International Civil Aviation Organization

INFORMATION PAPER

AERONAUTICAL COMMUNICATION PANEL (ACP)

FIFTEENTH MEETING OF WORKING GROUP - I

Bucharest, Romania 28 – 30 May 2012

Agenda Item 7

SYSTEM WIDE INFORMATION MANAGEMENT (SWIM) - Activity in Europe

(Presented by EUROCONTROL)

SUMMARY

Information on the state of play of System Wide Information Management (SWIM) development and early adoption in Europe[1]

1. Introduction

1.1. System Wide Information Management (SWIM) has already been in existence for several years, but has lacked a common, clear and accepted definition. SWIM deals with information management, and because of this many European initiatives took on the SWIM label in a relatively uncoordinated manner. Thanks to the SESAR programme, much work has been done to clarify what SWIM is. The first SWIM Concept of Operation has been developed, providing the first opportunity to assess the current state of SWIM adoption in Europe.

1.2. This information paper aims to provide the ICAO/ACP/WG1 with a complete picture of the current achievements relating to SWIM development and early adoption.

1.3. This information paper has been developed on the basis of several sources:

[1] SESAR Work Program, DEL08.01.01 A01 SWIM Concept of Operation, edition 00.02.00 (14.3.12)

[2] COG51 WP23, Review of EUR ANP, COG/51, WP/23 (5.10.11)

[3] ATMRPP-WG/WP/509, PP-WG/WHL/4-WP (23.3.12)

[1] This Information Paper has been already presented at the last ICAO/AFSG16 meeting in Paris in April 2012.

(8 Pages)

2. Current situation and need for change

2.1. Today's ATM system comprises a wide variety of applications developed over time for specific purposes. It is characterised by many custom communication protocols, each with their own self-contained information systems on board the aircraft, in the air traffic control centre, etc. Each of these interfaces is custom designed, developed, managed, and maintained individually and locally, at a significant cost. Moreover, the ways ATM information is defined and structured and the ways it is provided and used are specific for most ATM systems.

2.2. The expected increase in aviation capacity demands, economic pressure and concern for the environmental impact mean that there is an ever-increasing reliance on receiving accurate and timely information. Such information must be organised and provided through flexible means that support system-wide interoperability, secured seamless information access and exchange. This will result in a more cost- and time-efficient exchange of information between providers and users.

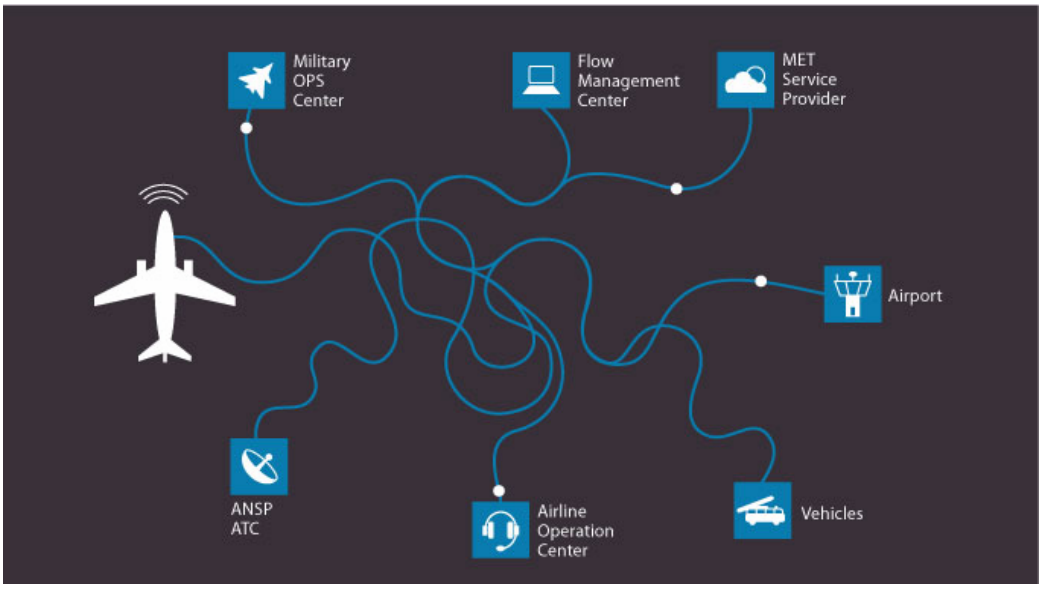

Figure 1: Sharing information today

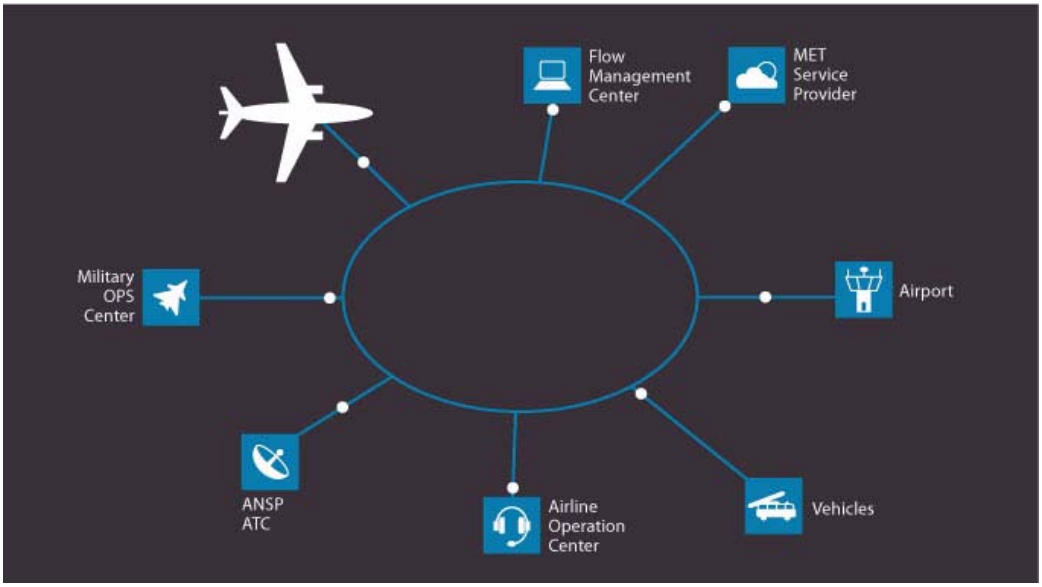

Figure 2: Sharing information tomorrow

2.3. Information management in ATM can be seen as a complex, distributed information processing community which covers the logistics and distribution of accredited, quality-assured and timely information used to support all ATM elements, thus forming the "glue" between them. It is the basis for collaborative decision-making.

2.4. This community is populated by a large number of humans and automated systems performing the roles of information providers, decision makers and information users, all collaborating to ensure the safe, timely and efficient flow of air traffic. The objective of information management[2] is to collect, organise, control, process and deliver information in order to provide decision makers and information users with the right information at the right time and in the right place.

3. SWIM Concept of Operation

3.1 Within the scope of the SESAR programme, the first SWIM Concept of Operation has been produced. It provides a definition of SWIM and, through a set of representative use-cases, a view of how SWIM is being applied in the SESAR programme and the future European ATM system. In addition to defining SWIM, the Concept of Operation discusses related matters such as the vision, principles, needs and benefits, and governance of SWIM. It explains how stakeholders will participate, and how it will be managed and used at various levels (from the business and institutional to the technical and implementation levels). The content of this initial Concept of Operation should be understood as a basis which requires future iterations providing the necessary refinements.

3.2 The sections below (SWIM Vision, SWIM Definition, SWIM Principles, SWIM Service Orientation and SWIM Building Blocks) are short abstracts of the initial SWIM Concept of Operation (Ref. [1]).

4. SWIM Vision

4.1 In order for the ATM system and its users to operate at their full potential, pertinent information needs to be available when and where required. Indeed, the ATM community increasingly depends on the provision of timely, relevant, accurate, authorised and quality-assured information in order to collaborate and make informed decisions. Having shared access to the clearest possible integrated picture of the historical, real-time and planned or expected future state of the ATM situation on a system-wide basis will allow the ATM community to conduct its business and operations in a safer and more efficient manner.

4.2 These requirements are supported by SWIM by means of an interconnected set of ATM systems which provide or consume information, including human users and aircraft. Through SWIM, information is made available and processed through services which need to conform to applicable standards and be registered so that they are accessible. In addition, SWIM improves the interconnectivity of ATM systems. SWIM promotes and contributes to open standards, and it also provides technology recommendations. The aim of this is to improve information management and therefore information sharing on a wide basis, providing support for permanent dialogue between the various partners. It also enables wider discoverability of the pertinent information, while making it easier and less costly to share.

4.3 Aircraft operators will have up-to-date, accurate and integrated information on which to base decisions about their flights, while ATM service providers, including aerodrome operators, will have a better knowledge of flight intentions for operational and planning purposes. Thereby, controllers, pilots, dispatchers and other flight operations personnel will share a common situational

[2] Information management (IM) is the collection and management of information from one or more sources and the distribution of that information to one or more audiences […]. Management means the organization of and control over the structure, processing and delivery of information (source: Wikipedia).

awareness with regard to the status and condition of the aeronautical infrastructure, the weather, the air traffic situation and other operationally significant information. On the basis of this shared situational information, ATM actors will make better and faster decisions collaboratively for the purpose of orchestrating and conducting highly efficient operations.

5. SWIM Definition

5.1 The definition of SWIM is as follows:

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

5.2 SWIM introduces a complete change in how information is managed throughout its life cycle across the whole European ATM system. SWIM is a key enabler for the future SESAR system, and as such SWIM enables direct ATM benefits from business, operational and technical points of view.

6. SWIM Principles

6.1 SWIM enables the stakeholders in the European ATM community to collaborate in a federated manner, at the pan-European, regional and local levels: **principle of federation**.

6.2 Information is available to all parties, except if specific policies restrict access to it: **principle of information sharing**.

6.3 SWIM uses services as the mechanism for supporting the ATM stakeholders with a view to the sharing of information: **principle of service orientation**.

6.4 SWIM services are based on open and internationally agreed standards when fit for purpose: **principle of open standards**.

6.5 SWIM information and services are governed throughout their life cycle: **principle of information and service life cycle governance.**

7. SWIM Service Orientation – Service Oriented Architecture (SOA)

7.1 One of the key principles of SWIM is the service orientation approach, which aims to use the service concept to describe ATM information exchanges among ATM systems in the ATM enterprise. In this context, a service can be described using various perspectives or aspects:

7.1.1 The business aspect of a service generally addresses the reasons for the service and is therefore related to its goals and value proposition. The business aspect can also address the business and legal entities which provide and use the service, i.e. the ATM stakeholders.

7.1.2 The operational aspect of a service describes what the service is about, and how it relates to operational processes in European ATM and the surrounding environment. This description acts as input for determining how the service is to be implemented.

7.1.3 The solution aspect of a service defines how it is provided within European ATM. This includes a determination of whether the service is provided using technological automation or human resources only.

7.1.4 The time perspective is of course also important so that there can be agreement on when the various services will be in place.

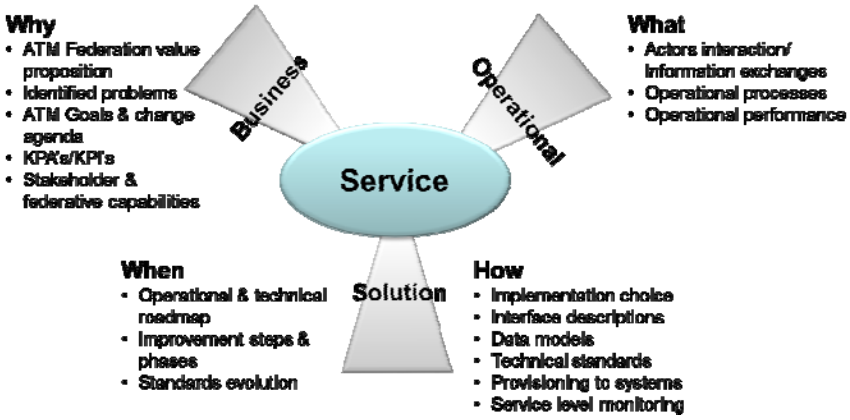

Figure 3: Service aspects

8. SWIM building blocks

8.1 SWIM includes an ATM information model representing the standard definition of all ATM information, through harmonised conceptual and logical data models. In the context of the SESAR Programme, this is instantiated in the AIRM (ATM Information Reference Model).

8.2 SWIM includes an ATM services model representing the logical breakdown of required information services and their behavioural patterns. These services are also called ATM-specific services. In the context of the SESAR Programme, this is instantiated in the ISRM (Information Service Reference Model).

8.3 SWIM provides information management functions (including governance), such as user identity management, discoverability of resources, security aspects such as authentication, encryption and authorisation, notification services and registration, which need to be defined to support information sharing. SWIM governance affects almost all of the roles and their interactions within the ATM system.

8.4 The SWIM technical infrastructure (SWIM-TI) is the interoperable (runtime) infrastructure (ground-ground and air-ground) via which ATM data and services are distributed, shared and consumed. The SWIM-TI contributes to the solution aspects of the services, providing a means of supporting effective and secure ATM-specific service provision and consumption among SWIM-enabled ATM applications. Its implementation may differ from one stakeholder to another, depending on the specific needs profile, in terms of both the scope and the type of implementation. It will be based mostly on commercial off-the-shelf (COTS) standards-based and interoperable products and services, but it is possible that in some cases specific software may need to be developed.

8.5 In accordance with what is described above, the SWIM-TI is a set of software components distributed over any IP-based network infrastructure (such as PENS or the Internet) providing capabilities enabling collaboration between ATM systems. These capabilities represent the SWIM-TI functional view, which is instantiated in a set of SWIM nodes (responsible for exchanging data with other SWIM nodes and allowing ATM systems to consume and expose ATM-specific services validation) and common components (providing capabilities to all the distributed SWIM nodes).

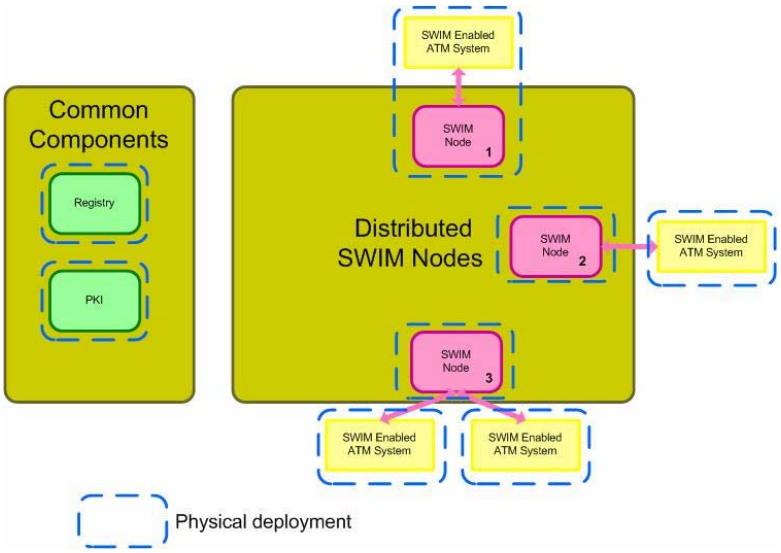

Figure 4: SWIM-TI high-level architecture

8.6 SWIM is a set of SWIM-enabled applications. The implementation of SWIM in the ATM system enables ATM business benefits by ensuring commonly understood quality information is provided to the right people at the right time.

9. SWIM is becoming a reality

9.1 The implementation of SWIM is not a big-bang replacement of the existing ATM environment, but rather an evolutionary process based on a gradual transition towards a service-oriented European ATM system.

9.2 As explained above, some SWIM principles have already been adopted, such as the separation of information provision and consumption in order to decouple information producers from potential consumers; loose system coupling where each component has, or makes use of, little or no knowledge of the definitions of other separate components; using open standards and mainstream IT technologies; and taking as a basis SOA principles driven by analysis of business processes and needs functionality, packaged and implemented as a suite of interoperable services that can be used in a flexible way within multiple separate systems from several business domains. Currently information is already being distributed, but in a manner involving many custom communication protocols, each with their own self-contained information systems and data formats. However, recent developments have been made which are based on SOA principles and which make use of existing state-of-the-art standards and mainstream IT technologies. Although they may not have been effected in specific accordance with SWIM concepts, they already comply with some of them. These developments (such as ICOG, EAD and CFMU NOP) and lessons learnt have been used as a starting point for defining SWIM.

9.3 The Network Operations Plan (NOP) B2B web service infrastructure complies with these initial definitions and design options on both local and federated capability level. It is the network management web interface for system-to-system interoperability. This network management web service infrastructure separates information provision from information consumption, is based on open standard (AIXM) and mainstream IT technologies (web services), and is fully SOA compliant. It is therefore the first (and for the moment only) officially labelled SESAR SWIM pioneer. The service layer defined for it can be seen as a SWIM node which is part of the SESAR SWIM infrastructure. It is an initial demonstration of the added value and the power of the service orientation principles as well as the use of mainstream IT technologies. It is therefore a reference implementation to be taken as a starting point for the full SESAR SWIM development.

9.4 Furthermore, an initial SWIM Technical Infrastructure demonstration was performed at the EUROCONTROL Experimental Centre last November. It displayed the initial building blocks of the future SESAR SWIM, showing several IT technologies interoperating. The SWIM Technical Infrastructure demonstration is a yearly SESAR event which aims to display concrete results of the SESAR SWIM programme.

10. SWIM at ICAO level

10.1 Ref. [2]: The Global Air Traffic Management Operational Concept (Doc. 9854) addresses the shortcomings of the current provision and management of ATM-related information by introducing information management. This System Wide Information Management (SWIM) should provide system architecture for the delivery of information services to help meet the expectations of the ATM community in various key performance areas. To this end, over the course of recent years SWIM concepts and solutions have been researched and are already under various stages of development in different Member States in a non-harmonised way. Programmes such as CARATS in Japan, the China New Generation ATM System (CNAS), NextGen in the United States and SESAR in Europe all consider the implementation of SWIM to be a fundamental requirement for future ATM systems. While it must be recognised that a "one size fits all" concept may not fit the needs of all regions, it is of the utmost importance for the consistency of the Global Air Transportation System to achieve some level of interoperability between the different solutions that may be developed. The development of SWIM infrastructure and services should proceed in alignment with a globally accepted operational concept setting out the expected SWIM implementation in terms of benefits, enablers, features, and principles for development and transition.

10.2 Ref. [3]: As agreed at the last ATMRPP meeting, in preparation for the 12th Air Navigation Conference (November 2012) the Air Navigation Bureau has drafted a System Wide Information Management Working Paper. This paper introduces ideas that are currently being discussed as a potential basis for the development of a global SWIM concept.

10.3 Again as input to he Air Navigation Conference #12, ICAO created an Information Management (IM) Roadmap combining different ATM data domains (flight and flow, aeronautical and meteorology) with the Aviation System Block Upgrades defined in the ICAO Global Air Navigation Plan. This constitutes an initial contribution to global SWIM integration.

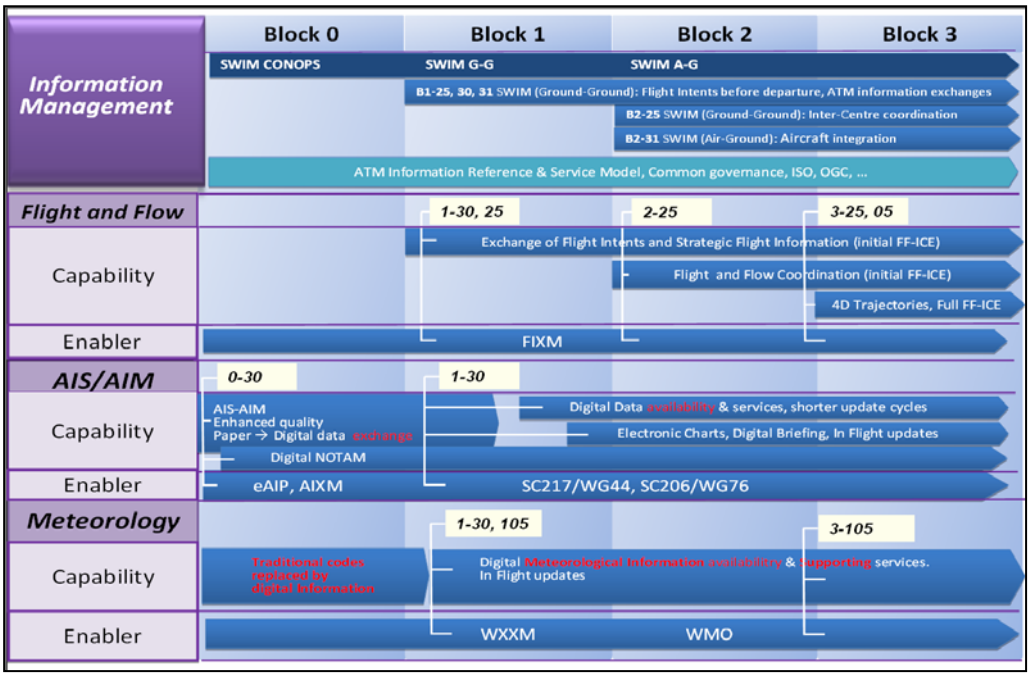

Figure 5: IM Roadmap

11. Action by the meeting

11.1. The ACP-WGI is invited:

- to note the current progress and achievements of SWIM development and early adoption;
- To note that organisations that want to move towards SWIM implementation can do so by starting to unlock their data (AIXM/WXXM are safe investments) and publish & consuming services in a SOA fashion.

-- END --