service orientation in a SWIM environment includes:

1) *simpler systems*: service orientation is based on industry standards and reduces complexity compared to integrating systems on a solution-by-solution basis;

2) *lower maintenance costs*: service orientation facilitates simplicity and ease of maintenance, which leads to lower support costs than those for point-to-point interfaces;

3) *enhanced architectural flexibility*: service orientation supports the creation of next-generation, performance-driven composite solutions that consolidate numerous business processes from multiple systems; and

4) *lower integration costs*: service orientation makes it possible for organizations to develop, implement and re-use processes that are technically enabled and integrated by using open technology standards. In addition, connectivity, information exchange and process integration efforts are simplified. This reduces integration-related development and support costs.

2.2.11 There is no single approach that follows a pre-defined process (for example, identify, design, implement, and deploy) and leads to service orientation. Approaches may be top-down (architecture driven) or bottom-up (productivity driven).

## 2.3 DEFINITION

2.3.1 SWIM consists of standards, infrastructure and governance, enabling the management of ATM-related information and its exchange between qualified parties using interoperable information services. SWIM introduces a change in the business practices of managing information during the entire lifecycle of an ATM process and seeks to provide the right information, to the right people, at the right time, in an interoperable manner that meets appropriate quality standards.

2.3.2 SWIM complements human-to-human with machine-to-machine communication and improves data distribution and accessibility. However, the flexibility whereby human intelligence and oral communication can adapt to

the situational nuances of communication and operations is to be engineered into IT systems. Hence, IT systems increasingly need to discover, request and access standardized information that is operationally relevant, depending on the circumstances, rather than simply ingest pre-agreed messages.

## 2.4 INTEROPERABILITY PRINCIPLES

2.4.1 SWIM uses the best practices from different information communities to meet the needs of the global ATM community. The aim of SWIM is to provide consumers with access to relevant and mutually understood information in an interoperable manner. The principles below support global interoperability.

a) *Use of interoperable information services.* Interoperable information services facilitate required information exchanges based on operational needs and the analysis of related processes.

b) *Separation of information provision and consumption.* A clear separation of provider and consumer concerns allows for flexibility in terms of the number and the nature of the consumer. To achieve this, each service is self-contained, and the information service consumer is isolated from the implementation details of the service.

c) *Loose coupling.* A system characteristic where each of its components has, or makes use of, minimal dependencies with other distinct components.

d) *Discoverability.* A system characteristic for an information service consumer to be able to find available information services with the help of an information service overview.

e) *Use of open standards.* An open standard is one made available to the general public, which has been developed and maintained via a collaborative and consensus-driven process.

f) *Secure information exchange.* The exchange of information based on a security framework that encompasses security dimensions, like the management, control and execution of responses to cyber threats and cyber-attacks.

2.4.2 These principles promote globally interoperable information exchanges. While some ASPs may adopt service orientation processes internally to promote an agile evolution, others may choose not to, or may plan evolutions of their back-end systems at a later stage. Interoperability between back-end systems in a SWIM environment may be facilitated through mediation services that act as a gateway between the services offered in a SWIM environment and the ASP back-end systems.

## 2.5 BENEFITS

2.5.1 When SWIM is implemented, the following benefits can be observed:

a) improved safety by providing the ATM community with relevant information more efficiently, while delivering the right information to the right place at the right time;

b) improved efficiency by enabling performance-based operations and transitioning from a message-based to a service-oriented environment;

c) improved collaborative decision-making among all stakeholders during all strategic and tactical phases of flight (pre-flight, in-flight and post-flight) through:

1) access to dynamic data;

2) improved shared situational awareness; and

3) improved availability of quality data and information from authoritative sources;

d) increased ATM system performance, leading to increased operations through operational efficiencies;

e) more flexible and cost-effective communications;

f) loose coupling, which minimizes any impact in changes between service providers and service consumers, leading to lower ICT system development and maintenance costs; and

g) improved information interoperability by leveraging global information exchange standards and promoting compliance with agreed principles.

2.5.2 When air-ground SWIM is implemented, these additional benefits can be observed:

a) provision of quality information to the ATM system by aircraft automation and flight crews and full integration of the aircraft, as a node, in ATM collaborative processes;

b) improved decision-making by airspace users to support ATFM operations and trajectory synchronization operations through improved situational awareness, taking into account the latest meteorological and aeronautical information;

c) increased system performance: operations without dispatch support can participate in ATFM solutions, submit preferences to better meet business objectives and engage in enhanced dispatch-type activities at various points in the flight, both pre- and post-departure;

d) improved decision-making for ATFM operations by providing ASP operational personnel and ATM systems with a higher quality of information (for example, weather updates, air reports, desired profiles, fuel endurance, etc.) from the aircraft and its automation, as well as the airspace users;

e) increased predictability, flexibility and efficiency within the ATM system through a timely bi-directional communication link with near real-time data input (for example, atmospheric conditions, ground operations facilities and systems) from the airborne platform;

f) enhanced access to airspace constraint information and flow restrictions to assist flight crews in re-planning their flights, provide information that supports negotiation with ATFM and enable coordination of flight plan updates initiated by the FOC;

g) increased situational awareness by enabling airspace users, specifically flight crews, to make information available to the ASP, including reroute preferences, air reports and airspace conditions. The addition of information from the aircraft and its automation supplements the ground ATM systems with the latest information on the atmospheric state and flight crew preferences for trajectory negotiations. Air-ground SWIM enables air traffic controllers to focus on their primary tasks and spend less time soliciting and relaying information;

h) enhanced negotiation of four-dimensional trajectories due to the reduction in voice communication and the increased speed of air-ground SWIM connections;

i) facilitated interoperability through standardization, which increases return on investment and encourages more widespread use of information. Increasing the bandwidth of air-ground SWIM permits a more extensive exchange of information than is currently supported by data link communications;

j) enhanced planning phase of demand and capacity balancing by giving flight crews timely access to information. This enables collaboration between the ASP and flight operations centres to optimize four-dimensional trajectories by considering resource constraints; and

k) enhanced resource allocation, operational control decisions and disruption mitigation through higher quality information available to stakeholders on the ground, such as aircraft arrival time, conditions of the aircraft, crew and payload, etc.

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# Chapter 3

# SWIM CONCEPT DESCRIPTION

## 3.1 COMPONENTS, CONTEXT AND SCOPE

### 3.1.1 Components

3.1.1.1 The components of SWIM comprise information, information services and technical infrastructure supported by governance (see Figure 3-1). These components enable the management of ATM-related information and its exchange between qualified parties via interoperable services. SWIM-enabled applications and Internet protocol-(IP) based networks are closely related, in the sense that SWIM-enabled applications exchange information through information services, which in turn use technical infrastructure capabilities based on underlying IP connectivity.

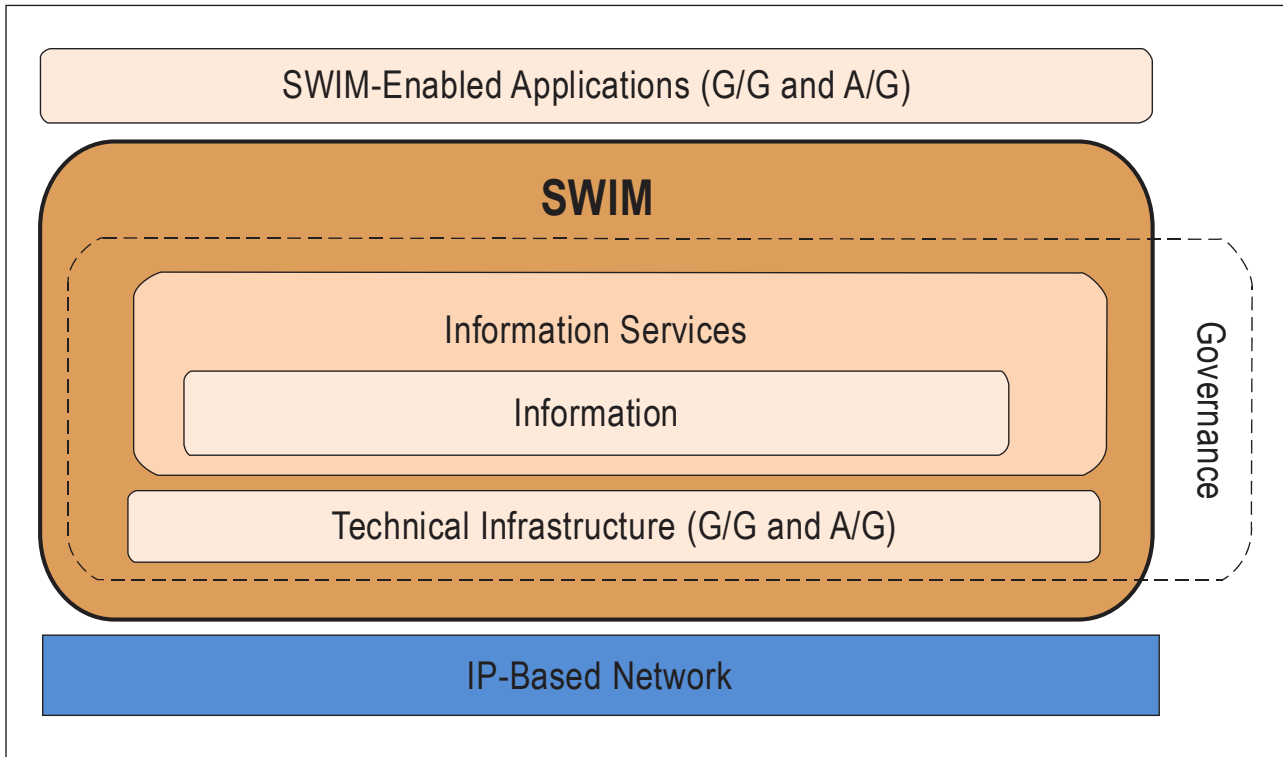


**Figure 3-1. The components of SWIM**

3.1.1.2 *Governance*. The objective of the governance is to help achieve interoperability, which requires that all components of SWIM adhere to agreed-upon rules, for example, access to information services, quality and trust.

3.1.1.3 *Information.* The ATM community depends on timely, accurate, relevant and quality-assured information to make informed decisions. Information is the foundation of SWIM, allowing the ATM system to operate in a safe and efficient manner.

3.1.1.4 *Information Services.* Information services are the means through which information service providers make information available, including the capabilities to allow an information service consumer to interact with the information service provider. Information services consist of operations and messages within a defined functional scope that allow for the efficient exchange of information. The intent is for information services to replace the current message-based information distribution.

3.1.1.5 *Technical Infrastructure.* The technical infrastructure (ground-ground and air-ground) consists of infrastructure services providing capabilities such as messaging and security. As much as possible, these services are based on mainstream ICT using IP-based network connectivity. The implementation of the technical infrastructure depends on the specific needs of common and agreed-upon technical infrastructure profiles and may be different from one context to another (for example, there may be differences in implementation across regions).

3.1.1.5.1 On-board IP-based network connectivity is essential for air-ground SWIM to enable the airborne platform to access and publish information. Air-ground SWIM leverages existing bandwidths to enable connectivity with the aircraft.

3.1.1.5.2 Additional components and functionalities are needed to allow information services to be delivered to an airborne platform. These specific air-ground SWIM components operate at the technical infrastructure level and provide functionalities to interface with ground-ground SWIM. The purpose of these additional components is to ensure that the information being exchanged is secure and valid. Depending on the specifics of ground-ground and air-ground SWIM implementations, some of the air-ground SWIM components may share similar functionalities with ground-ground SWIM components and certain functionalities may actually overlap with their ground-ground SWIM counterparts.

3.1.1.5.3 Figure 3-2 depicts a possible air-ground SWIM system architecture. The ground-ground SWIM technical infrastructure is based on an SOA messaging infrastructure. Primary (safety critical) command-and-control methods (for example, voice, data link) are depicted on the left side of the figure. The middle portrays a data link via air-ground solutions used solely for advisory information. The airline or flight operations centre (AOC/FOC) may receive advisory information through either an air/ground SWIM functionality or through the airborne solution. The right side of the figure shows the customary connections between an FOC and the aircraft.

### 3.1.2 Context

3.1.2.1 The ‘IM’ in SWIM (i.e., information management) refers to the leading, planning, organizing, structuring, describing and controlling of the collection of information (developed from one or more data sources), and monitoring that information throughout its lifecycle; including the exchange of information (e.g. distribution to one or more audiences) and reviewing user needs to incorporate future improvements of SWIM. SWIM will focus on streamlining global ATM information management activities necessary to minimize variation in exchanging information through information services; a subset of a larger set of information management activities.

3.1.2.2 Figure 3-3 shows the relationship between information management as a discipline and SWIM. It shows SWIM components – information, services and governance – and details lifecycle properties. The box in Figure 3-3 delineates the scope of the information management concepts covered in this manual. This scope focuses on the objective of SWIM at a global level: achieving the required interoperability between information service providers and consumers. The figure also provides examples of artefacts that support SWIM.

### 3.1.3 Scope

3.1.3.1 SWIM addresses information, information services, technical infrastructure and governance.

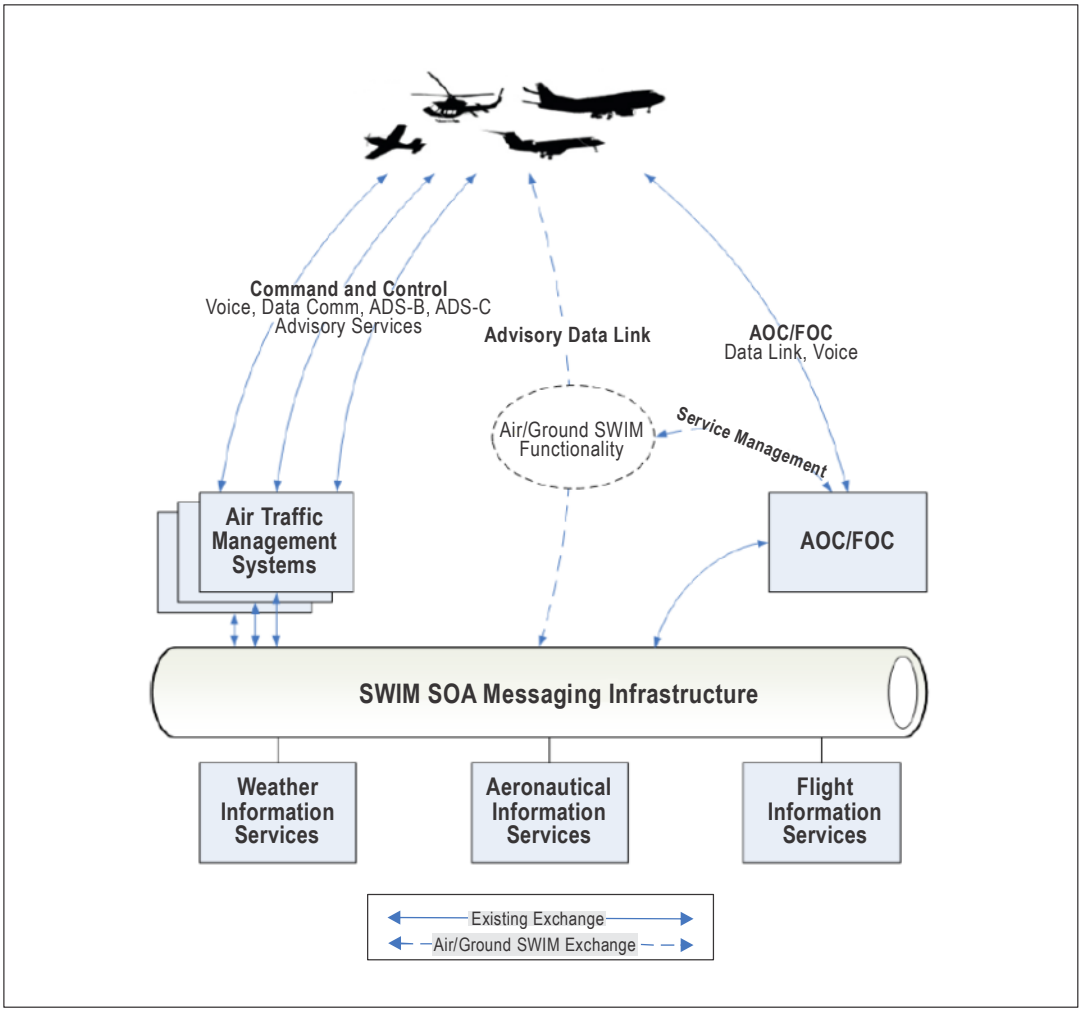


**Figure 3-2. Example of air-ground information exchange based on SWIM**

3.1.3.2 With air-ground SWIM, the scope of SWIM includes the aircraft and its ability to provide and consume information. Air-ground SWIM leverages air-ground data link connectivity (e.g., IP-based network) capabilities that are becoming more widespread on aircraft. Two technical infrastructure components are needed, namely:

a) ground-ground technical infrastructure to enable ASP and flight operators to exchange information; and

b) air-ground technical infrastructure to exchange information with the aircraft and its automated systems.

3.1.3.3 As an enabler, the need for SWIM development and deployment lies in the requirements of SWIM-enabled applications that, although not a part of SWIM, are the primary users thereof. The information exchange requirements of operational ATM services define the scope and quality of the information exchanged among SWIM-enabled applications using information services over an IP-based network.

3.1.3.4 Even though SWIM-enabled applications and IP-based network connectivity are key aspects in the realisation of SWIM, they are not in the scope of SWIM. However, this manual references SWIM-enabled applications and IP-based network connectivity to help present the SWIM concept.

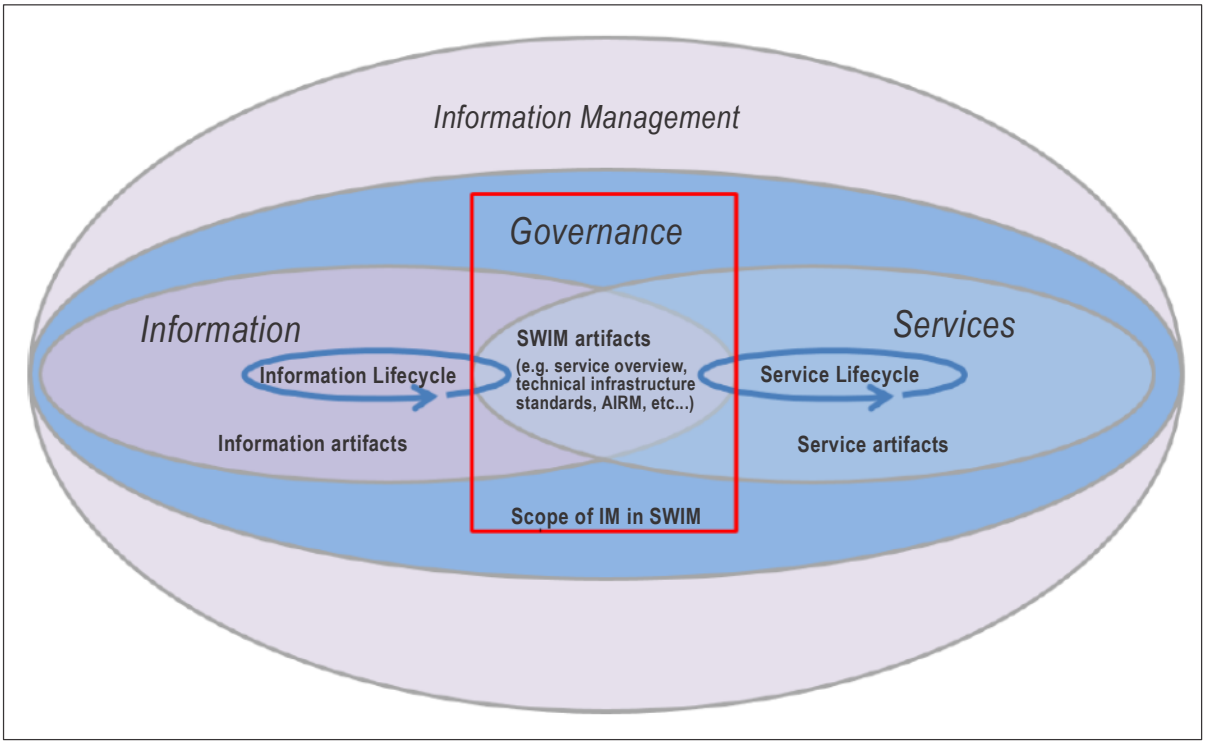


**Figure 3-3. Information management in SWIM**

## 3.2 SWIM STAKEHOLDERS AND ROLES

3.2.1 The Global ATM Operational Concept (Doc 9854) lists and describes the various members comprising the ATM community, as follows:

a) aerodrome community;

b) airspace providers;

c) airspace users;

d) ATM service providers;

e) ATM support industry;

f) ICAO;

g) regulatory authorities; and

h) States.

3.2.2 SWIM stakeholders are comprised by listed members above. Some of these members (e.g. ICAO, States and regulatory authorities) will be mainly responsible for the governance in SWIM.

3.2.3 SWIM stakeholders can have distinct roles aligned with the components of SWIM: information, information services, technical infrastructure and governance. The following roles can be distinguished:

a) the *originator* produces data and information as an information service payload;

b) the *information service provider* integrates, transforms and disseminates the payload via an information service, or provides the technical infrastructure over which the information service is delivered;

c) the *information service consumer* uses the information service or the technical infrastructure; and

d) the *regulator* ensures that policies are followed and requirements are met.

3.2.4 SWIM stakeholders may have multiple roles; for example, the aerodrome operator can be the originator and provider of aerodrome information services and a consumer of other services. Each role has certain responsibilities; for example, ensuring information quality, service availability, performance and compliance with requirements. There may be more than one stakeholder supporting the implementation of each SWIM component. Each of these stakeholders will assume a specific role and some of the listed responsibilities.

## 3.3 INFORMATION DOMAINS

3.3.1 SWIM supports the exchange of ATM-related information. This information may be categorized into information domains. Information domains comprise integrated information for a distinct set of business activities that produce unique information products and services. Some information domains have a dedicated information exchange model, for example, aeronautical, flight and flow, and meteorological information.

3.3.2 These models have been defined in harmonized conceptual and logical data models. They describe the format and structure of the data elements that make up the corresponding domain. Since the relationship between the information domains that capture aviation activities are complex, the domains can overlap significantly from State to State depending on the complexity of their national airspace systems.

3.3.3 Information domains set the scope of information exchange models. The initial information domains were based on the major information exchanges already in use prior to the development of the SWIM concept. Figure 3-4 shows several identified and user-based information domains.

3.3.4 The current information domains relate to the subdivision of identified activities. Information service consumers, however, see information in a more interrelated way, as shown on the right side of Figure 3-4. Furthermore, information service consumers expect interoperable information that can be integrated seamlessly. The notion of progressively achieving seamless information exchange, supported by information services, is realized by SWIM. SWIM-enabled applications, which consume and provide information services, may relate to one or more information domains, or to one or more stakeholders.

3.3.5 Although information service providers may organize activities according to information domains, information service consumers have crosscutting information needs.

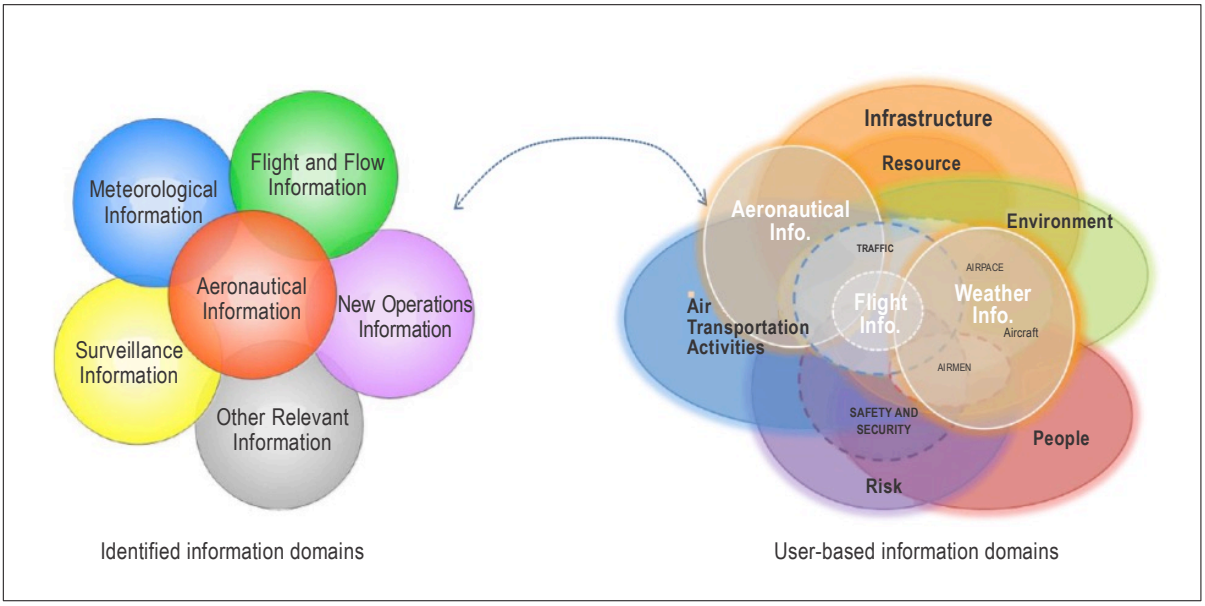


**Figure 3-4. Differences between information domains**

## 3.4 GLOBAL INTEROPERABILITY

### 3.4.1 Introduction

3.4.1.1 In the context of SWIM, interoperability:

a) is the ability of ICT systems, and of the business processes they support, to exchange data and to enable sharing of information and knowledge;

b) enables systems that belong to different organizations to communicate and exchange information; and

c) enables systems to interpret the information in a meaningful manner and to agree on the information required.

3.4.1.2 Achieving interoperability between information service providers and consumers is one of the key challenges of SWIM. To efficiently manage and exchange information, global standards and uniform principles are necessary to ensure that different implementations of information management systems work together seamlessly.

3.4.1.3 Achieving interoperability involves considerations at multiple levels including:

a) organizational level (e.g., business processes and rules);

b) information level (e.g., meaning of information and shared knowledge); and

c) technical level (e.g., network level protocols).

3.4.1.4 Interoperability alignments occur when using:

a) specific standards and specifications, for example, IP, hypertext transfer protocol (HTTP), simple object access protocol (SOAP), advanced message queuing protocol (AMQP), transactional web feature service (WFS-T), web map service (WMS), extensible markup language (XML) schema, JavaScript object notation (JSON), etc.;

b) profiled specifications (e.g., subset of ISO19115); or

c) newly created specifications (e.g., IWXXM).

3.4.1.5 Some specifications apply to SWIM in general (e.g., IP to be used cross-domain) and others pertain to a particular community of interest (e.g., IWXXM within the meteorological information domain). The version of a specification identifies the actual modernization step in which a community of interest is located. For example, IWXXM is a first step leading to the integration of meteorological information based on the use of an XML schema for a number of products currently defined in Annex 3 — *Meteorological Service for International Air Navigation*.

### 3.4.2 Global interoperability framework

3.4.2.1 Interoperability frameworks are useful tools to structure the complexity of interoperability. They focus on the essential aspects to be shared and considered by all involved stakeholders. Figure 3-5 presents a high-level implementation-oriented depiction of the SWIM global interoperability framework (GIF) with examples of actual standards.

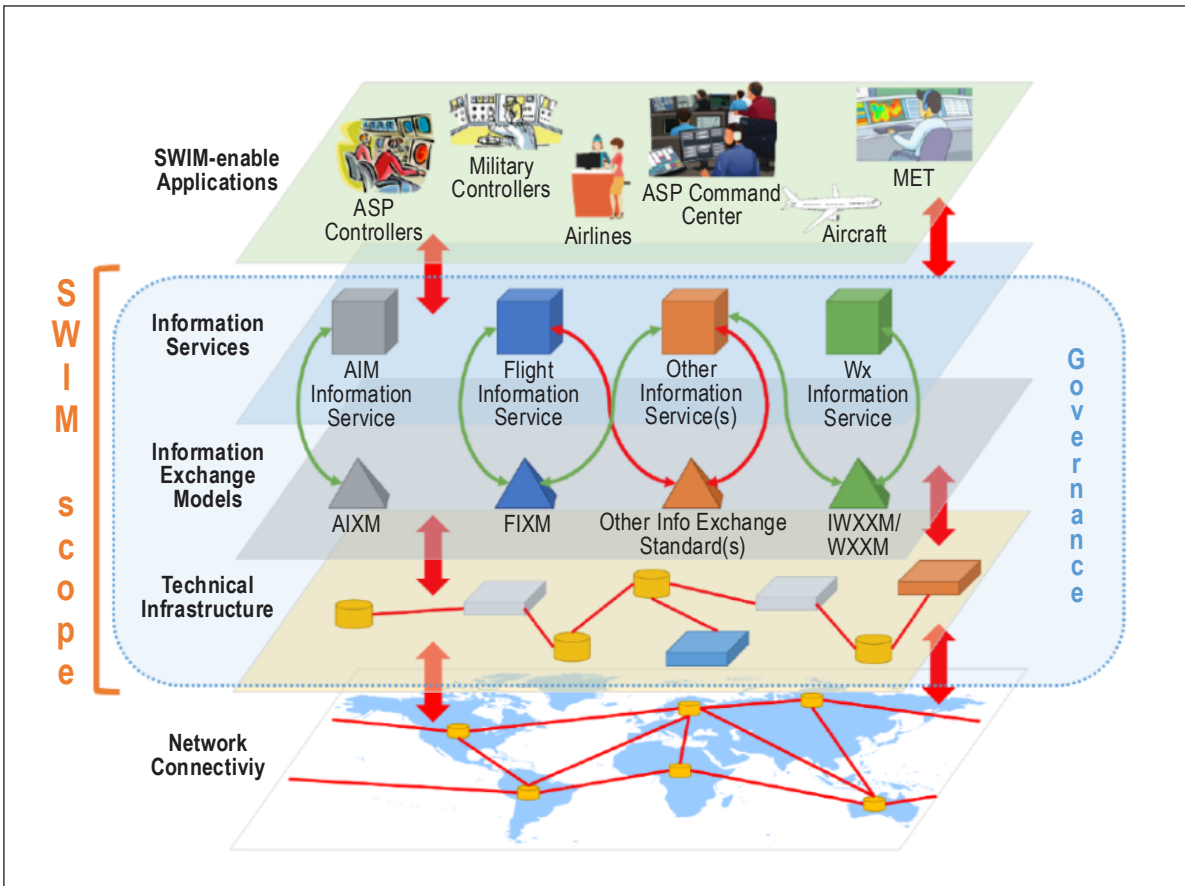


**Figure 3-5. The five-layered SWIM global interoperability framework**

3.4.2.2 The five-layered framework represents the sharing of information via SWIM and is based on several complementary descriptions of SWIM from its stakeholders. The layers explain the functions, the combination of representative standards and the mechanisms for interoperability. Although the following description of the five layers focusses on the technical elements of ground-ground SWIM, it is consistent with the air-ground SWIM solutions that are being developed.

a) *SWIM-enabled applications* that consume or provide information to information services, enabling stakeholders, such as air traffic managers and airspace users, to interact;

b) *Information services* for each ATM information domain, and for cross-domain, to perform the required information exchanges;

c) *Information exchange models* for the implementation of information exchanges through information services to define the syntax and semantics of the information service payloads;

d) *Technical infrastructure* for the actual exchange of information. It consists of infrastructure services providing capabilities, such as interface management, request-reply and publish-subscribe messaging, security, and enterprise service management; and

e) *Network connectivity* to provide consolidated telecommunications services, including hardware. This infrastructure is a collection of the interconnected network infrastructures of the different stakeholders. It is based on private or public IP networks.

3.4.2.3 SWIM addresses the three middle layers – information services, information exchange models (that include other information exchange standards) and technical infrastructure – as well as the governance of these layers.

### 3.4.3 Interoperability considerations

While the SWIM GIF provides a common view on the layers that together enable interoperability, it does not describe how to organise the enablers for each layer. This is the purpose of the interoperability architecture, which facilitates the collaboration between SWIM stakeholders. When performing service orientation activities, it provides the means to communicate about, and organise, SWIM enablers using common terminology and structure. It also provides a guiding means used by experts working on service orientation.

### 3.4.4 Cross-domain considerations

The fulfilment of information purposes specific to each particular information domain leads to interoperable technical solutions within a specific domain. However, information also flows between information domains that require cross-domain agreements. Since the responsibilities related to the components of SWIM may vary significantly, the common enablers are categorized according to information, information services and technical infrastructure.

### 3.4.5 Air-ground SWIM-specific considerations

3.4.5.1 Interoperability is critical to the wide-spread adoption of ground-ground and air-ground SWIM. Air-ground SWIM-enabled applications and technical infrastructure should be interoperable within and across flight information regions (FIRs) and SWIM regions as well as globally, without major modifications. Global interoperability of air-ground SWIM reduces the requirements of airspace users, especially those operating international flight operations, to equip and train.

3.4.5.2 When including aircraft and on-board automation as a node in the network, information exchanges may require additional formatting to ensure consistency with the aircraft communication protocols. If the information requires integration with existing on-board systems, a message processing gateway may be required.

3.4.5.3 The multiple implementations of air-ground SWIM worldwide will serve multiple customers in multiple FIRs. Standardization enables air-ground SWIM interoperability with multiple aircraft systems, guarantees that airspace users will not be required to equip aircraft with additional systems and ensures the compatibility of electronic flight bags with multiple air-ground SWIM implementations.

3.4.5.4 The objective of developing performance-based standards is to allow exchange and integration of information into on-board systems to ensure a variety of implementations can be accommodated. In particular, a common set of performance specifications must be established to ensure interoperability and operational harmonization.

### 3.4.6 Interoperability between civil and military SWIM

3.4.6.1 State aviation, in particular military aviation, is a major stakeholder and airspace user within the air navigation system. Similar to their civilian counterparts, State aviation produces and consumes information that is critical for the safety, capacity and efficiency of the ATM system. Military air operations rely on the effective exchange of information among relevant stakeholders and operators.

3.4.6.2 Being able to readily exchange information via information services (between civil and military stakeholders and across borders) is critical for the required collaboration and coordination functions that support planned air navigation system modernization efforts, like the afore-mentioned TBO. However, it is critical for the military to protect the confidentiality and integrity of mission-critical information. SWIM must ensure interoperability across the civil and military interfaces.

3.4.6.3 It is essential for the future information sharing network to provide appropriate protection and cyber resilience; effective governance is crucial for the military community to apply and enforce specific SWIM security policies. Achieving interoperability between the civil and military implementation of SWIM depends on the availability and implementation of global standards. Interoperability eliminates, or at least reduces, the need for exemptions for State aircraft operations.

3.4.6.4 The information being exchanged is oftentimes the same or similar for State and civil aircraft. Thus, there are economic as well as operational benefits to be gained by leveraging a common technology base and interoperable information services in support of seamless and flexible airspace operations.

## 3.5 QUALITY MANAGEMENT

3.5.1 Although the data originator is responsible for ensuring the initial quality of the data being distributed, there are various phases of data production during which the integrity of the data can be affected. Within the context of producing data and information, data can be acquired, new value added and the content re-distributed through SWIM, including components whose value may include proprietary elements.

3.5.2 It is essential to use a quality management system to instil trust in consumers by ensuring the quality of data, information and information services. Implementing a quality management system produces improvements in:

a) *organizational effectiveness*: Establishing controls on key processes by creating guidelines for tasks that are undertaken regularly and ensuring that plans and training templates are created to support these tasks. The information service provider offers a common, logical system with consistent and repeatable processes for delivering quality data, information and information services;

b) *consumer satisfaction*: Based on the perception of the degree to which user requirements have been met (ISO 9000). High consumer satisfaction increases return business;

c) *organizational culture*: Establishing a continuous improvement culture using systematic processes that involve a provider's employees and consumers and address opportunities and problems when they occur.

3.5.3 The quality management system covers the processes that create the information, the services that deliver it, and the environments (technical, regulatory, business, etc.) in which the processes reside. Information exchanges in a SWIM environment rely on the quality of the information (i.e., the quality of the information service payload) and the quality of the information service (the quality of the means to exchange the information). Both are equally important to ensure user requirements are met. Figure 3-6 shows how data quality influences the quality of service.

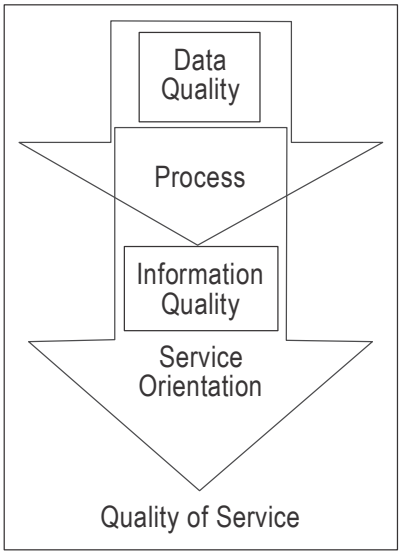


**Figure 3-6. Data quality influences quality of service**

3.5.4 Several processes are needed to transform data into information, that is, to make data useful in an ATM context, such as the assembling, analysing, formatting and documenting of data. Information quality is defined in terms of aggregation, credibility, relevance and consistency.

3.5.5 Access to information through information services has implications in ensuring the right information can be accessed at the right time to make quality and timely decisions. Thus, the quality of service is defined as the degree or level of confidence that the performance of a service meets user's requirements in terms of availability, recoverability, capacity, time behaviour, integrity and confidentiality.

## 3.6 PERFORMANCE IMPROVEMENT

3.6.1 To successfully share information between stakeholders, it is essential to provide, with a level of assurance, information service performance that meets the needs of the consumers. Performance characteristics are critical to establishing a trusted relationship between information service providers and consumers. In addition, performance requirements establish a common understanding of the level of service negotiated between information service providers and consumers.

3.6.2 Since a single global implementation is not foreseen, individual ASPs are expected to implement procedures in accordance with target performance levels as described in the *Manual on Global Performance of the Air Navigation System* (Doc 9883). Nevertheless, standardization and global interoperability are essential for efficient and safe international flight operations and the need for system-wide information management is an important driver for new and updated standards.

3.6.3 Performance improvement through SWIM means that performance requirements for information management systems are not only established from a technical perspective, but through a top-down or bottom-up trade-off process. The process links the performance requirements to the performance case of the corresponding operational improvement, which assesses the benefits and drawbacks across the eleven key performance areas identified in Doc 9883.

3.6.4 For example, a particular performance characteristic should be deemed necessary only after establishing its associated operational benefits, not simply because it is technically feasible or desirable, or because it could enable an aircraft or group of aircraft to have a potentially quicker operational response time. In other words, information management systems are just one link in the chain of process steps. The requirements for these systems must be balanced with the rest of the chain and with the overall benefits that can be achieved.

3.6.5 A single SWIM implementation may not fit the needs of all stakeholders, therefore achieving interoperability between the different implementations is important for maintaining the efficiency of the global air transportation system. In particular, technical infrastructure and information services should be developed to align with a globally accepted operational concept that articulates the expected SWIM implementation in terms of benefits, enablers, features and principles.

3.6.6 Since information security is an increasingly critical factor, SWIM also encompasses aspects such as authentication, authorization, encryption, intrusion detection and security policies, among others.

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# Chapter 4

# GOVERNANCE

## 4.1 INTRODUCTION

4.1.1 Governance addresses topics such as the rights regarding information use and quality of service, which help build confidence in SWIM.

4.1.2 In a loosely coupled environment where services are provided and consumed by a number of stakeholders, governance is essential. Governance establishes processes to ensure the appropriate rules, policies and standards for information management are followed. It addresses chains of responsibility, authority and communication as well as measurement and control mechanisms, i.e., quality of service parameters that guide participants as they carry out their roles and responsibilities. Governance also helps establish the roles and responsibilities of the various SWIM stakeholders: providers, consumers, common service (e.g., registry) providers, authorities, etc.

4.1.3 Governance entails activities that can be applied at different levels (e.g., global, regional, national and organizational). Activities such as:

a) establishing a common set of rules, policies, processes and standards for information, information services and technical infrastructure;

b) defining and establishing governance structures;

c) defining the processes for the development, approval and evolution of standards;

d) promoting information interoperability among stakeholders; and

e) defining the transition to a SWIM environment through national or regional arrangements.

4.1.4 Since national and regional requirements may differ, differences will exist between varying SWIM implementation methods. Emphasis should be placed on bilateral and multilateral compatibility and interoperability. Governance is applied to local and regional levels for flexibility and considers differences due to specific operational requirements.

4.1.5 The main elements of SWIM to be governed are information, information services and technical infrastructure, as explained in the following sections.

## 4.2 GOVERNANCE OF INFORMATION

4.2.1 Governance addresses the collaborative specification and definition of information within existing information domains (e.g., aeronautical information, meteorological information and flight information), across domains and within prospective domains. The ATM information reference model (AIRM) promotes alignment across ATM information domains, which results in semantic interoperability.

4.2.2 The various domain-specific information exchange models (e.g., AIXM, IWXXM and FIXM) need to evolve to meet the technical requirements of existing and new users. Governance is necessary to ensure the compatible evolution of these information exchange models. This may be achieved through configuration control boards and coordination between relevant communities of interests.

## 4.3 GOVERNANCE OF INFORMATION SERVICES

4.3.1 Governance addresses information services. In particular, it addresses the service lifecycle from the initial identification of a business need through the following stages: proposal, definition, development, verification, deployment, deprecation and decommissioning, all of which need to be managed. Throughout its lifespan, an information service may need to be changed. After the information service is in widespread use, managing changes is considerably more challenging than creating the initial information service. One consideration, therefore, is to balance stability versus continuous improvement.

4.3.2 Governance supports activities like information service registration, versioning, discovery and access, security for services, service lifecycle management and service validation.

4.3.3 The following methods can be used to validate such services:

a) *independent validation*, carried out by an independent authority;

b) *collaborative validation*, carried out by the service provider together with service users;

c) *user validation*, carried out by service users; and

d) *self-validation*, carried out by the service provider.

4.3.4 Information services have varying levels of requirements for access. If some information is to be accessed only by a subset of consumers, then clearly defined requirements are needed to restrict access to the information. In this regard, it may be helpful to define categories of consumers based on required levels of access to ensure services are accessed only by the intended consumer category.

## 4.4 GOVERNANCE OF TECHNICAL INFRASTRUCTURE

4.4.1 Although SWIM builds upon existing global ICT standards for its technical infrastructure, governance may impose particular policies to ensure its interoperability.

4.4.2 An important aspect to consider regarding standardization is choosing messaging protocols. Reducing the number of messaging protocols for sending and receiving information supports interoperability when connecting to multiple information services, without having to develop solutions using specific software vendors.

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# Chapter 5

# INFORMATION

## 5.1 INTRODUCTION

5.1.1 The aviation community is increasingly interconnected and dependent on high-quality information. To meet the operational needs of all stakeholders and improve the overall system performance, this information needs to be shared on a system-wide basis.

5.1.2 For information service consumers, the timely and secure exchange of quality information across borders is essential to support the increasingly integrated, complex ATM systems. In this regard, the adoption of common performance standards, business rules and information exchange models is critical to optimize the delivery of seamless information services in a globally harmonized and interoperable aviation system.

5.1.3 To enable interoperability, information needs to be clearly and unambiguously defined and well understood. Syntactic interoperability is the ability of systems to correctly interpret the structure of exchanged data, thus being capable to read its content. Semantic interoperability is the ability of computer systems and organisations to exchange information with unambiguous, shared meaning. Syntactic interoperability is a prerequisite for semantic interoperability.

5.1.4 The followings are key to information interoperability:

a) ATM information reference model;

b) information exchange models; and

c) metadata.

## 5.2 ATM INFORMATION REFERENCE MODEL

5.2.1 The AIRM serves as a common reference to enable semantic interoperability, at the level of information, in the global interoperability framework. This means that frequently used terms can be unambiguously referenced and reused by the entire aviation community. The terminology defined in the AIRM can be equally interpreted by both computer systems and humans.

5.2.2 The AIRM and the information exchange models play complementary but different roles. The AIRM is a crosscutting reference for aviation information, whereas the information exchange models target the narrower context of their respective information domains. As such, information exchange models support the implementation of solutions and possibly specific technology choices, within their respective information domains.

## 5.3 INFORMATION EXCHANGE MODELS

5.3.1 An information exchange model enables sharing of information in a digital format within a specific domain.

Therefore, information exchange models support the transition from analogue to digital data. The move towards a more network-centric modernization of the aviation system is an additional step. This second step builds upon the transition to the digital data. In order to achieve the benefits of service orientation and its associated agility, cross-domain interoperability is expected. This is reflected on the importance of cross-domain harmonization in which the AIRM plays a reference role.

5.3.2 Semantic interoperability also applies at the level of an information exchange model within a specific domain. There is also a need for syntactic interoperability, which requires additional detailed definitions, syntax agreements, and technology choices, such as XML or JSON, for exchanging information between systems and applications.

5.3.3 Information exchange models have been defined by different communities of interest for the following ATM operational domains: meteorological information (IWXXM), aeronautical information (AIXM), flight and flow information (FIXM) and surveillance information (all-purpose structured EUROCONTROL surveillance information exchange (ASTERIX)).

## 5.4 METADATA

5.4.1 Metadata is essential to understand, process and deliver information to information service consumers. In this regard, metadata is collected and provided to describe the information service payload and the information service responsible for delivering it.

5.4.2 Metadata of the information service payload, or information metadata, is often described as “data about data” and exchanged between information service providers and consumers. Metadata can be collected at any level of granularity during processing to ensure traceability throughout the information lifecycle, as per the requirements of each information domain. Metadata standards are also building blocks in the interoperability architecture. Metadata is not specific to the air transportation domain; hence, the practice is to leverage existing standards from other industry sectors (e.g., ISO 19115).

5.4.3 Information metadata enables information service consumers to make informed decisions as to the adequacy – for the intended use – of the information being made available by the information service. It also enables information service consumers to make informed contextual decisions as to the quality, timeliness and relevance of the information provided. Information-related metadata includes the originated source and the quality of the information.

5.4.4 In order to decide whether to use a specific information service, information service consumers require a consistent picture of the information service and its information service payload. This is achieved through information service overview comprised by different metadata.

# Chapter 6

# INFORMATION SERVICES

## 6.1 INTRODUCTION

6.1.1 Information services provide ATM information sharing capabilities. SWIM-enabled applications consume and provide information services. Consequently, an information service is a fundamental component of SWIM that enables interoperability through well-defined information exchanges.

6.1.2 Details of information services are exposed to information service consumers via standardized and structured information service overviews that indicate, for example, the name and version of the information service, what kind of information the service provides, the quality of service and how the information service can be accessed.

## 6.2 INFORMATION SERVICE PERFORMANCE CHARACTERISTICS

6.2.1 Information service providers and consumers expose, discover, access, construct and process information services through infrastructure, procedures and systems. Information quality and quality of service affect the outcome of decisions and, invariably, the performance of the ATM system as a whole. It is paramount that information service providers meet the expectations they are setting with the information services they are offering.

6.2.2 Quality of service characteristics may be further defined by individual performance and security parameters. Examples of performance parameters include availability, capacity, time behaviour and recoverability. Examples of security parameters include integrity and confidentiality.

6.2.3 From an information service consumer perspective, using an information service that is of lower quality may incur lower implementation costs but require a higher acceptance of risk. On the other hand, information services that are of higher quality may minimize risk but incur higher costs. It should also be noted that security parameters are defined in relation to the probability of an occurrence that has a harmful effect. These parameters are derived from the engineering or design approach that is assessing the elements of the service. The parameters are subsequently verified to provide assurance that the service and its elements meet acceptable security requirements.

6.2.4 Information service providers operate within constrained environments that drive the parameters of the information services they offer. For instance, the quality of service is dependent on the data generation process the information service provider uses. In the end, however, it is the information service consumer who determines whether the quality of service meets the performance requirements for its intended use.

## 6.3 INFORMATION SERVICE CLASSIFICATIONS

6.3.1 Information service performance is captured as quality of service parameters. Based on the diversity of information services and their related quality of service parameters, there are benefits to categorizing information services into operationally relevant classifications. These classifications serve to shape information service performance expectations between information service providers and consumers. They help to identify common quality of service

requirements for information services to support certain operations. These classifications, together with the information service consumer's quality of service requirements, are a starting point for information service-level negotiations between information service providers and consumers.

6.3.2 Information service integrity refers to the degree to which an information service prevents unauthorized or unintended access to, or modification of, data. Figure 6-1 shows different levels of integrity and the corresponding levels of safety criticality for some SWIM-enable applications.

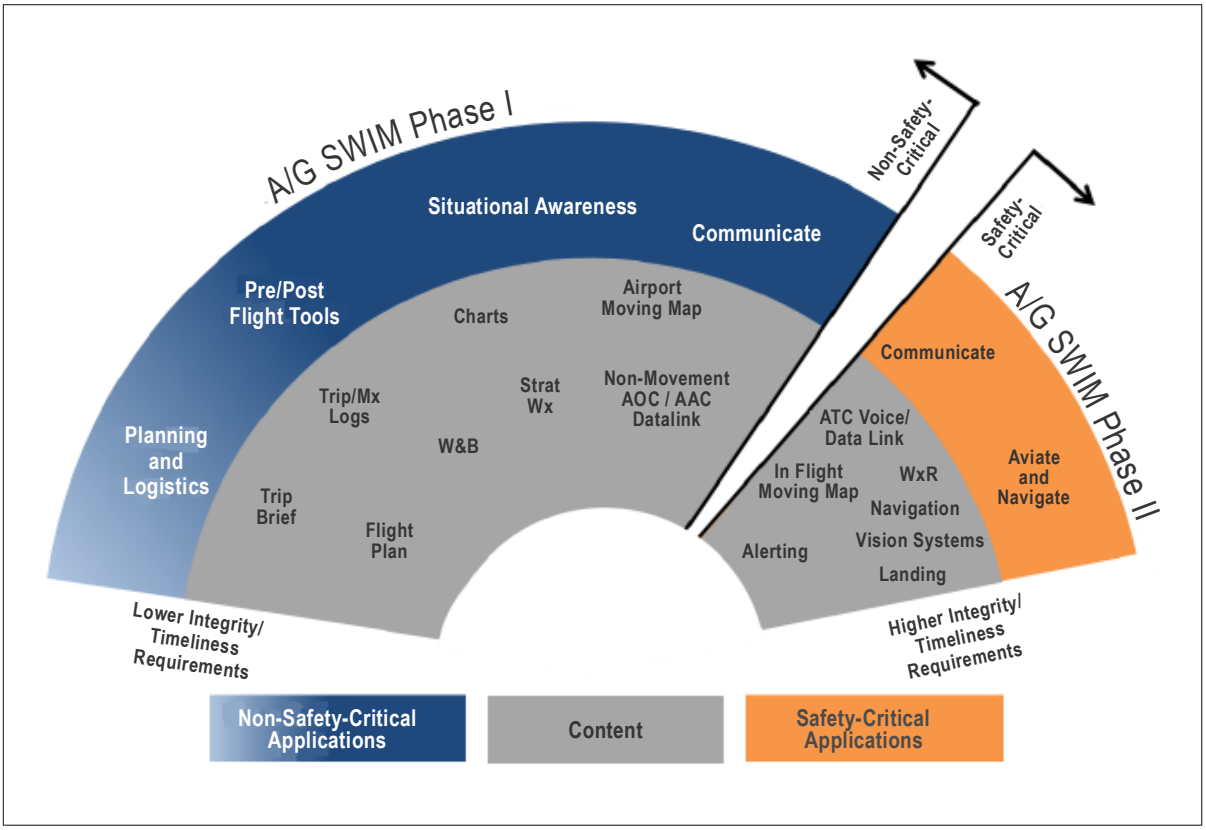


**Figure 6-1. Information safety-criticality**

6.3.3 Information service classification is linked to the information criticality. Some information can have different classifications depending on the operational context. For example, an information service meant to make available ground weather radar data can be used by flight crew to enhance decision making. Weather falling below minima at a key diversion airport may be critical for one aircraft, while the same information is relevant, but less critical, to another aircraft that has a different diversion airport available.

6.3.4 Quality of service requirements are determined either by an information service consumer's operational need, its intended use, an authority or a standard. When a category is defined, the requirements subsequently apply to all information service providers to ensure that information service consumers receive the expected quality of service. In some cases, information service consumers may use information services for operations that require a higher level of classification than the one the information services are approved for. When information service consumers employ information services for operations that require a higher level of classification than the one the information services offer, the responsibility rests with the information service consumers (not the service providers) for any safety issues that may arise.

## 6.4 INFORMATION SERVICE OVERVIEW

6.4.1 Information service consumers need to discover new and existing information services and the payloads they provide. Information service overviews provide potential consumers with a set of metadata, in the form of a high-level information service description, intended to promote information service discovery and initial evaluation of an information service before actually consuming it. Because it may be difficult for information service consumers to determine which information service best fits their needs, standardized information service overviews will enable comparisons between multiple similar information services.

6.4.2 Information service overviews are not intended to provide implementation details, nor are they intended to replace other technical information about the information services (e.g., interface control document, interface bindings, etc.). Instead, the information service overviews are intended to be published in a SWIM registry or by other means (e.g., an organization's website).

## 6.5 SWIM REGISTRY

6.5.1 A SWIM registry supports information service discoverability and provides search and filtering functionalities of service overview; it can typically be accessed over the Internet. A SWIM registry provides a registration process that publishes information service overviews in a controlled manner, ensuring that registered overviews satisfy specific requirements (e.g., completeness) and only those authorized can modify the information in the overviews. A SWIM registry is an important and well-defined component in SWIM (see Figure 6-2).

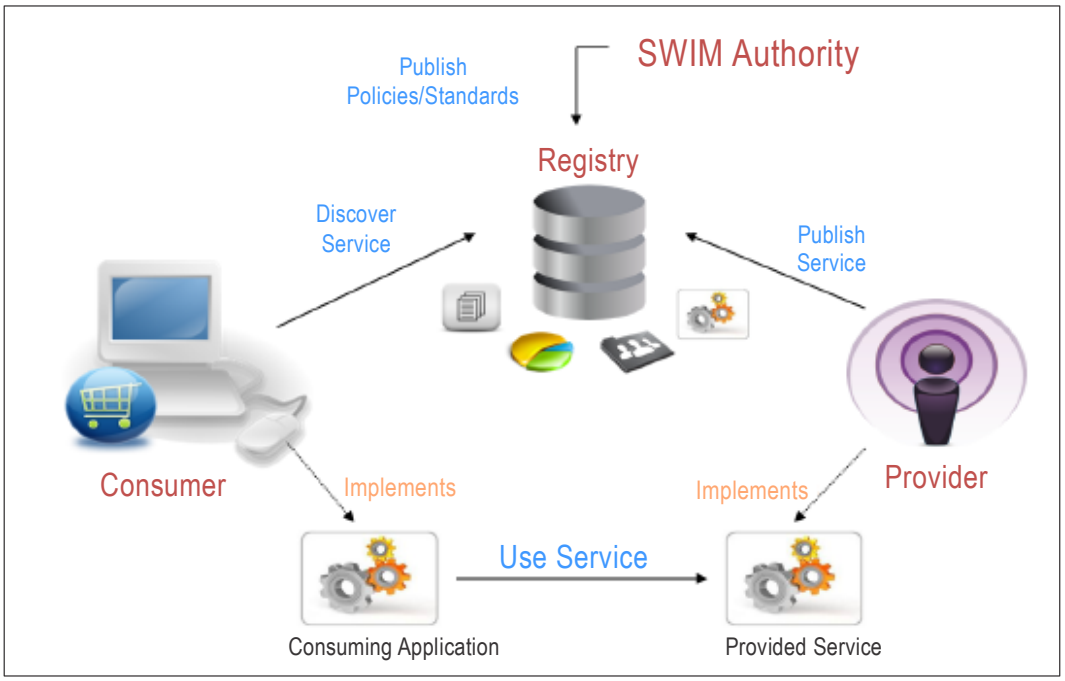


**Figure 6-2. Concept of a SWIM registry**

6.5.2 The SWIM registry provides a human interface for information service providers and consumers. It provides a list of information service overviews to information service providers and consumers, so they share a common view of the information service available. The provider of a SWIM registry may also offer additional information as appropriate. By using a SWIM registry, information service providers benefit from the visibility offered to their information services based on common principles. Information service consumers benefit from having consolidated access to information service overviews so they can identify the most suitable information services for their information needs.

6.5.3 There could be multiple SWIM service registries that contain information service overviews relevant to a particular organization or community of interest (e.g., a SWIM region). By using standardized interfaces, registries can exchange information between connected registries and thus extend the visibility of information service overviews from one registry to another.

*Note.— For this concept, the dynamic interaction of operational systems with a registry is outside the scope of the capabilities of the SWIM registry and thus not described. This capability is sometimes referred to as a 'runtime registry', when an operational ATM system dynamically reconfigures itself to consume from a different information service based on the content of the registry.*

# Chapter 7

# TECHNICAL INFRASTRUCTURE

## 7.1 INTRODUCTION

7.1.1 The technical infrastructure for SWIM is a collection of software and hardware that enable information services to be provided. SWIM requires a technical infrastructure (either ground-ground or air-ground, or both) to exchange information. The technical infrastructure consists of a number of infrastructure services providing capabilities such as messaging, security, mediation, interface management and enterprise service management. These services are based on mainstream ICT systems and use IP-based network connectivity. Figure 7-1 shows how SWIM-enabled applications use information services. The information services use the technical infrastructure, which, in turn, uses IP-based network connectivity.

*Note.—The items in blue depict components outside the scope of SWIM, whereas those in orange are within the scope of SWIM.*

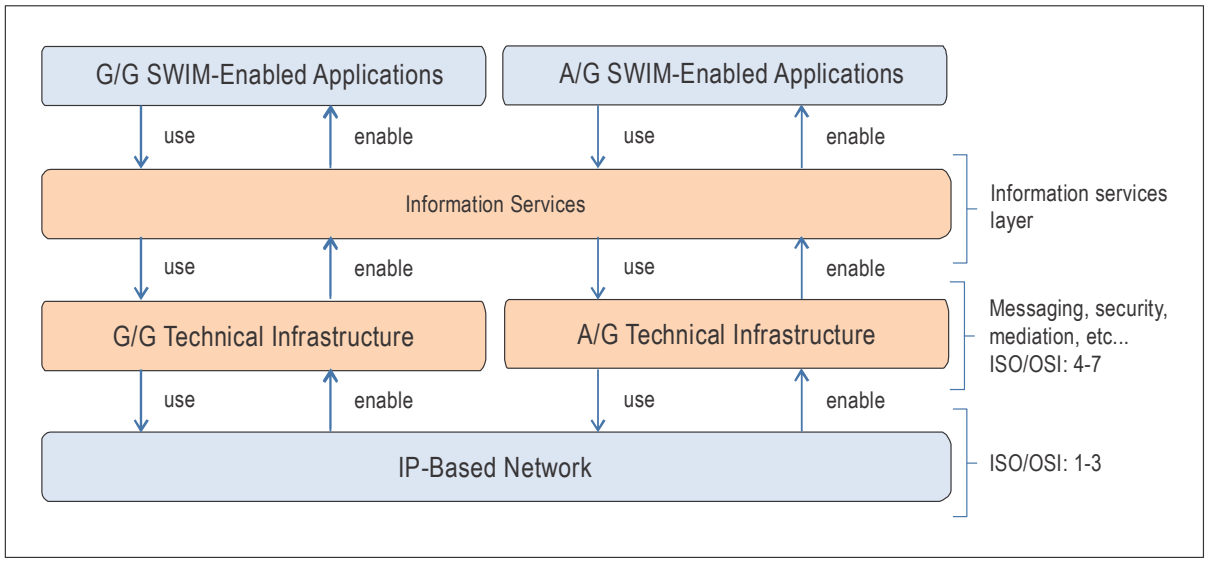


**Figure 7-1. Technical infrastructure relationship**

7.1.2 SWIM-enabled applications provide or consume information services when exchanging information. Information service interfaces are implemented in accordance with a defined protocol (i.e., the service interface binding) for interoperability. The technical infrastructure provides interface management with agreed-upon technical infrastructure performance requirements. The technical infrastructure messaging capability provides addressing and message assurance. Security capabilities provide authentication and authorization. Together, the technical infrastructure capabilities enable information to be exchanged using an IP-based network connectivity layer.

7.1.3 In order to achieve technical interoperability (i.e., enable ICT systems to communicate and exchange information), systems must use standardized interfaces (i.e., information service interfaces) and technical infrastructure capabilities that allow information to be exchanged reliably, securely and efficiently. It is therefore important to build SWIM technical infrastructures using ICT standards. These standards are customarily used when implementing information services based on a network-centric, service-oriented architecture. They represent a shift from the legacy store-and-forward messaging paradigm to one of the SWIM message exchange patterns – request-reply, publish-subscribe or one-way.

7.1.4 The ISO open system interconnection (OSI) model defines the seven layers architecture of a complete communication system consisting of application, presentation, session, transport, network, datalink and physical layers. As shown in Figure 7-1, technical infrastructure services cover ISO/OSI layers four to seven. Information services are introduced by SWIM as an additional layer on top of ISO/OSI application layer seven. Connectivity is established by the IP-based network, which maps to the ISO/OSI layer three.

7.1.5 Although Figure 7-1 shows security residing at ISO/OSI transport layer four in the air-ground technical infrastructure, for safety-critical applications certification credit may demand that end-to-end security is provided within the SWIM-enabled application. This is likely to occur in cases where the information services or the air-ground technical infrastructure are designed to a lower design assurance level or hosted in separate hardware.

7.1.6 The implementation of the SWIM technical infrastructure leverages established ICT standards. Even though these standards do not constitute a technical barrier, they continue to evolve. The specific implementation of technical infrastructure is left to each stakeholder's organization. The technical infrastructure must be based on SWIM concept objectives and interoperability standards that are within the remit of each stakeholder's business, operations and technical capabilities.

7.1.7 Given stakeholders can choose from a range of available ICT standards to build the technical infrastructure, this could lead to interoperability barriers. This in turn could necessitate defining technical infrastructure profiles to answer specific technical infrastructure requirements. The resulting technical infrastructure capabilities differ due to the constraints of the operating environment and the criticality of the information. For instance, the requirements of a ground-ground technical infrastructure differ from the requirements of an air-ground technical infrastructure, in particular when the latter is interacting with the on-board system. As a consequence, different technical infrastructure profiles are required.

7.1.8 For SWIM, the functional and non-functional technical requirements for exchanging information translate into specifications at the level of information service interfaces (i.e., ICT protocols used) and specifications for ICT infrastructure capabilities. Defining a set of ICT standards and technical infrastructure requirements as technical infrastructure profiles facilitates interoperability at the level of technical infrastructure implementation.

## 7.2 INFORMATION SECURITY CONSIDERATIONS

7.2.1 Information security is a critical aspect of SWIM since incidents that may affect the availability and integrity of the information can negatively impact aviation safety. In a SWIM environment, more information will be shared by an increasing number of interconnected stakeholders. As a consequence, organizations become increasingly dependent on ICT systems, which increase their vulnerability to cyber-attacks. Hence, information security is a critical aspect for the implementation of SWIM.

7.2.2 Information security encompasses the safeguards and actions used to protect the cyber domain from threats that may harm interdependent networks and information infrastructure. Information security for SWIM considers the following aspects:

a) governance (e.g., information security policy and information security coordination activities);

b) information (e.g., inventory of information assets, ownership and classification of risk associated to potential attacks);

c) information service (e.g., service development and operation: risk management, evolution, access management and service-level agreements); and

d) technical infrastructure (e.g., common components, like public key infrastructure (PKI) and security capabilities).

7.2.3 In a SWIM environment, information exchange is based on a well-structured framework. It encompasses potential security dimensions that need to be acted upon in terms of management, control and execution of responses to cyber threats and cyber-attacks.

7.2.4 Including aircraft and its automation as a participant in the ATM network implies that the aircraft and its systems become consumers and producers of information services and necessitates additional air-ground SWIM cyber security considerations.

7.2.5 From an air-ground SWIM perspective, an adaptive, multi-facet environment is expected. One component addresses erroneous information through operational procedures and processes for air-ground SWIM combined with a human in the loop. Information requires different levels of protection depending on how it is used by different air and ground systems and the criticality of the information for the safety of flight operations. Information exchange procedures also need to consider the resilience of the information services to guarantee continuity and safety of operations.

**— END —**

**APPENDIX B**

International Civil Aviation Organization | Organisation de l'aviation civile internationale | Organización de Aviación Civil Internacional | Международная организация гражданской авиации | منظمة الطيران المدني الدولي | 国际民用航空组织

Tel.: +1 514-315-2086

Ref.: AN 2/36.1-24/39

24 April 2024

**Subject:** Approval of the first edition of the *Procedures for Air Navigation Services — Information Management* (PANS-IM, Doc 10199)

**Action required:** a) implementation of the first edition of the PANS-IM on 28 November 2024; b) publication of any differences as of 28 November 2024

Sir/Madam,

1. I have the honour to inform you that the *Procedures for Air Navigation Services — Information Management* (PANS-IM, Doc 10199) was approved by the Council at the fifth meeting of its 231st Session on 18 March 2024, for applicability on 28 November 2024. A copy of the first edition of the PANS-IM is available as attachments to the electronic version of this State letter on the ICAO-NET (http://portal.icao.int) where you can access all other relevant documentation.

2. The first edition of the PANS-IM stems from recommendations of the second meeting of the Information Management Panel (IMP/2) and is related to system-wide information management (SWIM) and information security.

3. An implementation task list, including an outline of guidance material, and an impact assessment for the first edition of the PANS-IM are presented in Attachments A and B, respectively. An overview of the approval process is also included for your information in Attachment C.

4. Your Government is invited by the Council to implement the provisions of the first edition of the PANS-IM. In this connection, I draw your attention to the decision taken by the Council, on 1 October 1973, to discontinue the publication of differences in Supplements to PANS documents and, instead, to request States to publish up-to-date lists of significant differences from PANS documents in their Aeronautical Information Publications (AIPs).

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5. May I, therefore, invite your Government to publish in your AIP a list of any significant differences which will exist on 28 November 2024 between the provisions of the PANS-IM and your national regulations and practices.

Accept, Sir/Madam, the assurances of my highest consideration.

for Juan Carlos Salazar
Secretary General

**Enclosures:**

A — Implementation task list and outline of guidance material in relation to the first edition of PANS-IM
B — Impact assessment in relation to the first edition of PANS-IM
C — Overview of approval process for the first edition of PANS-IM

**ATTACHMENT A** to State letter AN 2/36.1-24/39

# IMPLEMENTATION TASK LIST AND OUTLINE OF GUIDANCE MATERIAL IN RELATION TO THE FIRST EDITION OF PANS-IM (DOC 10199)

## 1. IMPLEMENTATION TASK LIST

1.1 Essential steps to be followed by a State in order to implement the first edition of the *Procedures for Air Navigation Services — Information Management* (PANS-IM, Doc 10199):

a) conduct a SWIM needs assessment;

b) conduct a gap analysis between the new ICAO provisions and the national regulatory framework;

c) identify the rule-making process necessary to transpose the new ICAO provisions into the national regulations, where necessary, taking into consideration the applicability date;

d) draft of the necessary modifications to the national regulations and means of compliance;

e) adopt the national regulations and means of compliance;

f) establish a national implementation plan that takes into account the new ICAO provisions;

g) train relevant personnel prior to implementation of the new provisions;

h) communicate the changes to impacted industry stakeholders and airspace users;

i) introduce new or amended regulations, as appropriate, to implement the new provisions;

j) modify the oversight framework according to the new and modified national regulations;

k) oversee the implementation of the regulations; and

l) publish significant differences in the Aeronautical Information Publication (AIP), if necessary.

## 2. STANDARDIZATION PROCESS

2.1 Approval date: 18 March 2024

2.2 Applicability date: 28 November 2024

2.3 Embedded applicability date(s): N/A

## 3. SUPPORTING DOCUMENTATION

### 3.1 ICAO documentation

| Title | Type (PANS/TI/Manual/Circ) | Planned publication date |
|---|---|---|
| *Manual on the System-wide Information Management Concept* (Doc 10039) | Manual | First edition Q1 2024 |
| *Manual on System-wide Information Management Implementation* (Doc 10203) | Manual | First edition Q3 2024 |
| *Manual on Information Security* (Doc10204) | Manual | First edition Q3 2024 |

### 3.2 External documentation

| Title | External Organization | Publication date |
|---|---|---|
| Nil | | |

## 4. IMPLEMENTATION ASSISTANCE TASKS

| Type | Global | Regional |
|---|---|---|
| Training | Online training packages and courses | Workshops |

## 5. UNIVERSAL SAFETY OVERSIGHT AUDIT PROGRAMME (USOAP)

5.1 The content of this paper may require an amendment of the USOAP continuous monitoring approach (CMA) protocol questions (PQs) in the area of air navigation services (ANS) to assess the effective implementation by States. Existing PQs may need to be amended or new PQs may be required. This will be assessed during the next amendment cycle of the PQs.

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**ATTACHMENT B** to State letter AN 2/36.1-24/39

# IMPACT ASSESSMENT IN RELATION TO THE FIRST EDITION OF PANS-IM (DOC 10199)

## 1. INTRODUCTION

1.1 The first edition of the PANS-IM is intended to address the requirements and procedures concerning system-wide information management (SWIM) and information security.

## 2. IMPACT ASSESSMENT

2.1 *Safety impact*: Positive. Modern information exchange capabilities support collaborative decision making and improve situation awareness thus supporting safety.

2.2 *Financial impact*: An increase in the overall cost is expected for States and industry. The implementation of SWIM is not mandatory and should result from a needs' analysis. If a State decides to implement SWIM, rulemaking may be required depending on the existing regulatory framework for information sharing. Training of staff tasked with the oversight of the procedures would most likely be required. The implementation of SWIM requires the use of IP-based technologies. Therefore, rulemaking may be required by States depending on the existing regulatory framework for information security. Training of staff tasked with the oversight of the procedures on information security would most likely be required. For industry, there will be an investment cost for information service providers and consumers. These investments however are limited in comparison to the cost associated with maintaining the legacy technologies and systems, thus reducing costs and making it more cost effective in the long term. There will also be a cost for information service providers and consumers associated to the implementation of the information security provisions. However, these investments are necessary to trust the information being exchanged and to ensure information security interoperability. Moreover, they are marginal in comparison to the financial impacts associated with an information security breach that may result in an accident.

2.3 *Security impact*: Positive. The introduction of internet-based technologies for exchanging information could potentially increase cyber threats. However, PANS-IM reinforces the principle of secure information exchange as a basis for SWIM. Also, the implementation support material provides an information security framework appropriate for critical infrastructures. Therefore, it is anticipated that the proper implementation of PANS-IM provisions and the supporting guidance would ensure trusted and managed information exchanges regardless the technology used.

2.4 *Environmental impact*: Positive. Improved and timely information sharing across all airspace users will allow for operational efficiency benefits such as trajectory optimization that reduces fuel burn, therefore, contributing indirectly to the environment.

2.5 *Efficiency impact*: Positive. Compliance with PANS-IM ensures interoperability of diverse system implementations. In addition, the reliance on service-oriented principles simplifies the introduction of new information into the aviation systems. New information supports better decision making which in turns creates a more efficient ATM system.

2.6 *Expected implementation time:* One to two years for States since they will require to regulate, provide oversight, authorize, develop and enforce national and/or regional policies. Two to five years for industry since information service providers will need to define and provide information service(s) and information service consumers will need to identify and consume information services that meet their needs.

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**ATTACHMENT C** to State letter AN 2/36.1-24/39

## OVERVIEW OF APPROVAL PROCESS FOR THE FIRST EDITION OF PANS-IM (DOC 10199)

| Approval concerning | Source(s) | Preliminary review by the ANC | State letter and date | Final review by the ANC | No. of replies at final review | Approved Applicable |
|---|---|---|---|---|---|---|
| System-wide information management (SWIM) and information security | Second meeting of the Information Management Panel (IMP/2) | 29 November 2022<br>(ANC 221-6)<br>AN-WP/9573 and DP No. 1<br>AN-WP/9573.PDP | AN 2/36-23/6<br>13 February 2023<br>and Corr. No. 1 | 2 November 2023<br>(ANC 224-6)<br>AN-WP/9690 and DP No. 1 | 71 Contracting States (24)<br>4 int. orgs.<br>Total: 75 replies | 18 March 2024<br>28 November 2024 |

— END —

**FIRST EDITION**

**OF THE**

**PROCEDURES**
**FOR**
**AIR NAVIGATION SERVICES**

# INFORMATION MANAGEMENT

**(Doc 10199)**

The first edition of the *Procedures for Air Navigation Services — Information Management* (PANS-IM, Doc 10199) contained in this document was approved by the Council of ICAO on **18 March 2024** for applicability on **28 November 2024**. (State letter AN 2/36.1-24/39 refers.)

**MARCH 2024**

**INTERNATIONAL CIVIL AVIATION ORGANIZATION**

**TEXT OF THE FIRST EDITION OF THE**

**PROCEDURES FOR AIR NAVIGATION SERVICES**

**INFORMATION MANAGEMENT**
**(PANS-IM, DOC 10199)**

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# FOREWORD

## 1. HISTORICAL BACKGROUND

1.1 Following the need expressed at the 38th Session of the ICAO Assembly for global agreement on the principles for the standardization and harmonized implementation of system-wide information management (SWIM), the Air Navigation Commission, at the eighth meeting of its 194th Session, held on 28 November 2013, agreed to the establishment of the Information Management Panel (IMP) in order to develop a globally harmonized and interoperable approach to information management.

1.2 A global approach on information management (IM) is essential to ensure interoperability and harmonization across all information domains and to support activities such as: flight and flow – information for a collaborative environment (FF-ICE); the evolution of meteorological services towards digital information exchange; and addressing the need for aeronautical information, including the distribution of digital data sets via information services and a review of the NOTAM system.

1.3 This first edition of PANS-IM provides procedures related to the management of information in general and how they apply to the existing information domains and other domains that may arise. Future editions may also include related procedures for the different information domains.

## 2. SCOPE AND PURPOSE

2.1 The first edition of PANS-IM contains requirements supporting the transition towards a global air navigation system network as described in the *Global Air Navigation Plan* (GANP, Doc 9750). The focus of this first edition is on information services for ground-to-ground information exchanges based on the principles, benefits and components described in the *Manual on the System-wide Information Management Concept* (Doc 10039) to establish SWIM as a key enabler of the *Global Air Traffic Management Operational Concept* (Doc 9854). The PANS-IM is supplemented, when necessary, by regional procedures contained in the *Regional Supplementary Procedures* (Doc 7030).

*Note.— The transition towards a global air navigation system network, as described in the GANP (Doc 9750), requires the air navigation system to become increasingly automated, digitalized and interconnected where information management and the use of information play a particularly important role in the evolution of the air navigation system and global interoperability.*

2.2 Building on an Internet Protocol Suite (IPS)-based communications infrastructure, a key objective of SWIM is to ensure interoperable information exchange between all air traffic management (ATM) stakeholders. To this end, the procedures contained in this document are generic and applicable to all information domains and guidance for the implementation and transition to SWIM can be found in the *Manual on System-wide Information Management Implementation* (Doc 10203). Information domains may specify additional SWIM requirements, such as addressing aeronautical information, meteorological

information, and flight and flow information, to complement the generic SWIM requirements included in this document.

2.3 This first edition of PANS-IM also includes requirements for an information security framework to have a common understanding on the level of protection of the information and to provide end-to-end information security in a scalable approach.

## 3. STATUS

3.1 The PANS do not have the same status as Standards and Recommended Practices (SARPs). While the latter are *adopted* by Council in pursuance of Article 37 of the *Convention on International Civil Aviation*, and are subject to the full procedure of Article 90, the PANS are *approved* by the Council and recommended to Contracting States for worldwide application.

3.2 While the PANS may contain material, which may eventually become SARPs when it has reached the maturity and stability necessary for adoption as such, they may also comprise material prepared as an amplification of the basic principles in the corresponding SARPs and designed particularly to assist the user in the application of those SARPs.

## 4. IMPLEMENTATION

The implementation of procedures is the responsibility of Contracting States; they are applied in actual operations only after, and in so far as, States have enforced them. However, with a view to facilitating their processing towards implementation by States, they have been prepared in writing, which will permit direct use by the air navigation community.

## 5. PUBLICATION OF DIFFERENCES

5.1 The PANS do not carry the status afforded to Standards adopted by the Council as Annexes to the Convention and, therefore, do not come within the obligation imposed by Article 38 of the Convention to notify differences in the event of non-implementation.

5.2 However, attention of States is drawn to the provisions of Annex 15 — *Aeronautical Information Services* related to the publication in their aeronautical information publications (AIPs) of lists of significant differences between their procedures and the related ICAO procedures.

## Table A. Amendments to PANS-IM

| *Amendment* | *Source(s)* | *Subject(s)* | *Approved*<br>*Applicable* |
|---|---|---|---|
| First Edition | Second meeting of the Information Management Panel (IMP/2) | System-wide information management (SWIM) and information security. | 18 March 2024<br>28 November 2024 |

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# Chapter 1

## DEFINITIONS

When the following terms are used in the present document, they have the following meanings:

***Data.*** A representation of facts, concepts or instructions in a formalized manner suitable for communication, interpretation or processing.

***Exchange schema.*** Formal description of the data involved in an information exchange, including, in particular, the encodings and other applicable constraints.

*Note.— An exchange schema assists information service consumers in understanding the syntax of the data delivered by the information service, and the technologies required for locally processing the data received. An exchange schema is based on a data exchange language which is standardized. For example, Extensible Markup Language (XML) schema is a World Wide Web Consortium (W3C) data exchange language used to define XML encoded messages.*

***Governance.*** The set of bodies, standards, policies and processes that ensure globally interoperable information is provided by reliable and trusted services.

***Information.*** The result of the assembly, analysis, formatting and documenting of data, to make the data useful in an ATM context.

***Information domain.*** The scope of the integrated data for a distinct set of business activities that produce a set of unique information products and services.

***Information exchange model.*** A formal description of the information that is agreed to be shared between two or more organizations or groups and includes at least one exchange schema for the associated data.

*Note.— An information exchange model is normally defined for a specific information domain, such as aeronautical information, meteorological information or flight information. This typically includes the definition of information entities and their relationships.*

***Information security category.*** A categorization of the impact on the safety of operations due to the loss of information confidentiality, integrity or availability.

***Information service.*** A type of service in a service-oriented architecture that provides an ATM-related information-sharing capability.

***Information service overview.*** A set of information service metadata intended to promote information service discovery and an initial evaluation of the information service characteristics.

***Information service payload.*** The assembly of information exchanged using an information service.

*Note.— Information service payloads support a specified function(s) or purpose, independent of overhead required to enable the information exchange, such as headers, and security requirements.*

***Interface binding.*** Specification of the protocols and data formats to be used in transmitting messages defined by the associated interface.

***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.

***Message.*** A discrete unit of communication intended by the source for consumption by a given recipient or group of recipients.

***Metadata.*** Information about a resource.

*Note.— An information service, an information service overview and a dataset are examples of resources.*

***Reference model.*** An abstract framework for understanding significant relationships among the entities of information domains.

***Service-oriented architecture.*** Architectural style that supports the designing of systems in terms of services and service-based development.

***System-wide information management (SWIM).*** Standards, infrastructure and governance enabling the management of ATM-related information and its exchange between qualified parties via interoperable information services.

***System-wide information management (SWIM) region.*** A geographical area in which a group of States and/or ATM stakeholders has agreed upon common governance in support of regional system-wide information management implementation.

*Note.— A SWIM region can be an ICAO region or any other area in which a community of interest has agreed on common governance. Communities of interest are established in a variety of ways and may be composed of members from one or more functions and organizations as needed for a shared mission.*

***System-wide information management (SWIM) registry.*** A directory containing entries with the information (metadata) necessary to discover and access information services.

***Technical infrastructure.*** The assembly of software and hardware used to enable the provision of information services.

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# Chapter 2

# GENERAL

## 2.1 SYSTEM-WIDE INFORMATION MANAGEMENT

2.1.1 The provisions in this document are applicable to information being exchanged in a system-wide information management environment.

2.1.2 System-wide information management is essential for the digital transformation of air traffic management. The collection and processing of data within each information domain should result in information that can be exchanged and used for supporting ATM decision-making. Information management includes the following activities:

a) collection;

b) processing; and

c) exchange of data and information.

*Note 1.— Annex 3* — Meteorological Service for International Air Navigation, *Annex 4* — Aeronautical Charts, *Annex 11* — Air Traffic Services, *Annex 14* — Aerodromes, *Annex 15* — Aeronautical Information Services, Procedures for Air Navigation Services — Aerodromes *(PANS-Aerodromes, Doc 9981),* Procedures for Air Navigation Services — Aeronautical Information Management *(PANS-AIM, Doc 10066) and* Procedures for Air Navigation Services — Air Traffic Management *(PANS-ATM, Doc 4444) contain requirements on the collection and processing of data and information for the respective information domains.*

*Note 2.— Within this document, information refers to ATM-related information.*

2.1.3 The information management activities given in 2.1.2 shall be performed in a quality-controlled manner as specified in 2.2.

2.1.4 The exchange of information shall be performed through information services which are a type of service in a service-oriented architecture that provides an ATM information-sharing capability.

*Note 1.— More information on the evolution of information exchange in a service-oriented architecture can be found in Doc 10039.*

*Note 2.— More information on service-oriented architecture can be found in Doc 10203.*

*Note 3.— Annex 3, Annex 4, Annex 11, Annex 14, Annex 15, PANS-Aerodromes (Doc 9981), PANS-AIM (Doc 10066) and PANS-ATM (Doc 4444) contain other requirements of a particular information domain regarding the exchange of information.*

*Note 4.— Information exchange is based on message exchange patterns that determine interactions between information service providers and consumers.*

2.1.5 To support global interoperability, system-wide information management shall be based on the following six principles:

a) **Use of interoperable information services**. Interoperable information services facilitate required information exchanges and are based on operational needs and the analysis of related processes.

b) **Separation of information provision and information consumption.** Clear separation of provider and consumer concerns allows for flexibility in terms of the number and the nature of the consumers. To achieve this, each service is self-contained and the information service consumer is isolated from the implementation details of the service.

c) **Loose coupling**. A system characteristic where each of its components has, or makes use of, minimal dependencies with other distinct components. This principle applies to the information service interfaces.

d) **Discoverability**. A system characteristic for an information service consumer to be able to find available information services with the help of an information service overview.

e) **Use of open standards**. An open standard is one made available to the general public and which has been developed and maintained via a collaborative- and consensus-driven process.

f) **Secure information exchange.** The exchange of information based on a security framework that encompasses all the potential security dimensions, including the management, control and execution of responses to cyber threats and cyber attacks.

*Note.— See Doc 10203 for additional information on how these principles relate to the service-oriented architecture principles.*

## 2.2 QUALITY MANAGEMENT

2.2.1 The quality of the information shall comply with the requirements of the particular information domain(s) and be ensured through an implemented and maintained quality management system (QMS).

*Note 1.— Annex 3, Annex 4, Annex 14, Annex 15, PANS-AIM (Doc 10066) and PANS-ATM (Doc 4444) contain specific provisions on information quality for the respective information domains.*

*Note 2.— Annex 3, Annex 4, Annex 15 and PANS-AIM (Doc 10066) contain specific provisions on QMS for information in the respective information domains.*

2.2.2 Information service providers shall implement and maintain a QMS to establish the necessary assurance and confidence for providing the required information service quality. The quality of the information service should be based on the requirements of the particular information domain(s).

*Note.— International Organization for Standardization (ISO) 9000 series describes a quality management system as a way of defining how an organization can:*

*a) meet the requirements of stakeholders;*

*b) identify and address the risks associated with the organization;*

*c) determine efficient use of resources; and*

d) *continually improve.*

## Chapter 3

## GOVERNANCE

*Note 1.— Governance provisions are contained throughout this document, as they specifically apply to information, information services and technical infrastructure. Therefore, this chapter only includes governance requirements that have not already been captured in the other chapters.*

*Note 2.— Further guidance on governance and implementation frameworks can be found in Doc 10203.*

3.1 Governance supports the six global interoperability principles stated in 2.1.5 and should be addressed through the establishment of an implementation framework in accordance with 3.4.

*Note.— Governance helps build and maintain trust among the various stakeholders providing and consuming information services in a collaborative environment.*

3.2 Where system-wide information management is planned for implementation, States shall ensure that an appropriate implementation framework is established at the national level and/or within a SWIM region.

*Note.— See Doc 10203 for information on SWIM regions.*

3.3 States shall ensure adherence to the implementation framework for the provision of information under their responsibility.

*Note.— Information under the responsibility of States is provided in Annex 3, Annex 4, Annex 11, Annex 14, Annex 15, PANS-Aerodromes (Doc 9981), PANS-AIM (Doc 10066) and PANS-ATM (Doc 4444).*

3.4 The implementation framework should include:

a) defining roles, responsibilities and accountabilities of the various system-wide information management stakeholders including, but not limited to, originator, information service provider, information service consumer and regulator;

b) identifying, if necessary, the appropriate governance bodies responsible for coordinating the implementation within a State or region;

*Note.— See Doc 10203 for more information on governance bodies.*

c) identifying and documenting the relevant standards and any additional standardization requirements; and

*Note.— Standardization requirements may include standards such as ISO, Radio Technical Commission for Aeronautics (RTCA), European Organisation for Civil Aviation Equipment*

*(EUROCAE) or Open Geospatial Consortium (OGC), as well as any additional procedure included in Doc 7030.*

d) developing and maintaining policies, processes and guidance in support of system-wide information management implementation.

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# Chapter 4

# INFORMATION

## 4.1 GENERAL

4.1.1 Information service providers should determine how to meet the information exchange requirements by considering the intended uses of the information in the information service payload.

*Note.— For more information on how to meet the information exchange requirements see Doc 10203.*

4.1.2 Information service providers and consumers should have a common understanding of the meaning of the information in an information service payload.

*Note 1.— The common understanding of the meaning of the information is achieved using an information exchange model or by aligning the information with a global reference model.*

*Note 2.— The information exchange models address the specific context of their related domain(s) while the global reference model supports alignment across various information domains.*

*Note 3.— See the air traffic management information reference model (AIRM) for a global reference model (https://airm.aero/).*

4.1.3 Information service providers and consumers shall have a common understanding of the exchange schema used for the data in an information service payload.

## 4.2 INFORMATION EXCHANGE MODELS

4.2.1 Information service providers should use the domain-specific information exchange models and their business rules for their information service payloads. If the domain-specific information exchange models do not support the information exchange requirements, then information service providers should request a change to the domain-specific information exchange models.

*Note 1.— The use of domain-specific information exchange models aligned with the AIRM satisfies the procedures stated in 4.1.2 and 4.1.3.*

*Note 2.— See Doc 10203 for more information on the domain-specific information exchange models and their management.*

4.2.2 If information service providers do not use the domain-specific information exchange models for their information service payloads, they should align the definition of the information in the information service payloads with a global reference model. In this case, information service providers shall use a standardized exchange schema for the information service payloads.

*Note 1.— Alignment with the AIRM and indication of the exchange schema used satisfy the procedures stated in 4.1.2 and 4.1.3.*

*Note 2.— Guidance on aligning the information in an information service payload with the AIRM is provided in Doc 10203.*

## 4.3 METADATA

*Note.— Metadata is essential in the understanding and exchange of information by an information service.*

4.3.1 Information service providers shall provide metadata that describes both the information service payload and the information service that delivers the information.

*Note.— Procedures related to the means to make available information service metadata are described in 5.2.*

4.3.2 Metadata on information should be collected when performing information management activities based on the requirements of the particular information domain(s).

*Note.— Annex 4, Annex 15 and PANS-AIM (Doc 10066) include requirements on metadata for providers of information services. These requirements on metadata for information may be different from the requirements on metadata for the information service.*

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# Chapter 5

# INFORMATION SERVICES

## 5.1 GENERAL

5.1.1 Information service providers shall publicize the information services that they provide.

5.1.2 Information service consumers should assess the fitness for purpose of an information service using information service metadata.

## 5.2 INFORMATION SERVICE OVERVIEW

5.2.1 Information service providers shall provide information service metadata through information service overviews.

5.2.2 Information service overviews shall be structured using the metadata fields in Table 5-1. This practice facilitates discoverability of information services and enables information service consumers to compare different information services.

5.2.3 Information service providers shall provide a complete description of all metadata fields in the information service overview for each version of an information service.

### Table 5-1. Information service overview metadata fields

*Note.— The "field schema" column serves to define the requirements for the internal structure of the metadata fields. It is not intended to prescribe an encode or a format.*

| Field name | Requirements | Field schema | Example |
|---|---|---|---|
| Information service name | Information service providers shall name the information service. The name of the information service should enable information service consumers to reference or identify the information service. The name should provide an indication of the purpose of the information service. | Free text | *DONLON TargetOffBlockTimeSetting Service* |
| Information service version | Information service providers shall provide versioning to the information services. The service version shall be provided in numerical format (n.n[.n]). The version of the information service shall allow information service | n.n[.n] | *1.0.0* |

| Field name | Requirements | Field schema | Example |
|---|---|---|---|
| | consumers to distinguish between versions of an information service. | | |
| Information service life cycle status | Information service providers shall specify the stage that the information service version is currently in as one of three stages: prospective, operational or retired.<br>*Note.— For more information on service stages see Doc 10203.* | Prospective<br>*or*<br>Operational<br>*or*<br>Retired | *OPERATIONAL* |
| Information service life cycle date | Information service providers should include the dates for current and future lifecycle stages. The planned date of retirement should be listed whenever it is known to exist. If an information service provider does not make the date available, the *information service life cycle date* metadata field shall specify "NIL".<br>*Note.— In the case of a prospective stage, the date indicates the date by which the information service provider plans to make the information service operational.* | YYYY-MM-DD<br>*or* NIL | *2018-07-31* |
| Information service functions | Information service providers should provide a description of the business level characteristics of the information service functions. This will provide information service consumers a business view of the interactions with the information service, without having to look at the interface details. The description should include the functionality of the service as a list of the functions and real world effects. If an information service provider does not make the information service functions available, the *information service functions* metadata field shall specify "NIL". | Free text<br>*or* NIL | *Business function: Service for the information service consumer to set (i.e. define or update) or delete the target off-block time (TOBT) value for a specific flight.*<br><br>*Real world effect: The TOBT values are updated for each flight as the information service consumer performs:*<br>• *Set TOBT – TOBT value is defined or updated*<br>• *Delete TOBT – TOBT is marked as undefined* |
| Information category | The information domain(s) covered by the information service shall be listed as one or more of the following:<br>a) flight information;<br>b) aeronautical information;<br>c) meteorological information;<br>d) environment information;<br>e) capacity, demand and flow information;<br>f) surveillance information; and/or<br>g) other information. | Flight information;<br>*and/or*<br>Aeronautical information<br>*and/or*<br>Meteorological information<br>*and/or*<br>Environment information<br>*and/or*<br>Capacity, demand | *FLIGHT INFORMATION* |

| Field name | Requirements | Field schema | Example |
|---|---|---|---|
| | | and flow information *and/or* Surveillance information *and/or* Other information | |
| Brief description of the information service | Information service providers shall provide a brief description of the information service to assist information service consumers on whether the described service is suitable for use in a particular situation. The brief description shall include the information domain(s) covered by the information service, the operational need being addressed by the information service, the intended use of the information service, and the intended consumer audience for the information service. | Free text (intended use) | *The TargetOffBlockTimeSetting service supports the Airport Collaborative Decision Making (A-CDM) concept and its implementation by allowing A-CDM Partners, typically aircraft operators and ground handlers, with the capability to set TOBT that indicates the target time for the aircraft to be ready for off-block.* |
| Additional information on the information service | Information service providers should provide a description of the location at which more information, potentially including more detailed technical information on an information service, may be found. The location should be provided as a link to where an information service consumer can find more information. If an information service provider does not make additional information available on the information service overview, the *additional information on the information service* metadata field shall specify "NIL". | Free text *or* NIL | *Additional information on the information service can be found at the DONLON Service Registry: https://donlonregistry.com/*<br>*or*<br>*DONLON service web site:*<br>*https://donlon-atlanticservices.com* |
| Quality of the service | Information service providers shall provide a description on the qualitative and quantitative information pertaining to the characteristics of an information service to allow information service consumers to understand the quality of the information service. The description should specify parameters based on ISO 25010. The quality of the information service should be expressed using the following parameters (or other applicable parameters):<br>a) performance parameters (quantitative);<br>i) capacity of a service;<br>ii) time behaviour of a service;<br>b) reliability parameters (quantitative);<br>i) availability of a service;<br>ii) recoverability of a service;<br>c) security parameters (qualitative);<br>i) confidentiality of a service; and/or | Capacity: free text (description of capacity) *and/or* Time behaviour: free text (description of time behaviour) *and/or* Availability: free text (description of availability) *and/or* Recoverability: free text (description of recoverability) *and/or* Confidentiality: | *AVAILABILITY: 99.95 % outside the planned outages*<br>*CAPACITY: 2 000 service requests per hour*<br>*TIME BEHAVIOUR: 2 s delay for 95 % of messages* |

| Field name | Requirements | Field schema | Example |
|---|---|---|---|
| | ii) integrity of a service.<br>*Note.— Examples of applicable parameters related to performance, reliability and security are provided in Doc 10203.* | free text (description of confidentiality) *and/or* Integrity: free text (description of integrity) | |
| Information service validation type | Information service providers shall ensure that the information service is validated. This validation shall include the parameters provided in the *quality of service* metadata field of the information service overview to assist information service consumers with the initial evaluation of the information service. Information services shall be validated by at least one of the following validation methods:<br>a) independent validation;<br>b) collaborative validation;<br>c) user validation; or<br>d) self-validation.<br>The validation method(s) used and its corresponding result shall be recorded. Information services may evolve which triggers the need for revalidation. Each new version of an information service should be revalidated.<br>*Note.— For more information on the validation methods see Doc 10203.* | Independent validation *and/or* Collaborative validation *and/or* User validation *and/or* Self-validation | *SELF-VALIDATION* |
| Information service validation description | Information service providers shall provide a description of the validation method applied to assist information service consumers in assessing the confidence level of the information service. By sharing the validation results, information service providers reassure information service consumers that the information service and its provider have the ability to deliver the declared capabilities and quality of service. The description should include a brief statement on the validation results, and it should describe how the information service consumers may obtain the validation evidence. | Free text (validation result) | *DONLON Airport tested the service in accordance with its QMS-based requirements.* |
| Filtering available | Information service providers should provide information on the availability of filtering to allow information service consumers to narrow the content of information that they | Free text *or* NIL | *The DONLON Airport Weather data service supports the following filtering:* |

| Field name | Requirements | Field schema | Example |
|---|---|---|---|
| | consume. The capability of filtering information should describe the filters information service providers offer for an information service. If an information service provider does not offer filtering or does not make information on filtering available on the service overview, the *filtering available* metadata field shall specify "NIL". | | *Report Type - specify one or more of "METAR", "SPECI" or "TAF" in the subscription request to filter the results to only these types of reports.*<br>*If no filtering option is specified, then all messages will be subscribed to.* |
| Access restrictions | Information service providers shall provide a description of any constraints on access to the information service to assist information service consumers in understanding whether they may be eligible to access the information service. These constraints should specify the requirements and/or restrictions on information service consumers for accessing the information exchanged by the information service that are considered to be sensitive. | Free text | *The service is targeting aircraft operators and ground handlers for their flights at DONLON Airport. The access to the service is subject to the signature of a Service Level Agreement with the DONLON Airport Operator. The access to the service is based on user ID and password, which can be obtained for authorized users through the point of contact (POC) listed.*<br>*The service may, as well, be used by the DONLON Tower Controllers in specific circumstances, such as under adverse conditions or other special circumstances.* |
| Message exchange patterns | Information service providers shall indicate the message exchange pattern used by the information service to assist information service consumers in understanding the relationships of multiple messages exchanged with the information service providers. The message exchange pattern shall be expressed as one or more of the following:<br>a) request/reply;<br>b) one way; *and/or*<br>c) publish/subscribe. | Request/Reply<br>*and/or*<br>One way<br>*and/or*<br>Publish/Subscribe | *Request/Reply* |
| Information exchange models | If information service providers use for their information service payloads the domain specific information exchange models, then information service providers shall indicate the domain-specific information exchange models used for their information service payloads, including the extensions of the information exchange models and their versions. If information service providers do not use the domain-specific information exchange models for their information service | Free text | *The service is using an information exchange model aligned with the AIRM version 1.0.0.* |

| Field name | Requirements | Field schema | Example |
|---|---|---|---|
| | payloads, then information service providers shall describe the alignment to a global reference model and indicate the exchange schema used.<br><br>*Note.— See the AIRM for an example of a global reference model (https://airm.aero/).* | | |
| Geographical extent of information | Information service providers shall provide a description of the geographical coverage of the information exchanged to allow information service consumers to understand the geographical coverage of the information being provided.<br><br>*Note.— The geographical coverage may be expressed in terms such as ICAO Region, flight information region (FIR), aerodrome or polygon. More granular information such as coverage at airport "x" or FIR "y" may be provided as it may facilitate search responses.* | Free text | *DONLON Airport* |
| Source of information | Information service providers should specify the sources of information exchanged. Information service providers should also provide information on any subsequent modifications applied in order to provide information service consumers with background on information sources and modifications. If an information service provider does not make the source of information available, the *source of information* metadata field shall specify "NIL". | Free text<br>*or* NIL | *DONLON Airport Operator* |
| Information security category | Information service providers shall indicate the information security category to provide information service consumers with an understanding of the level of protection of the information. The information security category shall be expressed as one of the following:<br><br>a) none;<br>b) basic;<br>c) intermediate; or<br>d) advanced.<br><br>*Note.— More information is provided in the* Manual on Information Security *(Doc 10204).* | None<br>*or*<br>Basic<br>*or*<br>Intermediate<br>*or*<br>Advanced | *Intermediate* |
| Provider organization | Information service providers shall provide the name of their organization to assist information service consumers in identifying | Free text | *DONLON Atlantic Services* |

| Field name | Requirements | Field schema | Example |
|---|---|---|---|
| | and gaining context on the information service. The name of the organization shall be followed by any abbreviated name, if any, by which the organization is known.<br>*Note.— The provider organization may or may not be the organization originating the information.* | | *Federal Aviation Administration (FAA)* |
| Support availability | Information service providers should provide a description of the support offered to information service consumers on all relevant aspects related to the information service, to allow information service consumers to understand the level of support to expect. If an information service provider does not make support availability information available, the *support availability* metadata field shall specify "NO SUPPORT AVAILABLE". | Free text<br>or NO SUPPORT AVAILABLE | *For incidents on services in operation, contact the Service desk [24/7]: +693 555 01 service-desk@donlon-atlanticservices.com* |
| Provider point of contact | Information service consumers should have a point of contact to request, if needed, additional information regarding an information service. Information service providers shall provide a point of contact such as an email or website where a potential information service consumer can direct additional questions regarding the information service. | Free text | *To request access to the service:* www.donlon-atlanticservices.com/swim/service-request |

## 5.3 INFORMATION SERVICE OVERVIEW PUBLICATION

5.3.1 Information service providers shall inform consumers where they can access the information service overviews and the metadata on information services therein.

5.3.2 The uniform resource locator (URL) where information service overviews are publicized shall be included in the AIP. In case a SWIM registry is used (see 5.4), the URL shall be the one of the registry.

*Note 1.— To mitigate the risk of inconsistencies, a limited number of locations where service overviews are made available by the information service providers is preferred.*

*Note 2.— Information regarding the URL is provided in PANS-AIM (Doc 10066), Appendix 2, GEN 3.7.1.*

## 5.4 SYSTEM-WIDE INFORMATION MANAGEMENT REGISTRY

5.4.1 SWIM registries should be used by:

a) information service providers as a means to publicize available information services; and

b) information service consumers as a means to discover information services.

*Note.— Information service providers do not have to implement a SWIM registry, they could use a SWIM registry already implemented. The implementation of a SWIM registry could be done by any stakeholder.*

5.4.2 When a SWIM registry is used:

a) it shall make information service overviews available;

b) it shall provide access control for the registration of information service overviews;

c) it shall provide search functionalities on information service overviews and their fields;

d) it should provide notification functionalities on changes to information service overviews and their fields; and

e) it should be made publicly available.

*Note.— The classification of information services according to information category and/or information service lifecycle status will facilitate the search functionality of a SWIM registry (see Table 5-1).*

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# Chapter 6

# TECHNICAL INFRASTRUCTURE

## 6.1 GENERAL

Information services shall be provided and consumed using a technical infrastructure based on the Internet Protocol Suite (IPS).

*Note.— The ATN/IPS meets the requirements for the technical infrastructure. Corresponding provisions are contained in Annex 10 —* Aeronautical Telecommunications, *Volume III —* Communication Systems *and the* Manual on the Aeronautical Telecommunication Network (ATN) using Internet Protocol Suite (IPS) Standards and Protocols *(Doc 9896).*

## 6.2 INTERFACE BINDINGS

6.2.1 Information services use interface bindings to interact with the technical infrastructure.

*Note.— See Doc 10203 for more information on interface bindings.*

6.2.2 Interface bindings shall be based on standardized and widely used and supported protocols.

*Note 1.— These protocols provide the necessary capabilities to enable information service providers and consumers to exchange information via interoperable services applying loose coupling principles between systems.*

*Note 2.— Two systems that implement the same interface binding are technically interoperable, and therefore capable to connect and to exchange information.*

6.2.2.1 In order to ensure interoperability, if information service providers and consumers are using different protocols, both parties shall ensure that lossless mediation between protocols has been established.

*Note 1.— Lossless mediation means that the message and its properties are preserved in the bi-directional conversion between two protocols.*

*Note 2.— Guidance on lossless mediation, including the required application property names and types can be found in Doc 10203.*

6.2.3 Information service providers should manage interface bindings to consolidate the potentially large number of technologies that could be used for implementing interfaces between systems and to maintain flexibility in relation to the opportunities of emerging potential technologies.

6.2.4 Information services should use defined interface bindings in accordance with 6.2.2 and 6.2.3.

*Note 1.— Doc 10203 provides further guidance on functional capabilities, loosely coupling, interface bindings and interoperable mediation between protocols.*

*Note 2.— An example of a specification on interface bindings is shown in EUROCONTROL Specification for SWIM Technical Infrastructure (EUROCONTROL-SPEC-170).*

## 6.3 INFORMATION SECURITY FRAMEWORK

6.3.1 System-wide information management stakeholders processing, storing, consuming or transferring information shall implement an information security framework, designed to ensure the confidentiality (when needed), integrity and availability of the information and information services.

6.3.2 The information security framework shall apply to the IPS-based network, the technical infrastructure, the information, the information service and the applications that process, use or distribute information in an integrated manner.

*Note.— Guidance on how to implement the information security framework, as part of another framework or an independent framework, is provided in Doc 10204.*

6.3.3 Information service providers shall classify information according to defined information security categories to ensure a mutual understanding of the level of protection of the information exchanged.

*Note.— See Doc 10204 for classification of information in the defined information security categories.*

6.3.4 System-wide information management stakeholders should implement information security requirements commensurate with the information security category determined in 6.3.3.

*Note.— For more information on commensurate information security requirements, see Doc 10204.*

6.3.5 Information service consumers shall assess the impact of the loss of confidentiality, integrity and availability of the information on safety to determine the information security category required for the operational use of the information.

*Note 1.— The loss of confidentiality, integrity and availability of the information may impact safety.*

*Note 2.— See Doc 10204 for the assessment of the impact of the loss of confidentiality, integrity and availability of the information on safety and classification of information in information security categories.*

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End of the First Edition of PANS-IM.

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