APPENDIX A

MODULE NO. B0-25: INCREASED INTEROPERABILITY, EFFICIENCY AND CAPACITY THROUGH GROUND-GROUND INTEGRATION

Summary	To improve coordination between air traffic service units (ATSUs) by using ATS interfacility data communication (AIDC) defined by the ICAO *Manual of Air Traffic Services Data Link Applications* (Doc 9694). The transfer of communication in a data link environment improves the efficiency of this process particularly for oceanic ATSUs.	
Main performance impact as per Doc 9854	KPA-02 – Capacity, KPA-04 – Efficiency**,** KPA-07 – Global Interoperability, KPA-10 – Safety.	
Operating environment/ Phases of flight	All flight phases and all type of ATS units.	
Applicability considerations	Applicable to at least two area control centres (ACCs) dealing with en-route and/or terminal control area (TMA) airspace. A greater number of consecutive participating ACCs will increase the benefits.	
Global concept component(s) as per Doc 9854	CM – conflict management	
Global plan initiatives (GPI)	GPI-16: Decision support systems	
Main dependencies	Linkage with B0-40	
Global readiness checklist		Status (ready now or estimated date)
	Standards readiness	√
	Avionics availability	No requirement
	Ground systems availability	√
	Procedures available	√
	Operations approvals	√

1. NARRATIVE

1.1 General

1.1.1 Flights which are being provided with air traffic services are transferred from one air traffic services (ATS) unit to the next in a manner designed to ensure safety. In order to accomplish this objective, it is a standard procedure that the passage of each flight across the boundary of the areas of responsibility of the two units is co-ordinated between them beforehand and that the control of the flight is transferred when it is at, or adjacent to, the said boundary.

1.1.2 Where it is carried out by telephone, the passing of data on individual flights as part of the coordination process is a major support task at ATS units, particularly at area control centres (ACCs). The operational use of connections between flight data processing systems (FDPSs) at ACCs replacing phone coordination (on-line data interchange (OLDI)) is already proven in Europe.

1.1.3 This is now fully integrated into the ATS interfacility data communications (AIDC) messages in the *Procedures for Air Navigation Services — Air Traffic Management,* (PANS-ATM, Doc 4444) which describes the types of messages and their contents to be used for operational communications between ATS unit computer systems. This type of data transfer (AIDC) will be the basis for migration of data communications to the aeronautical telecommunication network (ATN).

1.1.4 The AIDC module is aimed at improving the flow of traffic by allowing neighbouring air traffic services units to exchange flight data automatically in the form of coordination and transfer messages.

1.1.5 With the greater accuracy of messages based on the updated trajectory information contained in the system and where possible updated by surveillance data, controllers have more reliable information on the conditions at which aircraft will enter in their airspace of jurisdiction with a reduction of the workload associated to flight coordination and transfer. The increased accuracy and data integrity permits the safe application of reduced separations.

1.1.6 Combined with air-ground data link applications, AIDC also allows the transfer of aircraft logon information and the timely initiation of establishing controller-pilot data link communications (CPDLC) by the next air traffic control (ATC) unit with the aircraft.

1.1.7 These improvements outlined above translate directly into a combination of performance improvements.

1.1.8 Information exchanges between flight data processing systems are established between air traffic services units for the purpose of notification, coordination and transfer of flights and for the purpose of civil/military coordination. These information exchanges rely upon appropriate and harmonized communication protocols to secure their interoperability.

1.1.9 Information exchanges apply to:

a) communication systems supporting the coordination procedures between air traffic services units using a peer-to-peer communication mechanism and providing services to general air traffic; and

b) communication systems supporting the coordination procedures between air traffic services units and controlling military units, using a peer-to-peer communication mechanism.

1.2 Baseline

1.2.1 The baseline for this module is the traditional coordination by phone, and procedural and/or radar distance/time separations.

1.3 Change brought by the module

1.3.1 The module makes available a set of messages to describe consistent transfer conditions via electronic means across ATS units' boundaries. It consists of the implementation of the set of AIDC messages in the flight data processing systems (FDPS) of the different ATS units involved and the establishment of a Letter of Agreement (LoA) between these units to set the appropriate parameters.

1.3.2 Prerequisites for the module, generally available before its implementation, are an ATC system with flight data processing functionality and a surveillance data processing system connected to each other.

1.4 **Other remarks**

1.4.1 This module is a first step towards the more sophisticated 4D trajectory exchanges between both ground/ground and air/ground according to the ICAO *Global Air Traffic Management Operational Concept* (Doc 9854).

2. INTENDED PERFORMRANCE 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).

Capacity	Reduced controller workload and increased data integrity supporting reduced separations translating directly to cross sector or boundary capacity flow increases.
Efficiency	The reduced separation can also be used to more frequently offer aircraft flight levels closer to the flight optimum; in certain cases, this also translates into reduced en-route holding.
Global interoperability	Seamlessness: the use of standardized interfaces reduces the cost of development, allows air traffic controllers to apply the same procedures at the boundaries of all participating centres and border crossing becomes more transparent to flights.
Safety	Better knowledge of more accurate flight plan information.
Cost Benefit Analysis	Increase of throughput at ATS unit boundary and reduced ATCO workload will outweigh the cost of FDPS software changes. The business case is dependent on the environment.

3. NECESSARY PROCEDURES (AIR AND GROUND)

3.1 Required procedures exist. They need local analysis of the specific flows and should be spelled out in a Letter of Agreement between ATS units; the experience from other regions can be a useful reference.

4. NECESSARY SYSTEM CAPABILITY

4.1 **Avionics**

4.1.1 No specific airborne requirements.

4.2 **Ground systems**

4.2.1 Technology is available. It consists in implementing the relevant set of AIDC messages in flight data processing and could use the ground network standard AFTN-AMHS or ATN. Europe is presently implementing it in ADEXP format over IP wide area networks.

4.2.2 The technology also includes for oceanic ATSUs a function supporting transfer of communication via data link.

5. HUMAN PERFORMANCE

5.1 Human factors considerations

5.1.1 Ground interoperability reduces voice exchange between ATCOs and decreases workload. A system supporting appropriate human-machine interface (HMI) for ATCOs is required.

5.1.2 Human factors have been taken into consideration during the development of the processes and procedures associated with this module. Where automation is to be used, the HMI has been considered from both a functional and ergonomic perspective (see Section 6 for examples). The possibility of latent failures, however, continues to exist and vigilance is required during all implementation activity. In addition it is important that human factor issues, identified during implementation, be reported to the international community through ICAO as part of any safety reporting initiative.

5.2 Training and qualification requirements

5.2.1 To make the most of the automation support, training in the operational standards and procedures will be required and can be found in the links to the documents in Section 8 to this module. Likewise, the qualifications requirements are identified in the regulatory requirements in Section 6 which are integral to the implementation of this module.

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

- Regulatory/standardization: use current published criteria that include:

  a) ICAO Doc 4444, *Procedures for Air Navigation Services — Air Traffic Management*;
  b) EU Regulation, EC No 552/2004.

- Approval plans: to be determined based on regional consideration of ATS interfacility data communications (AIDC).

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

7.1 Although already implemented in several areas, there is a need to complete the existing SARPs to improve harmonization and interoperabiltiy. For Oceanic data link application, North Atlantic (NAT) and Asia and Pacific (APAC) (cf ISPACG PT/8- WP.02 - GOLD) have defined some common

coordination procedures and messages between oceanic centres for data link application (ADS-C CPDLC).

7.2 **Current use**

- **Europe:** It is mandatory for exchange between ATS units.
  http://europa.eu/legislation_summaries/transport/air_transport/l24070_en.htm

  The European Commission has issued a mandate on the interoperability of the European air traffic management network, concerning the coordination and transfer (COTR) between ATS units through REG EC 1032/2006 and the exchange of flight data between ATS units in support of air-ground data link through REG EC 30/2009. This is based on the standard OLDI-Ed 4.2 and ADEXP-Ed 3.1.

- **EUROCONTROL:** Specification of interoperability and performance requirements for the flight message transfer protocol (FMTP). The available set of messages to describe and negotiate consistent transfer conditions via electronic means across centres' boundaries have been used for trials in Europe in 2010 within the scope of EUROCONTROL's FASTI initiative.

- **India:** AIDC implementation is in progress in Indian airspace for improved coordination between ATC centres. Major Indian airports and ATC centres have integrated ATS automation systems having AIDC capability. AIDC functionality is operational between Mumbai and Chennai ACCs. AIDC will be implemented within India by 2012. AIDC trials are underway between Mumbai and Karachi (Pakistan) and are planned between India and Muscat in coordination with Oman.

- **AIDC:** is in use in the Asia-Pacific Region, Australia, New-Zealand, Indonesia and others.

7.3 **Planned or ongoing activities**

7.3.1 To be determined.

7.4 **Currently in operation**

7.4.1 To be determined.

8. **REFERENCE DOCUMENTS**

8.1 **Standards**

- ICAO Doc 4444, *Procedures for Air Navigation Services - Air Traffic Management*, Appendix 6 - *ATS Interfacility Data Communications (AIDC) Messages*

- ICAO Doc 9880, *Manual on Detailed Technical Specifications for the Aeronautical Telecommunication Network (ATN) using ISO/OSI Standards and Protocols*, Part II — *Ground-Ground Applications — Air Traffic Services Message Handling Services (ATSMHS).*

8.2 **Procedures**

8.2.1 To be determined.

8.3 **Guidance material**

- ICAO Doc 9694, *Manual of Air Traffic Services Data Link Applications;* Part 6;
- GOLD Global Operational Data Link Document (APANPIRG, NAT SPG), June 2010;
- Pan Regional Interface Control Document for Oceanic ATS Interfacility Data Communications (PAN ICD) Coordination Draft Version 0.3. 31 August 2010;
- Asia/Pacific Regional Interface Control Document (ICD) for ATS Interfacility Data Communications (AIDC) available at http://www.bangkok.icao.int/edocs/icd_aidc_ver3.pdf, ICAO Asia/Pacific Regional Office.
- EUROCONTROL Standard for On-Line Data Interchange (OLDI); and EUROCONTROL Standard for ATS Data Exchange Presentation (ADEXP).

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APPENDIX B

MODULE NO. B1-25: INCREASED INTEROPERABILITY, EFFICIENCY AND CAPACITY THOUGH FF-ICE, STEP 1 APPLICATION BEFORE DEPARTURE

Summary	To introduce FF-ICE, Step 1 providing ground-ground exchanges using common flight information exchange model (FIXM) and extensible markup language (XML) standard formats before departure.	
Main performance impact as per Doc 9854	KPA-02 – Capacity, KPA-04 – Efficiency, KPA-06 – Flexibility, KPA-07 – Global Interoperability, KPA-08 – Participation by the ATM community, KPA-10 – Safety.	
Operating environment/ Phases of flight	Planning phase for FF-ICE, Step 1	
Applicability considerations	Applicable between ATS units to facilitate exchange between ATM service provider (ASP), airspace user operations and airport operations.	
Global concept component(s) as per Doc 9854	DCB – demand capacity balancing CM – conflict management	
Global plan initiatives (GPI)	GPI-6: ATFM GPI-7: Dynamic and flexible route management GPI-16: Decision support systems	
Main dependencies	Successor of B0-25 and B0-30 (AIXM) Connection to B1-30 (AIRM) and B1-31 (SWIM)	
Global readiness checklist		Status (ready or estimated date)
	Standards readiness	Est 2016
	Avionics availability	No requirement
	Ground systems availability	Est 2018
	Procedures available	Est 2018
	Operations approvals	Est 2018

1. NARRATIVE

1.1 General

1.1.1 The use of FF-ICE, Step 1 permits a better sharing of flight information before departure for improved flight planning submission and amendment, and for pre-flight air traffic flow management (ATFM) by facilitating the flight information sharing between all stakeholders (airspace users, airport and ASP).

1.2 Baseline

1.2.1 The baseline for this module is the present process for submission of the flight plan (FPL) through ICAO standardized FPL/2012 messages (Amendment 1 to the PANS-ATM) and automated standard for information exchange through a set of messages and the limited need for direct speech coordination (B0-25).

1.3 Change brought by the module

1.3.1 This module implements FF-ICE, Step 1 before departure.

1.3.2 ICAO SARPs for FF-ICE, Step 1 will be developed by ICAO groups between 2012 and 2015. It will facilitate the exchange of information associated with the flight plan, allowing more flexibility for flight data submission, amendment and publishing.

1.3.3 The objective of FF-ICE, Step 1 is to establish the basis for transition towards a full FF-ICE deployment. This basis consists of the introduction of:

a) a globally unique flight identifier (GUFI);

b) a common data format, i.e. flight information eXchange model (FIXM) in the context of the overall transition to extensible markup language/geography markup language (XML/GML) for aeronautical and meteorological information; and

c) basic roles, rules and procedures for submission and maintenance of FF-ICE information including provisions for the early sharing of trajectory information.

1.3.4 The use of the new format will facilitate the evolution of the FPL contents to introduce new data and solve specific regional needs.

1.3.5 The changes included in FF-ICE, Step 1 are the following:

a) support for early provision of flight intention information;

b) support for exchange of 4D trajectory information between the AOC and the ASP;

c) a new format for flight and flow information using internet protocol and XML;

d) a globally unique flight identifier (GUFI); and

e) FF-ICE, Step 1 information elements.

1.3.6 The foreseen services related to flight information submission and management in the framework of FF-ICE, Step 1 are:

a) initial submission;

b) validation;

c) GUFI allocation (after the initial flight submission);

d) nominal trajectory generation (in absence of airspace users defined trajectory);

e) flight information negotiation (to solve conflict between airspace users' intended flight and existing constraints);

f) flight information update (to change or add to current flight information);

g) acknowledgement/rejection;

h) flight information publication;

i) flight information subscription;

j) flight information cancellation;

k) flight suspension; and

l) flight information.

1.4 **Other remarks**

1.4.1 This module is a first step towards the more sophisticated 4D trajectory for both ground/ground and air/ground exchanges according to the ICAO *Global Air Traffic Management Operational Concept* (Doc 9854).

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).

Capacity	Reduced air traffic controller (ATC) workload and increased data integrity supporting reduced separations translating directly to cross sector or boundary capacity flow increases.
Efficiency	Better knowledge of aircraft capabilities allows trajectories closer to airspace user preferred trajectories and better planning.
Flexibility	The use of FF-ICE, Step 1 allows a quicker adaptation on route changes.
Global Interoperability	The use of a new mechanism for FPL filing and information sharing will facilitate flight data sharing among the actors.
Participation by the ATM community	FF-ICE, Step 1 for ground-ground application will facilitate collaborative decision-making (CDM), the implementation or the systems interconnection for Information sharing, trajectory or slot negotiation before departure providing better use of capacity and better flight efficiency.
Safety	More accurate flight information.
Cost Benefit Analysis	The new services have to be balanced by the cost of software change in the ATM service provider (ASP), airline operations center (AOC) and airport ground systems.

3. NECESSARY PROCEDURES (AIR AND GROUND)

3.1 The use of FF-ICE, Step 1 will require significant change in the procedures for flight information submission from the initial intention to the full set of data before departure and the sharing and use by the actors (airports operators, air traffic services, air traffic flow management (ATFM)).

3.2 FF-ICE, Step 1 Standards and Recommended Practices (SARPs) and concept of use to be developed.

4. NECESSARY SYSTEM CAPABILITY

4.1 Avionics

4.1.1 There are no specific airborne requirements, but use of electronic flight bag onboard with high speed connection, in particular when aircraft is on the ground, could facilitate the FF-ICE information sharing with both AOC and ASP.

4.2 Ground systems

4.2.1 Ground ATC functionalities dealing with flight information will need to be updated to cater for FF-ICE, Step 1.

4.2.2 Airspace user systems will need to be modified to support the provision of FF-ICE to air navigation service providers (ANSPs).

5. HUMAN PERFORMANCE

5.1 Human factors considerations

5.1.1 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 on the new procedures and change in flight data information is required for operators in charge of the provision flight data information and for the users of this information.

5.2.2 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)

- Regulatory/standardization: use current published requirements given in Section 8.4. New SARPs documentation is needed for FF-ICE at this time.

- Approval plans: to be determined based upon regional consideration of advanced AIDC and FF-ICE.

- Discussion: for advanced AIDC, ICAO material is available (PANS-ATM, ATN). Regions should consider the possible mandating of AIDC. Means of compliance are also described in

EUROCONTROL OLDI standard and EU regulations: i.e. implementing rule on coordination and transfer (CE 1032/2006).

- For FF-ICE, Step 1 SARPs should be developed and validated (cf ATMRPP tasks, ref ATM001).

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

7.1 Current use

7.1.1 None at this time.

7.2 Planned or ongoing trials

- SESAR: Flight object validation is taking place within the framework of the SESAR projects 10.2.5 and 4.3 and completion is planned between 2011 and 2013.

- FF-ICE/1 could be considered as part of SESAR WP/8 and WP/14 in the development of AIRM.

- United States – FIXM with full FF-ICE functionality standardized will be available by 2018.

8. REFERENCE DOCUMENTS

8.1 B0-25 reference documents:

- ICAO Doc 4444, *Procedures for Air Navigation Services — Air Traffic* Management, Appendix 6 – *ATS Interfacility data communications (AIDC) messages*.

- ICAO 9880, *Manual on Detailed Technical Specifications for the Aeronautical Telecommunications Network (ATN) using ISO/OSI Standards and Protocols*, Part II – *Ground-ground Applications – Air Traffic Services Message Handling Services (ATSMHS)*.

- ICAO 9694, *Manual of Air Traffic Services Data Link Applications*, Part 6.

- GOLD Global Operational Data Link Document (APANPIRG, NATSPG), June 2010.

8.2 Standards

- Eurocae ED-133 June 09, Flight Object Interoperability Specification.

- FF-ICE, Step 1 based on FIXM to be developed.

8.3 Guidance material

- ICAO Doc 9965, *Manual on Flight and Flow – Information for a Collaborative* Environment, FF-ICE concept document.

- EUROCONTROL specification for online data interchange (OLDI), V4.2.

8.4 Approval documents

- ICAO Doc 4444, *Procedures for Air Navigation Services — Air Traffic Management*.

- EU Regulation, EC No 552/2004.

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APPENDIX C

MODULE NO. B2-25 IMPROVED COORDINATION THROUGH MULTI-CENTRE GROUND-GROUND INTEGRATION: (FF-ICE, STEP 1 AND FLIGHT OBJECT, SWIM)

Summary	FF-ICE supporting trajectory-based operations through exchange and distribution of information for multi-centre operations using flight object implementation and interoperability (IOP) standards. Extension of use of FF-ICE after departure supporting trajectory-based operations. New system interoperability SARPs will support the sharing of ATM services involving more than two ATSUs.	
Main performance impact as per Doc 9854	KPA-02 – Capacity, KPA-04 – Efficiency, KPA-06 – Flexibility, KPA-07 – Global Interoperability, KPA-08 – Participation by the ATM community, KPA-10 – Safety.	
Operating environment/ Phases of flight	All flight phases and all types of ground stakeholders	
Applicability considerations	Applicable to all ground stakeholders (ATS, airports, airspace users) in homogeneous areas, potentially global.	
Global concept component(s) as per Doc 9854	AUO – airspace user operations AO – airport operations DCB – demand and capacity balancing CM – conflict management	
Global plan initiatives (GPI)	GPI-7: Dynamic and flexible route management GPI-12: Functional integration of ground systems with airborne systems GPI-16: Decision support systems	
Main dependencies	B1-25, B1-31	
Global readiness checklist		Status (ready now or estimated date)
	Standards readiness	Est.2018
	Avionics availability	No requirement
	Ground systems availability	Est. 2020
	Procedures available	Est. 2020
	Operations approvals	Est. 2020

1. NARRATIVE

1.1 General

1.1.1 The exchange and distribution of information for multi-centre operations will support the introduction of trajectory-based operations.

1.2 Baseline

1.2.1 The baseline for this module is coordination transfers and negotiation as described in B0-25 and B1-25 and the first step of FF-ICE, Step 1 for ground application, during the planning phase before departure.

1.3 **Change brought by the module**

1.3.1 Sharing of all the flight and flow information during planning and execution flight phase.

1.3.2 FF-ICE, Step 1 will be extended for a complete use of FF-ICE after departure supporting trajectory-based operations. The technical specification for FF-ICE will be implemented in the ground systems (ASP, AOC, airport) using flight object implementation and IOP standards.

1.3.3 The module makes available a protocol to support exchange and distribution of information for multi-centre operations.

1.3.4 The flight object (FO) concept has been developed to specify the information on environments, flights and flows managed by and exchanged between FDPS. FF-ICE is a subset of FO but includes, at the conceptual level, the interface with the airspace user (AOC and aircraft). FO will be deployed in the target period of FF-ICE, Step 1. FF-ICE, Step 1 standards should therefore be consistent with the evolving standards for FO and especially compliment them with standards on the ground-ground interactions with the airspace users.

1.3.5 The first implementations of SWIM (B1-31, B2-31) will facilitate flight information sharing.

1.4 **Other remarks**

1.4.1 This module is a second step towards the more sophisticated 4D trajectory exchanges between both ground/ground and air/ground according to the ICAO Global ATM Operational Concept.

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).

Capacity	Reduced air traffic controller workload and increased data integrity and improved seamlessness at borders of air traffic services units (ATSUs).
Efficiency	Through more direct route and use of required time of arrival (RTA) to upstream centres.
Flexibility	Better adaptation to user-requested change through facilitated information exchange.
Global Interoperability	Increased facility of system connection and wide exchange of the information among the actors.
Participation by the ATM community	FF-ICE will facilitate the participation of all interested parties.
Safety	More accurate and updated information.
Human performance	Positive impact of more accurate information.
Cost Benefit Analysis	Balance between cost of ground system change and improved capacity/flight efficiency to be determined.

3. NECESSARY PROCEDURES (AIR AND GROUND)

3.1 There is a need for new procedures for new set of applications related to trajectory-based operation.

4. NECESSARY SYSTEM CAPABILITY

4.1 Avionics

4.1.1 Aircraft access to SWIM will be introduced by Module No. B2-31.

4.2 Ground systems

4.2.1 ATM ground systems need to support the IOP and SWIM concepts. Data communication infrastructure is required to support high-speed ground-ground communication between ground systems and to be connected to air-ground data links.

5. HUMAN PERFORMANCE

5.1 Human factors considerations

5.1.1 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 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 highlighted. Likewise, any qualifications requirements that are recommended will be included in the regulatory needs prior to implementation of this performance improvement.

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

- Regulatory/standardization: updates required to current published requirements given in Section 8.4. Of this material ED133 addresses only civil ATSU's flight data processing system (FDP) interoperability needs. Other flight information users' needs will also be accommodated.

- New standards for CDM applications and flight information sharing/access are needed.

- Approval plans: to be determined.

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

7.1 Current use

7.1.1 Planned or ongoing activities

7.1.1.1 In SESAR Project 10.2.5, flight object interoperability (IOP) system requirement and validation using EUROCAE ED133 first demonstration and validation activities are planned during the 2012-2014 period and first developments in industrial systems are available from 2015.

7.1.1.2 It is anticipated that the initial implementation date in Europe between two ATSUs from two system providers and two ANSPs will occur between 2018 and 2020.

7.1.1.3 SESAR research and development projects on SWIM are in WP/14, SWIM technical architecture and WP/8, Information management.

7.1.1.4 United States – Flight information exchange model will be standardized by 2018.

8. REFERENCE DOCUMENTS

8.1 Standards

- EUROCAE ED-133, Flight Object Interoperability Standards.
- FF-ICE FIXM SARPs (to be developed).

8.2 Guidance material

- ICAO Doc 9965, *Manual on Flight and Flow – Information for a Collaborative* Environment, FF-ICE concept document.

8.3 Approval documents

- ICAO Doc 4444, *Procedures for Air Navigation Services — Air Traffic Management*.
- EUROCAE ED-133, Flight Object Interoperability Standards.

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APPENDIX D

MODULE NO B3-25 IMPROVED OPERATIONAL PERFORMANCE THROUGH THE INTRODUCTION OF FULL FF-ICE

Summary	Data for all relevant flights systematically shared between the air and ground systems using SWIM in support of collaborative ATM and trajectory-based operations.	
Main performance impact as per Doc 9854	KPA-04 – Efficiency, KPA-06 – Flexibility, KPA-07 – Global Interoperability, KPA-08 – Participation by the ATM community, KPA-10 – Safety,	
Operating environment/ Phases of flight	All phases of flight from initial planning to post-flight	
Applicability considerations	Air and ground	
Global concept component(s) as per Doc 9854	ATM/SDM – ATM service delivery management	
Global plan initiatives (GPI)	GPI-7: Dynamic and flexible route management GPI-12: Functional integration of ground systems with airborne systems GPI-16: Decision support systems	
Main dependencies	B2-25, B2-31	
Global readiness checklist		Status (ready now or estimated date)
	Standards readiness	Est. 2023
	Avionics availability	Est. 2025
	Ground systems availability	Est. 2025
	Procedures available	Est. 2025
	Operations approvals	Est. 2025

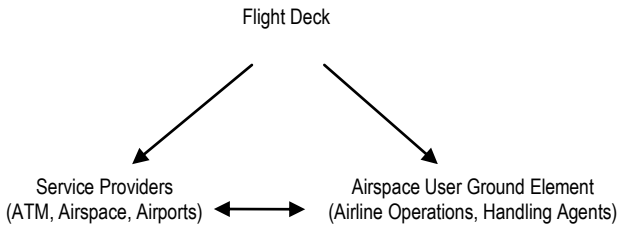
1. NARRATIVE

1.1 The role of FF-ICE: as a product of the ICAO Global ATM Operational Concept, FF-ICE defines information requirements for flight planning, flow management and trajectory management and aims to be a cornerstone of the performance-based air navigation system. Flight information and associated trajectories are principal mechanisms by which ATM service delivery will meet operational requirements.

1.2 FF-ICE will have global applicability and will support all members of the ATM community to achieve strategic, pre-tactical and tactical performance management. FF-ICE emphasizes the need for information sharing to enable significant benefits.

1.3 The exchange of flight/flow information will assist the construction of the best possible integrated picture of the past, present and future ATM situation. This exchange of information enables improved decision-making by the ATM actors involved in the entire duration of a flight, i.e. gate-to-gate, facilitating management of the full 4D trajectory. FF-ICE ensures that definitions of data elements are globally standardized and provides the mechanisms for their exchange. Thus, with appropriate information management a collaborative decision-making environment is created enabling the sharing of appropriate data across a wider set of participants resulting in greater coordination of the ATM community, situational awareness and the achievement of global performance targets.

1.4 The future collaborative and dynamic flight information process will involve the full spectrum of ATM community members as envisaged in the Global ATM Operational Concept. The cornerstone of future air traffic management is the interaction between these various parties and FF-ICE allows dynamic exchange of information.



1.5 The Global ATM Concept, implemented through regional programmes foresees air traffic control becoming traffic management by trajectory. The roles of the parties illustrated above will evolve to support the requirements of this concept which will:

a) entail systematic sharing of aircraft trajectory data between actors in the ATM process;

b) ensure that all actors have a common view of a flight and have access to the most accurate data available;

c) allow operations respecting the airspace users' individual business cases; and

d) improve the performance of aeronautical search and rescue service.

2. THE NEED FOR CHANGE

2.1 The Global ATM Operational Concept envisages an integrated, harmonized and globally interoperable system for all users in all phases of flight. The aim is to increase user flexibility and maximize operating efficiencies while increasing system capacity and improving safety levels in the future ATM system. The current system, including the flight planning process, has many limitations. FF-ICE helps to address these limitations and establishes the environment to enable improvements such as:

a) reduced reliance on voice radio communications for air/ground links;

b) increased collaborative planning amongst ATM actors;

c) provision of facilities for real time information exchange; and

d) maximized benefits of advanced equipment and encouraging deployment of improved air and/or ground systems.

3. GENERAL

3.1 Baseline

3.1.1 FF-ICE, Step 1 is implemented and initial SWIM applications are available on the ground as a result of modules B2-25 and B1-31 – Flight object has been deployed as a basis of the new flight data processing (FDP) system.

3.2 Change brought by the module

3.2.1 The module brings a new way to exchange trajectory data to provide better ATM services to airspace users.

3.2.2 Flight object will be implemented in the ground systems and will support the flight information and trajectory sharing through SWIM during all phases of flight between air and ground. All messages between air and ground systems will use XML format to facilitate development and evolution.

3.2.3 The main challenge is to implement FF-ICE in airborne systems and use SWIM for airborne access to ATM information.

4. INTENDED PERFORMANCE OPERATIONAL IMPROVEMENT

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

Efficiency	Better knowledge of trajectory information will allow more optimum flight profile.
Global Interoperability	Global interoperability is facilitated by easier connection of all stakeholders.
Participation by the ATM community	Participation of all stakeholders is facilitated through real time data sharing.
Predictability	The sharing of information between aircraft and ground systems will enhance the predictability.
Safety	System wide data sharing will allow early detection of inconsistencies and updated information which will improve situation awareness.
Cost Benefit Analysis	To be demonstrated by the balance of the cost of system change with other performance improvement.

5. NECESSARY PROCEDURES (AIR AND GROUND)

5.1 Publish and subscribe mechanisms will allow real time sharing of the flight information for concerned and authorized actors.

5.2 The use of these data will be mainly for decision-making tools and further automation.

6. NECESSARY SYSTEM CAPABILITY

6.1 Avionics

- Connection of the flight deck systems to the ground systems through a high-speed data communication system.

- Necessary distributed applications to manage the new services.

6.2 Ground systems

- There is a need for full secure and high throughput ground-ground and air-ground communications networks supporting SWIM access for exchange of flight and flow information from planning phase to post-flight phases.

- Necessarily distributed applications to manage the new services.

7. HUMAN PERFORMANCE

7.1 Human factors considerations

7.1.1 This technological evolution does not affect directly the pilots or controllers and could be transparent (system-to-system exchange, more accurate and updated data). However, 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 issues if there are any, and providing high-risk mitigation strategies to account for them.

7.2 Training and qualification requirements

7.2.1 Training of pilots and controllers to use the new services associated with decision support tools through new procedures. 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 highlighted. Likewise, any qualifications requirements that are recommended will be included in the regulatory needs prior to implementation of this performance improvement

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

- Regulatory/standardization: updates required to current published requirements given in Section 8.4.

- Approval plans: to be determined.

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

9.1 Current use

9.1.1 None at this time.

9.2 Planned or ongoing activities

- Full FF-ICE could be considered as the ultimate goal of the trajectory-based operations and it is part of NextGen and SESAR research and development plans.

- List of SESAR Projects: WP/14 and WP/8.

10. REFERENCE DOCUMENTS

10.1 Guidance material

- ICAO Doc 9965, *Manual on Flight and Flow – Information for a Collaborative* Environment, FF-ICE concept document.

- Trajectory-based operations documents.

10.2 Approval documents

ICAO Doc 4444, *Procedures for Air Navigation Services — Air Traffic Management.*

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