# APPENDIX A

## MODULE NO. B1-31: PERFORMANCE IMPROVEMENT THROUGH THE APPLICATION OF SYSTEM-WIDE INFORMATION MANAGEMENT (SWIM)

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| **Summary** | Implementation of system-wide information management (SWIM) services (applications and infrastructure) creating the aviation intranet based on standard data models, and internet-based protocols to maximize interoperability. | |
| **Main performance impact as per Doc 9854** | KPA-03 – Cost-effectiveness, KPA-04 – Efficiency, KPA-05 – Environment, KPA-10 – Safety, KPA-11 – Security. | |
| **Operating environment/ Phases of flight** | All phases of flight | |
| **Applicability considerations** | Applicable at State level, with increased benefits as more States participate | |
| **Global concept component(s) as per Doc 9854** | ATM/SDM – ATM service delivery management | |
| **Global plan initiatives (GPI)** | GPI-18: Electronic information services | |
| **Main dependencies** | Successor of: B0-30<br>Parallel progress with: B1-30 | |
| **Global readiness checklist** | | Status (ready now or estimated date) |
| | Standards readiness | Est. 2016 |
| | Avionics availability | NA |
| | Ground systems availability | Est. 2018 |
| | Procedures available | Est. 2016 |
| | Operations approvals | Est. 2016 |

## 1. NARRATIVE

### 1.1 General

1.1.1 A goal of the Global ATM Operational Concept is a net-centric operation where the air traffic management (ATM) network is considered as a series of nodes, including the aircraft, providing or using information. Aircraft operators with operational control centre facilities will share information while the individual user will be able to do the same using other applications. The support provided by the ATM network will in all cases be tailored to the needs of the user concerned.

1.1.2 The sharing of information of the required quality and timeliness in a secure environment is an essential enabler to the ATM target concept. The scope extends to all information that is of potential interest to ATM including trajectories, surveillance data, aeronautical information of all types, meteorological information etc. In particular, all partners in the ATM network will share trajectory information in real time to the extent required from the trajectory development phase through operations and post-operation activities. ATM planning, collaborative decision making processes and tactical operations will always be based on the latest and most accurate trajectory data. The individual trajectories will be managed through the provision of a set of ATM services tailored to meet their specific needs, acknowledging that not all aircraft will (or will need to) be able to attain the same level of capability at the same time.

1.1.3 System-wide information management (SWIM) is an essential enabler for ATM applications which provides an appropriate infrastructure and ensures the availability of the information needed by the applications run by the users. The related geo- and time-enabled, seamless and open interoperable data exchange relies on the use of common methodology and the use of a suitable technology and compliant system interfaces. The availability of SWIM will make possible the deployment of advanced end-user applications as it will provide extensive information sharing and the capability to find the right information wherever the provider is.

1.1.4 The phased approach to the deployment of SWIM has been developed to ensure that benefits start to be realized at the earliest possible time by integrating simple end-user applications first. The deployment of SWIM is not dependent on the deployment of ATM changes, benefits can be achieved in largely legacy environments though regulations might be required notably concerning the liability, usage rights and intellectual property rights aspects of data provision.

1.1.5 At each stage, the phased implementation of SWIM will consider the three interrelated dimensions (applications, information and infrastructure):

a) applications represent the user side of SWIM. They will be addressed through the identification of "communities of interest" gathering stakeholders that have to share information to serve their interests. The partners in the community know the information they need to share with what quality of service and for effective collaboration they require a common understanding of the information and the information has to be available in a commonly agreed structure. Initially the communities will comprise a core group of air navigation service providers (ANSPs), airports and aircraft operators evolving to include more complex collaborations across the whole ATM business chain;

b) information covers both the semantic and syntactic aspects of data composing information and the information management functions. The former is dealt with by modelling activities which aim to use and or define common standards while the latter include mainly distribution, quality, maintenance, user identity and profile to enable data exchange and sharing within a community of interest and between communities independently of the underlying communication infrastructure; and

c) infrastructure will be concerned mainly by the connectivity aspects: it will be built on existing legacy infrastructure as far as practicable until an internet protocol (IP)-based network is available. The air/ground segment is an example of SWIM connectivity that is intended to be added at a later stage as aircraft are integrated into the communities of interest (see B1-40).

1.1.6 The combination of the above areas at particular stages of their common evolution, constitute the ATM capability levels for information management.

## 1.2 **Baseline**

1.2.1 Module B0-30 will have created a nucleus of modern information management and provided experience to move forward in domains other than aeronautical information management (AIM). Module B1-30 will in parallel allow ATM information to be structured and managed in a fully digital and consistent manner, using the same standards for their description. Module B0-30 remained a traditional environment where information needed to be requested or was the subject of distribution via

classical subscriptions. It was not adapted to the fully dynamic environment that ATM is about, and therefore it started with information not considered as safety critical and/or integrated with other data.

### 1.3 Change brought by the module

1.3.1 This module allows, thanks to the notion of SWIM, to ensure that the right, up-to-date and accurate data is timely available to the right user with the required performance and quality. It represents the achievement of a significant paradigm shift in ATM and is the enabler, together with the appropriate telecommunication infrastructure, of the most advanced features of the Global concept, in particular seamless trajectory based operations.

1.3.2 The module addresses applications of SWIM on the ground. Most of the air ground data exchanges will remain based on point-to-point communication.

## 2. INTENDED PERFORMANCE OPERATIONAL IMPROVEMENT

2.1 Metrics to determine the success of the module are proposed in the *Manual on Global Performance of the Air Navigation System* (Doc 9883).

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| *Cost effectiveness* | Further reduction of costs; all information can be managed consistently across the network, limiting bespoke developments, flexible to adapt to state-of-the-art industrial products and making use of scale economies for the exchanged volumes. |
| *Efficiency* | Using better information allows operators and service providers to plan and execute better trajectories. |
| *Environment* | Further reduction of paper usage more cost-efficient flights as the most up to date is available to all stakeholders in the ATM system. |
| *Safety* | Access protocols and data quality will be designed to reduce current limitations in these areas. |
| *Security* | Access protocols and data quality will be designed to reduce current limitations in these areas. |
| *Cost Benefit Analysis* | The business case is to be considered in the full light of other modules of this block and the next one. Pure SWIM aspects unlock ATM information management issues; operational benefits are more indirect. |

## 3. NECESSARY PROCEDURES (AIR AND GROUND)

3.1 SWIM implies new procedures regarding access to and delivery of information. While most of them should be transparent to tactical air traffic control (ATC) functions, there will be a need to be able to distinguish, at least during a transition period, those operators which will have been able to access and deliver information via SWIM from those which still need less advanced modes.

## 4. NECESSARY SYSTEM CAPABILITY

### 4.1 Avionics

4.1.1 No avionics requirement.

### 4.2 Ground systems

4.2.1 The ground SWIM infrastructure (i.e. inter-networking between stakeholders and communication protocols) and its oversight functions to allow the progressive connection of ATM stakeholder systems while meeting the necessary safety, security and reliability requirements. The ATM stakeholder systems adaptation will vary from low to high depending on their architecture and their ability to transform this architecture into a concrete service oriented one.

## 5. HUMAN PERFORMANCE

### 5.1 Human factors considerations

1.1.1 SWIM is a new concept for addressing information. In essence it is close to the notion of an intranet. It therefore needs to be understood as such by all personnel, which will need to be aware of the principles and conditions of use. In addition, the architecture (logical and physical) and the management of the information data will be different from today and affect those that were in charge of these functions. End-users will be affected only if their access to data via interfaces does not remain stable.

1.1.2 The identification of human factors considerations is an important enabler in identifying processes and procedures for this module. In particular, the human-machine interface for the automation aspects of this performance improvement will need to be considered and where necessary accompanied by risk mitigation strategies such as training, education and redundancy.

### 5.2 Training and qualification requirements

5.2.1 Training requirements will be required and will have a high necessity. Training in the operational standards and procedures will be identified along with the standards and recommended practices necessary for this module to be implemented. Likewise the qualifications requirements will be identified and included in the regulatory readiness aspects of this module when they become available.

## 6. REGULATORY/STANDARDIZATION NEEDS AND APPROVAL PLAN (AIR AND GROUND)

6.1 Regulatory/standardization: new standards and guidance needed to address all formatting/template type information in order to meet all the requirements described in Section 8.

## 7. IMPLEMENTATION AND DEMONSTRATION ACTIVITIES (AS KNOWN AT TIME OF WRITING)

### 7.1 Current use

- **Europe**: The Pan-European Network Service (PENS) is used as a backbone for Internet Protocol (IP) ground-ground communications, but currently with no SWIM application. Also used are the Central Flow Management Unit (CFMU) Network Operations Plan Portal web services and European AIS Database AIM service layer.

- **Europe**: SESAR SWIM Step1 infrastructure demonstration at the end of 2011.

- **United States**: Using SWIM with FAA Telecommunications Interface (TCP/IP) sharing of data such as terminal weather data, and special activity airspace information will be implemented in 2013.

7.2 **Planned or ongoing activities**

- **SESAR**:
  - Planned release 2 validation and verification SWIM-enabled exercises
  - "IOP Validation": ATC-ATC coordination by means of a new mechanism based on the Flight Object
  - Validation of the first AIM service through SWIM using a AIXM5 data simulator
  - "Slot Swapping": DMEAN implemented improvement (slot swapping). Prototype of enhanced slot swapping function to cover extension to all flights from/to a given airport.
  - "AIM Quickwin (Step1)": Validate new ways of publishing complex up-to-date aeronautical information based on the digital NOTAM concept with its particular temporality data representation
  - SESAR trials in 2013-16 for SWIM protocols and prototype

- **United States:** Flight data publication and additional weather information are currently being planned to be on-ramped enabling publication , subscription and registry capabilities

8. **REFERENCE DOCUMENTS**

8.1 **Standards**

- PANS-AIM planned for availability in 2016 will address all information formats and templates referenced in Annex 15 — *Aeronautical Information Services*

8.2 **Procedures**

To be developed.

8.3 **Guidance material**

- WXXM
- ICAO Doc 8126, *Aeronautical Information Services Manual*

8.4 **Approval documents**

- Annex 15 — *Aeronautical Information Services*;
- Doc 8126, *Aeronautical Information Services Manual*; and
- PANS-AIM planned for availability in 2016

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# APPENDIX B

## MODULE NO. B2-31: ENABLING AIRBORNE PARTICIPATION IN COLLABORATIVE ATM THROUGH SWIM

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| **Summary** | This allows the aircraft to be fully connected as an information node in SWIM, enabling full participation in collaborative ATM processes with exchange of data including meteorology. This will start with non-safety critical exchanges supported by commercial data links. | |
| **Timescale** | From 2023 | |
| **Main performance impact as per Doc 9854** | KPA-01 – Access & Equity, KPA-04 – Efficiency, KPA-05 – Environment, KPA-08 – Participation by the ATM community, KPA-09 – Predictability, KPA-10 – Safety. | |
| **Operating environment/ Phases of flight** | All phases of flight | |
| **Applicability considerations** | Long-term evolution potentially applicable to all environments | |
| **Global concept component(s) as per Doc 9854** | ATM/SDM – ATM service delivery management | |
| **Global plan initiatives (GPI)** | GPI-17: Implementation of data link applications<br>GPI-18: Electronic information services | |
| **Main dependencies** | B1-30, B1-31,B1-80, B1-105, | |
| **Global readiness checklist** | | Status (ready or date) |
| | Standards readiness | 2023 |
| | Avionics availability | 2023 |
| | Infrastructure availability | 2023 |
| | Ground automation availability | 2023 |
| | Procedures available | 2023 |
| | Operations approvals | 2023 |

## 1. NARRATIVE

### 1.1 General

1.1.1 The Global concept envisages that the aircraft is an integral part of the collaborative, information-rich air traffic management (ATM) environment. This ultimately makes it a regular node of the system-wide information management (SWIM) processes and infrastructure, able to participate in the 4D-trajectory management and collaborative processes. Enabling the aircraft to participate in SWIM is the availability of a low cost data link capability for strategic information exchange.

### 1.2 Baseline

1.2.1 Modules B1-30 and B1-31 have created the ground SWIM infrastructure and the information reference model, and implemented processes and applications for ground users. Through datalinks such as WiMax, a high capacity data link exists for aircraft at the gate (end of pre-flight phase). Aviation, motivated first by non-ATM needs, has access to commercial satellite communication.

### 1.3 Change brought by the module

1.3.1 This module allows the aircraft to be fully connected as an information node in SWIM, enabling full participation in collaborative ATM processes. This will allow the aircraft to provide data, including meteorological, in addition to receiving it. Initially this will be for non-safety critical exchanges supported by commercial data links. The applications of this module are integrated into the processes and the information infrastructure which had evolved over the previous blocks.

1.3.2 The module can then evolve smoothly to the use of other technologies as they become available for the air-ground link when the aircraft is airborne. To enable the collaborative ATM, and meteorological information exchange capabilities in this module, network access on the aircraft is required on the ground and in the air. However, since these capabilities are not safety-critical, the security and reliability requirements are lower than those of critical systems such as the VHF digital link (VDL) network, a commercial system utilizing cell-based or satellite-based internet services could be used.

## 2. INTENDED PERFORMANCE OPERATIONAL IMPROVEMENT/METRIC TO DETERMINE SUCCESS

2.1 Metrics to determine the success of the module are proposed in the *Manual on Global Performance of the Air Navigation System* (Doc 9883).

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|---|---|
| *Access and Equity* | Access by the aircraft to the ATM information environment. |
| *Efficiency* | Better exploitation of meteorological and other operational (e.g. airport situation) information to optimize the trajectory. |
| *Environment* | Better exploitation of meteorological information to optimize the trajectory. |
| *Participation by the ATM community* | The aircraft becomes an integral part of continuous collaboration and of the overall information pool. |
| *Predictability* | Anticipation of situations affecting the flight through the access to relevant information. |
| *Safety* | Anticipation of potentially hazardous or safety bearing situations affecting the flight through the access to relevant information. |
| *Cost Benefit Analysis* | The business case will be established in the relevant validation programmes. |
| *Human Performance* | A critical element is the integration of the new information processes in the tasks of the pilot; they may also affect the respective duties of the aircraft crew and the airline dispatchers.<br><br>The use of the applications during demanding flight conditions will need careful investigation.<br><br>Training will be required. |

## 3. NECESSARY PROCEDURES (AIR AND GROUND)

3.1 Procedures are to be defined. They will define the conditions of access to information and the use to supported applications depending on the characteristics of these and of the communication channels available, in particular safety, security and latency.

## 4. NECESSARY SYSTEM CAPABILITY

### 4.1 Avionics

4.1.1 The enabling technologies are under development. The most important one is the availability of a suitable combination of air-ground data links to support safety and non-safety applications.

### 4.2 Ground systems

4.2.1 The enabling technologies are under development.

## 5. HUMAN PERFORMANCE

### 5.1 Human factors considerations

5.1.1 A critical element is the integration of the new information processes in the tasks of the pilot; they may also affect the respective duties of the aircraft crew and the airline dispatchers.

5.1.2 The use of the applications during demanding flight conditions will need careful investigation. This module is still in the research and development phase so the human factors considerations are still in the process of being identified through modelling and beta testing. Future iterations of this document will become more specific about the processes and procedures necessary to take the human factors considerations into account. There will be a particular emphasis on identifying the human-machine interface issue if there are any and providing the high risk mitigation strategies to account for them.

### 5.2 Training and qualification requirements

5.2.1 This module will eventually contain a number of personnel training requirements. As and when they are developed, they will be included in the documentation supporting this module and their importance signified. Likewise, any qualifications requirements that are recommended will become part of the regulatory needs prior to implementation of this performance improvement**.**

## 6. REGULATORY/STANDARDIZATION NEEDS AND APPROVAL PLAN (AIR AND GROUND)

- Regulatory/standardization: new standards and guidance needed to enable aircraft to participate as full information node, and full participation in collaborative ATM.

- Approval plans: to be determined.

## 7. IMPLEMENTATION AND DEMONSTRATION ACTIVITIES (AS KNOWN AT TIME OF WRITING)

### 7.1 Planned or ongoing trials

**United States:** Airborne access to SWIM simulations are planned to begin in 2012, with multiple operational trials occurring in 2013-2014. Expected specifications and performance requirements to be defined as part of trials.

## 8. REFERENCE DOCUMENTS

### 8.1 Guidance material

Doc 9965, *Manual on flight and flow – information for collaborative environment (FF-ICE)*

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