Organización de Aviación Civil Internacional
Oficina Regional Sudamericana
REUNION DE IMPLANTACION SAM COM/MET 2012
(Lima, Perú, 1 – 3 de agosto de 2012)

Cuestión 5 del Orden del Día: **Introducción a la metodología *Mejoras por Bloques del Sistema de Aviación* (ASBU), y su impacto en la planificación de los sistemas y servicios de meteorología y comunicaciones**

INICIATIVAS DE LA OACI PARA LA IMPLANTACIÓN DEL CONCEPTO OPERACIONAL ATM: METODOLOGIA MEJORAS POR BLOQUES DEL SISTEMA DE AVIACION (ASBU)

(Nota presentada por la Secretaría)

RESUMEN

Esta nota de estudio presenta información sobre la iniciativa de la OACI para la implantación del concepto operacional ATM a través de la metodología *Mejoras por bloques del sistema de aviación (ASBU)*, resaltando los aspectos de meteorología y de comunicaciones

Referencias:

- 37ava Asamblea General de la OACI (Montreal, Canadá, 28 de septiembre al 8 de octubre del 2010);
- Simposio Mundial sobre la Industria de la Navegación Aérea (GANIS) (Montreal, Canadá, 20-23 de septiembre de 2011);
- Duodécima Reunión de Autoridades de Aviación Civil (RAAC/12) (Lima, Perú, 3-6 de octubre de 2011); y
- Taller sobre Preparativos para la AN-Conf/12 – Metodología Mejoras por Bloques del Sistema de Aviación (ASBU) y Uso de la Herramienta IFSET (Lima, Peru, 16-20 de abril de 2012).

Objetivos estratégicos de la OACI:	*A – Seguridad operacional* *C - Protección del medio ambiente y desarrollo sostenible del transporte aéreo*

1. Introducción

1.1 La 37ava Asamblea General de la OACI instó a la Organización doblar sus esfuerzos para alcanzar las necesidades globales para la interoperabilidad del espacio aéreo, manteniendo la seguridad operacional como objetivo principal.

1.2 La OACI entonces elaboró la iniciativa *Mejoras por bloque del sistema de aviación (ASBU)*, que representa un marco programático que desarrolla un conjunto de soluciones y actualizaciones ATM tomando en consideración el equipamiento existente, estableciendo un plan de transición y habilitando la interoperabilidad global.

1.3 El concepto de *mejoras por bloque* está basado en los programas del Nuevo Sistema de Generación de Transporte Aéreo de los Estados Unidos (Next Gen), del desarrollo ATM en el cielo único Europeo (SESAR) y de las acciones colaborativas para la renovación de los sistemas de tránsito aéreo en Japón (CARATS) para la implantación del concepto operacional ATM.

1.4 El ASBU comprende un conjunto de módulos que contienen los siguientes aspectos esenciales:

a) Mejoras operativas claramente definidas y apreciables;
b) Equipo necesario y/o sistemas en las aeronaves y en tierra, junto a una aprobación operacional o plan de certificación;
c) Normas y procedimientos para los sistemas tanto en aire y en tierra; y
d) Un modelo de negocio positivo durante un periodo de tiempo claramente definido.

1.5 Los módulos están organizados en bloques flexibles y escalables que pueden introducirse e implantarse en los Estados o una Región, dependiendo de las necesidades y del nivel de prontitud reconociendo que no todos los módulos son requeridos en todos los espacios aéreos.

1.6 Los módulos están asociados a las siguientes cuatro aéreas de mejoras de performance:

a) Operaciones en aeropuertos;
b) Interoperabilidad global de datos y sistemas;
c) Optimización de la capacidad y vuelo flexible; y
d) Trayectorias de vuelos eficientes.

1.6.2 La totalidad de los módulos identificados hasta la fecha en el ASBU es de 52.

1.7 Los bloques describen un camino para aplicar los conceptos definidos en el Plan Mundial de Navegación Aérea (GANP) (Doc 9750) con el objetivo de implantar las mejoras de performance regionales. En éstos se incluyen la hoja de ruta del desarrollo tecnológico para asegurar que las normas están maduras y para facilitar el sincronismo entre los sistemas en tierra y en el aire, así como entre regiones. El objetivo final es alcanzar la interoperabilidad global. La interoperabilidad y armonización demanda seguridad operacional. La seguridad debe alcanzarse a un costo razonable con beneficio a la vista. Basado en la tecnología existente, los bloques están organizados en periodos de cinco años, empezando en el 2013 hasta el 2028 y mas allá. Esta estructura provee una base para definir estrategias de inversiones y acuerdos para los fabricantes de equipos, Estados, proveedores de servicios y operadores.

1.8 Los bloques se presentan inicialmente a través de cuatro fases evolutivas llamados Bloques 0, 1, 2 y 3 que se definen a continuación:

1.8.1 *Bloque* 0: disponible para su implementación ahora. Está diseñado para proporcionar mejoras operativas basadas en las tecnologías de aire-tierra. Estas incluyen Navegación Basada en Performance (PBN), Operaciones de Descenso Continuo (CDO) y las Operaciones de ascenso continuo (Continuous Climb Operations (CCO)). Dichas iniciativas deben implementarse como prioridad para sentar las bases de los bloques sucesivos (2013-2018). En el Bloque 0 se tienen 19 módulos.

1.8.2 *Bloque1*: Disponible para ser utilizado a nivel mundial a partir de 2018. El Bloque 1 está basado en la implementación de las Operaciones Basadas en Trayectorias (TBO) a través de la Toma de Decisiones Colaborativas (CDM) y depende en gran medida de la implementación del SWIM (System Wide Information Management). Resulta ser fundamental para el Bloque 1 el desarrollo del análisis de Caso de Negocio para apoyar las decisiones de inversión. Existe también la necesidad de desarrollar normas y material. Se debe desarrollar un plan completo CNS/AIM y un plan de aviónica para evitar la diseminación de diferentes tecnologías y para garantizar interoperabilidad a nivel mundial. En el Bloque 1 se tienen 16 módulos.

1.8.3 *Bloque* 2: disponible para ser utilizado a nivel mundial a partir del 2023 y *Bloque 3*, disponible para ser utilizado a nivel mundial a partir del 2028 en adelante. Las mejoras operativas de los Bloques 2 y 3 todavía se encuentran en una fase conceptual y dependen de los esfuerzos en investigación y desarrollo (I+D). Los Bloques 2 y 3 prevén la plena integración de los sistemas de vuelo y en tierra a través del intercambio de datos en tiempo real. Este intercambio de datos permitirá la trayectoria 4 D, separación en el aire, integración de los UAV en el espacio aéreo no segregado y gestión de tráfico complejo. En el Bloque 2 se tienen 10 módulos y en el Bloque 3 se tienen 7 módulos.

1.9 La iniciativa ASBU se formalizará en la Decimosegunda Conferencia de Navegación Aérea (AN-Conf/12) que está previsto celebrarse en noviembre de 2012 en Montreal, Canadá. Será incluida en el Plan Mundial de Navegación Aérea (GANP) (Doc 9750). Información sobre la AN-Conf/12 se encuentran en el siguiente portal WEB de la OACI:
(http://www.icao.int/Meetings/anconf12/Pages/default.aspx).

2. **Análisis**

2.1 Como seguimiento a la GREPECAS Conclusión 15/1, en la cual se instaba al desarrollo de un plan regional basado en la performance, de conformidad con el Plan Mundial de Navegación Aérea y el Concepto Operacional ATM Mundial, en la Región SAM se elabora el *Plan de Implantación del Sistema de Navegación Aérea Basado en el Rendimiento para la Región SAM (SAM PBIP)*.

2.2 El SAM PBIP fue aprobado por la Duodécima Reunión de Autoridades de la Región Sudamericana (RAAC/12) celebrada en Lima, Perú, del 3 al 6 de octubre de 2011. El mismo está dirigido a establecer una estrategia de implantación destinada a lograr beneficios para la comunidad ATM en el corto y mediano plazo (2012–2018) basados en la infraestructura relacionada a la ATM y las capacidades de las aeronaves disponibles y previstas.

2.3 El documento contempla las diferentes áreas de navegación aérea (ATM, CNS, AIS, MET, SAR y AGA/AOP), así como considera también otros aspectos relevantes, necesarios para acompañar dicha evolución, tales como recursos humanos y gestión de la seguridad operacional.

2.4 Como consecuencia de la iniciativa de la OACI de los ASBU, se requiere armonizar el SAM PBIP con los ASBU con el fin de alcanzar la interoperabilidad del espacio aéreo a nivel global. Para realizar esta actividad, se tendrá que adaptar los *Formularios relativos al marco de rendimiento* (PFF) especificados en el SAM PBIP en las diferentes áreas de navegación aérea con los módulos de los Bloques, en su mayoría del Bloque 0, en vista que el SAM PBIP cubre el periodo 2012-2018. Para realizar este trabajo a nivel regional, está previsto realizar el *Seminario/Taller para la Armonización del Plan de Implantación del Sistema de Navegación Aérea basado en Rendimiento con el Nuevo Plan Mundial de Navegación Aérea aprobado por la AN-Conf/12* (Lima, 15-19 de abril de 2013), con el apoyo del proyecto RLA/06/901.

2.5 En lo que se refiere estrictamente al área de meteorología, el ASBU contempla los módulos B0-105, B1-105 y B3-105. En estos módulos, asociados al área de mejora de performance de interoperabilidad global de datos y sistemas, se describen la evolución de la automatización e integración de la información meteorológica, con el fin de incrementar la seguridad y la eficiencia de la navegación aérea a lo largo de los cuatro bloques. El Bloque B0-105 es requisito del B1-105 y así sucesivamente para los otros módulos. La descripción detallada se presenta como **Apéndice A** de esta nota de estudio.

2.6 En el área de comunicaciones, se tiene en el Bloque 0 el Modulo B0-25 - *Mayor interoperabilidad, eficiencia y capacidad mediante la integración tierra-tierra* y el B0-30 - *Mejoramiento de los servicios mediante gestión de la información aeronáutica digital*.

2.7 En el Bloque 1, se tiene el B1-25 - *Mayor interoperabilidad, eficiencia y capacidad mediante la aplicación de FF ICE/1 antes de la salida*, el B1-30 - *Mejoramiento de los servicios mediante la integración de toda la información ATM digital* y el B1-31 - *Mejoramiento de la eficiencia mediante la aplicación de la gestión de la información a escala del sistema (SWIM)*. En el Bloque 2 se tiene el B2-25 - *Mejor coordinación mediante la integración tierra-tierra entre centros múltiples: (FF ICE/1 y "objeto de vuelo", SWIM)* y el B2-31 - *Posibilitar la participación de a bordo en la ATM colaborativa mediante una SWIM*. En el Bloque 3 de tiene el módulo B3-25 - *Mayor eficiencia operacional mediante la introducción de FF-ICE completa*. En el **Apéndice B** de esta nota de estudio se presenta mayor información sobre estos módulos.

3. **Acción sugerida**

3.1 Se invita a la Reunión a tomar nota de la información presentada en esta nota de estudio y los Apéndices A y B, con el fin de que se tome en cuenta de esta iniciativa, hagan un seguimiento de la misma y la consideren a la hora de planificar los planes de implantación de los servicios y sistemas de meteorología y comunicaciones regional y nacional.

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APPENDIX A / APENDICE A

International Civil Aviation Organization

Aviation System Block Upgrades

Module N° B0-105/PIA2

Meteorological information supporting enhanced operational efficiency and safety

Module N° B0-105

Meteorological information supporting enhanced operational efficiency and safety

Summary	• Aerodrome warnings to give concise information of meteorological conditions that could adversely affect all aircraft at an aerodrome including windshear. • Forecasts provided by world area forecast centres (WAFC), volcanic ash advisory centres (VAAC) and tropical cyclone advisory centres (TCAC)	
Main Performance Impact	KPA(Capacity); KPA (Environment); KPA (Safety); KPA (Efficiency);	
Operating Environment/ Phases of Flight	Single word entries explaining operating environment(s), i.e airport surface, etc. and/or phases of flight, i.e. approach, en-route, etc. All phases of flight.	
Applicability Considerations	Specifics on operating environment and/or types of airspace where Module is applicable Applicable to traffic flow planning, and to all aircraft operations in all domains and flight phases, regardless of level of aircraft equipage.	
Global Concept Component(s)	AOM - Airspace Operations and Management DCB - Demand and Capacity Balancing AO - Aerodrome Operations	
Global Plan Initiatives (GPI)	GPI-19 Meteorological Systems GPI-6 Air Traffic Flow Management GPI-16 Decision Support Systems and Alerting Systems	
Pre-Requisites	None. Meteorological information and supporting distribution systems are in existence today.	
Global Readiness Checklist		Status (ready now or estimated date).
	Standards Readiness	Ready now
	Avionics Availability	Ready now
	Ground System Availability	Ready now
	Procedures Available	Ready now
	Operations Approvals	Ready now

2

Module N° B0-105: Baseline

- No Specific other that change brought by the Module
- **OPMET and QMS for MET (not included in this Module but mapped to this Module)**

3

Module N° B0-105: Change Brought by the Module

- The global availability of meteorological information provided by designated Centres within the WAFS, IAVW and the tropical cyclone watch on the ICAO AFS enhances pre-tactical and/or tactical decision making for aircraft surveillance, air traffic flow management and flexible/dynamic aircraft routing.
  - *Element 1: WAFS.*
  - *Element 2: IAVW*
  - *Element 3: Tropical cyclone watch*
  - *Element 4: Aerodrome warnings*
  - *Element 5: Wind shear warnings and alerts*

4

Module N° B0-105 – Intended Performance Operational Improvement

KPAs	Specific improvement provided.
KPA-02: Capacity	Optimized usage of airspace capacity, thus achieving arrival and departure rates. Metric: ACC and aerodrome throughput.
KPA-04: Efficiency	Harmonized arriving air traffic (en-route to terminal area to aerodrome) and harmonized departing air traffic (aerodrome to terminal area to en-route) will translate to reduced arrival and departure holding times and thus reduced fuel burn. Metric: Fuel consumption.
KPA-05: Environment	Reduced fuel burn through optimized departure and arrival profiling/scheduling. Metric: CO2 emissions.
KPA-10: Safety	Increased situational awareness and improved consistent and collaborative decision making. Metric: Incident occurrences.

5

Module N° B0-105: Necessary Procedures (Air & Ground)

- No new procedures necessary.
- Supporting guidance material is contained in a number of ICAO manuals, including but not limited to: *Manual of Aeronautical Meteorological Practice* (Doc 8896); *Manual on Coordination between Air Traffic Services, Aeronautical Information Services and Aeronautical Meteorological Services* (Doc 9377); *Handbook on the International Airways Volcano Watch – Operational Procedures and Contact List* (Doc 9766); and *Manual on Low Level Wind Shear* (Doc 9817). In addition, the *Manual on volcanic ash, radioactive material and toxic chemical clouds* (Doc 9691) provides extensive guidance on, *inter alia*, the observation/detection and forecasting of volcanic ash in the atmosphere and the effect of volcanic ash on aircraft.

6

Module N° B0-105: Necessary System Capabilities

- ***Avionics***
  - No new or additional avionics requirements

- ***Ground Systems***
  - ANSPs, Airport operators and Airspace users may want to implement functionalities allowing them to display in plain text the different messages provided by the different Met organisations. For Block 0 airspace users may use their AOC data link connection to the aircraft to send the information where appropriate.

7

Module N° B0-105: Training and Qualification Requirements

- Description of required training and qualification requirements: Where they exist or are under development, references to these must be provided. For training and qualification requirements to be developed, the requirement must be clearly stated
- No new or additional training and qualification requirements are brought about by this module

8

Module N° B0-105: Regulatory/Standardization needs and Approval Plan (Air & Ground)

- No new or additional regulatory/standardization needs and approval plan(s) are brought about by this module.
- Provisions relating to the WAFS, the IAVW and the tropical cyclone watch, as well as aerodrome warnings, wind shear warnings and alerts, already exist within ICAO Annex 3, regional air navigation plans, and supporting guidance

Module N° B0-105: Reference Documents

– ***Standards***

- ICAO and Industry Standards (ie; MOPS, MASPS, SPRs).
- ICAO and World Meteorological Organization (WMO) international standards for meteorological information (including, content, format, quantity, quality, timeliness and availability).

– ***Procedures***

- Documented procedures by States and ANSPs. [To be developed]

– ***Guidance Material***

- ICAO Manuals, Guidance Material and Circulars. Also any similar industry documents
- ICAO Doc 7192, Training Manual - Part F1 – *Meteorology for Air Traffic Controllers and Pliots*;
- ICAO Doc 8896, *Manual of Aeronautical Meteorological Practice;*
- ICAO Doc 9161, *Manual on Air Navigation Services Economics;*
- ICAO Doc 9377, *Manual on Coordination between Air Traffic Services, Aeronautical Information Services and Aeronautical Meteorological Services;*
- ICAO Doc 9691, *Manual on Volcanic Ash, Radioactive Material and Toxic Chemical Clouds;*
- ICAO Doc 9766,– *Handbook on the International Airways Volcano Watch – Operational Procedures and Contact List;*
- ICAO Doc 9817, *Manual on Low Level Wind Shear;*
- ICAO Doc 9855, *Guidelines on the Use of the Public Internet for Aeronautical Applications*
- *SADIS User Guide;*
- Agreement on the Sharing of Costs of the Satellite Distribution System for Information relating to Air Navigation.

– ***Approval Documents.***

-

Module N° B0-105: Implementation - Benefits and Elements

Meteorological information supporting enhanced operational efficiency and safety

- **Benefits: Capacity, Cost-effectiveness, Efficiency, Environment, Flexibility, Global interoperability , Participation of the ATM Community, Predictability**
- **Elements**
  - **OPMET; QMS for MET not included in this Module**
  - **WAFS-IAVW-TCW**
  - **Aerodrome warning**
  - **Wind shear warning and alerts**

To be reflected in ANRF

11

Module N° B1-105: Better Operational Decisions through Integrated Weather Information (Strategic >40 Minutes)

Summary	The primary goal of this module is to enable the reliable identification of applicable air traffic management (ATM) solutions when weather phenomena are impacting, or forecast to impact, aerodromes or airspace. In order to achieve this goal, full ATM-Weather Integration is necessary. ATM-Weather Integration means that weather information is included in the logic of a decision process or aid such that the impact of the weather constraint is automatically calculated and taken into account when the decision is made or recommended.	
Main Performance Impact	KPA-02 Capacity, KPA-04 Efficiency, KPA-09 Predictability, KPA-10 Safety	
Domain / Flight Phases	En-route, Terminal Area, Aerodrome, Supporting Infrastructure domains All flight phases	
Applicability Considerations	Applicable to traffic flow planning, and to all aircraft operations in all domains and flight phases, regardless of level of aircraft equipage. Benefits accrue and/or costs are avoided as processes and Decision Support Tools (DSTs) employing ATM-Weather Integration concepts and techniques are adopted.	
Global Concept Component(s)	AOM - Airspace Operations and Management DCB - Demand and Capacity Balancing AO - Aerodrome Operations	
Global Plan Initiatives (GPI)	GPI-19: Meteorological Systems GPI-6: Air Traffic Flow Management GPI-16: Decision Support Systems and Alerting Systems	
Reference Documents	None at this time	
Main Dependencies		
Global Readiness Checklist		**Status (ready or date)**
	Standards Readiness	2018
	Avionics Availability	TBD
	Infrastructure Availability	2018
	Ground Automation Availability	2018
	Procedures Available	2018
	Operations Approvals	2018

1 Narrative

1.1 General

Weather is a major cause of flight delay in many airspace systems. Research analyses have suggested that a significant portion of that delay could be mitigated if weather forecasts were "perfect" and appropriate air traffic management (ATM) solutions were able to be consistently devised and employed. Unfortunately, weather forecasts, while improving steadily, are not perfect. Rigid airspace structures often preclude the consistent employment of the best ATM solutions.

Today, the task of taking weather observations and forecasts and turning them into the impact values needed to devise operationally effective ATM solutions is left almost completely up to the individual human ATM decision maker. Therefore the accurate assessment of the impact of a forecast weather constraint and quality of resultant ATM initiatives are dependent on both the cognitive capability and experience level of the decision maker. The primary goal of Enhanced Weather Decision-Making Capability is to enable the reliable identification of operationally effective ATM solutions when weather phenomena are affecting, or are forecast to affect, aerodromes or airspace. In order to achieve this goal, full ATM-Weather Integration is necessary.

ATM-Weather Integration means that weather information is included in the logic of a decision process or aid such that the impact of the weather constraint is automatically calculated and taken into account when the decision is made or recommended. By minimizing the need for humans to manually gauge weather constraints and determine the most appropriate mitigation of those constraints, ATM-Weather Integration enables the best ATM solutions to be consistently identified and executed.

There are four elements of ATM-Weather Integration (see Attachment 1) as enabled by this module. With respect to airspace, the output of the first element, *Weather Information*, is ingested by automation associated with the second, *Weather Translation*. Through filters such as safety regulations and standard operating procedures, the weather information (observations and forecasts) is turned ("translated") into a non-meteorological parameter called an airspace constraint, a measure of the expected capacity of the affected airspace. This parameter is, in turn, fed to the third component called *ATM Impact Conversion.* By comparing projected demand and weather-constrained capacity, this component transforms ("converts") the airspace constraint into an airspace impact. The fourth component, *ATM Decision Support*, takes the quantified impact values from *ATM Impact Conversion* and develops one or more strategic and tactical ATM solutions to the forecast or actual weather constraint.

The concepts, capabilities and processes achieved in this module are applicable to multiple decision time frames, from pre-flight planning to daily flow planning to tactical flow planning. Tactical weather avoidance is considered, but utilization of aircraft-based capabilities in this regard is emphasized in module B3-105.

1.1.1 Baseline

In today's baseline case, ATM decision makers manually determine the amount of change in capacity associated with an actual or forecast weather phenomenon, manually compare the resultant capacity with the actual or projected demand for the airspace or aerodrome, and then manually devise ATM solutions when the demand exceeds the weather-constrained capacity value.

1.1.2 Improvement brought by the module

The transition to systems and processes embodied by ATM-Weather Integration leads to the consistent identification and use of operationally effective ATM solutions to weather-related demand/capacity imbalances.

1.1.3 Other remarks

This module is a key component in the evolution of procedures and automation capabilities, both aircraft-based and ground-based, intended to mitigate the effects of weather on flight planning, flight operations and flow management.

2 Element 1: Weather Information

Weather Information is the superset of all approved meteorological observations, analyses and forecasts available to operator and air navigation service provider (ANSP) decision makers. Included in this superset are data designated as the authoritative weather information based upon which ATM decision makers will build their solutions.

2.1 Intended Performance or Operational Improvement / Metric for Success

Capacity and Efficiency

Improvements in weather information lead to better data concerning the extent, time period and severity of weather impacts on airspace. This in turn enables more precise estimates of expected capacity of that airspace.

Associated Metric - Capacity

One measure of capacity improvement due to improved weather information would be the number of user-preferred profiles that can be accommodated.

Associated Metric - Efficiency

An improvement in efficiency associated with improved weather information would be the number of deviations from user-preferred profiles.

Safety

Weather information improvements should lead to increased situation awareness by pilots, AOCs and ANSPs, enabling avoidance of hazardous weather conditions.

Associated Metric – Safety

A safety improvement associated with better weather information would be the number of weather-related aircraft incidents and accidents.

2.2 Necessary Procedures (Air & Ground)

Procedures exist today for ANSPs and users to collaborate on weather-related decisions. Extensions to those procedures must be developed to reflect the increased use of decision support automation capabilities by both. International standards for information exchange between systems to support global operations must also be developed, including the development of global standards for the delivery of weather information.

2.3 Necessary Technology (Air & Ground)

Technology development in support of this element will include the creation and implementation of a consistent, integrated 4-D database of global weather observations and forecasts, including linkage (data exchange and communications standards) between global weather information systems. ATM ground systems will have to be modified to make use of the weather information to better serve the ATM community.

2.4 Regulatory/standardisation needs and Approval Plan (Air & Ground)

This element requires the development of global standards for weather information exchange, with emphasis on the exchange of 4-D (X, Y, Z and T [time]) gridded weather information, and regulatory agreement on what constitutes required weather information in the age of digital exchange, versus text and graphics.

2.5 Business Case specific to the Element

The business case for this element is still to be determined as part of the development of this overall module, which is in the research phase. However, current experience with the utilization of enhanced weather information to improve ATM decision making by stakeholders has resulted in benefits due to more efficient flight planning and less disruption to user-preferred trajectories.

2.6 Implementation and Demonstration Activities

2.6.1 Current Use

The development of the United States' 4D Weather Data Cube is underway. Decisions concerning internal infrastructure, data exchange standards and communications are nearing completion, and initial demonstrations of the system have taken place.

2.6.2 Planned or Ongoing Trials

No global demonstration trials are currently planned for this element. There is a need to develop such a plan as part of the collaboration on this module.

3 Element 2: Weather Translation

Weather Translation refers to automated processes which ingest raw weather information and translate them into characterized weather constraints and aerodrome threshold events. The output of the Weather Translation process is a non-meteorological value which represents a potential change in the permeability of airspace or capacity of the aerodrome.

It is unlikely that future automation systems will incorporate Weather Translation methodology without also including ATM Impact Conversion components. As such, this element is likely to be more of an enabler of the next element and the entire process as opposed to an interim end state.

3.1 Intended Performance or Operational Improvement / Metric for Success

Predictability

Weather Translation combined with ATM Impact Conversion will lead to more consistent evaluations of weather constraints, which in turn will allow users to plan trajectories that are more likely to be acceptable from the standpoint of the ANSP. Fewer reroutes and less variability in associated traffic management initiatives (TMIs) can be expected. Consequently, users will be able to carry less contingency fuel than is felt necessary today, resulting in lower fuel burn.

> Associated Metric - Predictability
>
> Among the measures of success for both Weather Translation and Impact Conversion are decreases in the variability and numbers of responses to a given weather situation, along with reduced contingency fuel carriage for the same weather situation.

3.2 Necessary Procedures (Air & Ground)

The only procedural changes likely to be associated with this element are cultural in nature, as automation is introduced which performs tasks currently accomplished manually.

3.3 Necessary Technology (Air & Ground)

Technology development in support of this element will include the introduction of automated weather translation methodologies based on the operational needs for such information.

3.4 Regulatory/standardisation needs and Approval Plan (Air & Ground)

This element will require the development of standardised Weather Translation parameters.

3.5 Business Case specific to the Element

The business case for this element is still to be determined as part of the development of this overall module, which is in the research phase. However, current limited experience (see 1.3.6) with the utilization of translated weather information in the face of convective weather has shown that the concept can help inform ATM decision making.

3.6 Implementation and Demonstration Activities

3.6.1 Current Use

A considerable amount of research and analysis is currently underway for this element. One example is the weather avoidance field (WAF) methodology currently in operational use in the Route Availability Planning Tool (RAPT) in the New York and Chicago areas.

3.6.2 Planned or Ongoing Trials

No global demonstration trials are currently planned for this element. There is a need to develop such a plan as part of the collaboration on this module.

4 Element 3: ATM Impact Conversion

The ATM Impact Conversion element determines the anticipated weather-constrained capacity of the airspace or aerodrome and compares this to the projected demand. If an imbalance exists between the two, this information is provided to the system user and/or the ATM Decision Support element to inform development of mitigation strategies for dealing with the imbalance.

4.1 Intended Performance or Operational Improvement / Metric for Success

Predictability

ATM Impact Conversion, informed by Weather Translation, will lead to more consistent evaluations of weather constraints, which in turn will allow users to plan trajectories that are more likely to be acceptable from the standpoint of the ANSP. Fewer reroutes and less variability in associated traffic management initiatives (TMIs) can be expected. Consequently, users will be able to carry less contingency fuel than is felt necessary today, resulting in lower fuel burn.

Associated Metric - Predictability

Among the measures of success for both Weather Translation and Impact Conversion are decreases in the variability and numbers of responses to a given weather situation, along with reduced contingency fuel carriage for the same weather situation.

4.2 Necessary Procedures (Air & Ground)

The only procedural changes likely to be associated with this element are cultural in nature, as automation is introduced which performs tasks currently accomplished manually.

4.3 Necessary Technology (Air & Ground)

Technology development in support of this element will include the introduction of automated methodologies that utilize weather translation information to assess the impact on ATM operations, for flows and individual flights.

4.4 Regulatory/standardisation needs and Approval Plan (Air & Ground)

This element will require the development of standardised ATM Impact Conversion parameters.

4.5 Business Case specific to the Element

The business case for this element is still to be determined as part of the development of this overall module, which is in the research phase. However, current limited experience (see 1.4.6) with the utilization of weather information which has been converted to ATM Impact has shown that the concept results in better and more consistent information going to ATM decision maker and systems.

4.6 Implementation and Demonstration Activities

4.6.1 Current Use

A considerable amount of research and analysis is currently underway for this element. One system (Integrated Departure Route Planner [IDRP]) that identifies the impact of convective activity on departure routes is in early testing. A weather forecast product called the Aviation Impact Guidance for Convective Weather that calculates impact through the joint probability of the presence of convective activity and air traffic is in operational testing.

4.6.2 Planned or Ongoing Trials

No global demonstration trials are currently planned for this element. There is a need to develop such a plan as part of the collaboration on this module.

5 Element 4: Weather Integrated Decision Support

The final element is Weather Integrated Decision Support, which is comprised of automated systems and processes that create ranked mitigation strategies for consideration and execution by ATM decision makers. The solutions are based on requirements and rules established by the ATM community.

5.1 Intended Performance or Operational Improvement / Metric for Success

Capacity

Advanced decision support tools, fully integrated with weather information, support stakeholders in assessing the weather situation and in planning optimal mitigation strategies which make maximum use of available airspace.

Associated Metric - Capacity

With respect to capacity, the number of user-preferred profiles that can be accommodated would be an appropriate metric for Weather Integrated Decision Support.

Efficiency

Advanced decision support tools, fully integrated with weather information, support stakeholders in planning for the most efficient routes possible, given the anticipated weather situation.

Associated Metric - Efficiency

Among the measures of success for Weather Integrated Decision Support in the area of efficiency would be the number of deviations from user-preferred profiles.

Predictability

Advanced decision support tools, fully integrated with weather information, produce consistent, optimal solution sets, and allow users to plan trajectories that are more likely to be acceptable from the standpoint of the ANSP. Fewer reroutes and less variability in other associated traffic management initiatives (TMIs) can be expected. In turn, this will allow users to carry less contingency fuel than is felt necessary today, resulting in lower fuel burn.

Associated Metric - Predictability

Among the measures of success for Weather Integrated Decision Support are decreases in the variability and numbers of ATM responses to a given weather situation, along with reduced contingency fuel carriage for the same weather situation.

Safety

Advanced decision support tools, fully integrated with weather information, produce solution sets which minimize pilot exposure to hazardous weather. This, combined with increased weather situational awareness by pilots and ANSPs, enables avoidance of hazardous conditions.

Associated Metric - Safety

Among the measures of success for both Weather Translation and Impact Conversion are decreases in the variability and numbers of responses to a given weather situation, along with reduced contingency fuel carriage for the same weather situation.

A safety improvement associated with Weather Integrated Decision Support would be the number of weather-related aircraft incidents and accidents.

5.2 Necessary Procedures (Air & Ground)

No changes in procedures, either in the air or on the ground, are required to support the development of this element.

5.3 Necessary Technology (Air & Ground)

Technology development in support of this element will include the introduction of decision support tools, for both ANSPs and users, which automatically ingest ATM Weather Impact information, and support decision making via generation of candidate mitigation strategies..

5.4 Regulatory/standardisation needs and Approval Plan (Air & Ground)

Aside from identifying and using the most capable tools, there would appear to be no regulatory or standardisation needs or approval plan associated with this element.

5.5 Business Case specific to the Element

The business case for this element is still to be determined as part of the development of this overall module, which is in the research phase. Current experience with utilization of ATM decision support tools, with rudimentary weather inputs, to improve ATM decision making by stakeholders has proven to be positive in terms of producing consistent responses from both the ANSP and user community.

5.6 Implementation and Demonstration Activities

5.6.1 Current Use

Research and analysis is in the early stages for this element. One system, the San Francisco (SFO) Ground Delay Program Parameters Selection Model (GPSM), meets all Weather Integrated Decision Support system definition criteria. It has been field tested and is now in the initial stages of being used operationally.

5.6.2 Planned or Ongoing Trials

No global demonstration trials are currently planned for this element. There is a need to develop such a plan as part of the collaboration on this module.

6 Main Dependencies

This module is dependent on the concurrent development of weather capabilities (e.g. Weather Translation and ATM Impact Conversion methodologies) and ATM automation capabilities that will utilize the translated and converted weather information to inform decision making. It is a predecessor of B3-105.

This module has an impact on, or is a key component of, a number of related Block 0 and Block 1 Modules. Several of these key modules, along with an explanation of the connection between the two, are listed below:

- Module B0-10: Improved En-Route Profiles

Desired en-route profiles can be significantly impacted by ATM initiatives associated with weather constraints such as thunderstorms, turbulence and icing. Module B1-105: Enhanced Weather Decision Making Capability provides a better understanding of the impact on airspace of forecast weather constraints. This will allow users to more frequently plan profiles that are appropriate for the actual or expected weather conditions and airspace managers to more consistently allow those profiles to be flown.

- Module B0-15: Runway Arrival Sequencing
- Module B0-35: Air Traffic Flow Management/Network Operations Procedures (ATFM/NOP) and Collaborative Decision Making (CDM)
- Module B1-15 Arrival Management/Departure Management (AMAN/DMAN) Metroplex and Linked DMAN/Surface Management (SMAN)
- Module B1-35: Enhanced NOP, Integrated Airspace/Flow Management

Trajectory-based, time-based and sequencing operations require processes and procedures for dealing with weather constraints in the aerodrome and en-route airspace. Improvements derived from Module B1-105, such as a better understanding of weather constraints and their ATM impact, allows more accurate, less volatile trajectory information to be calculated and used in the above four modules.

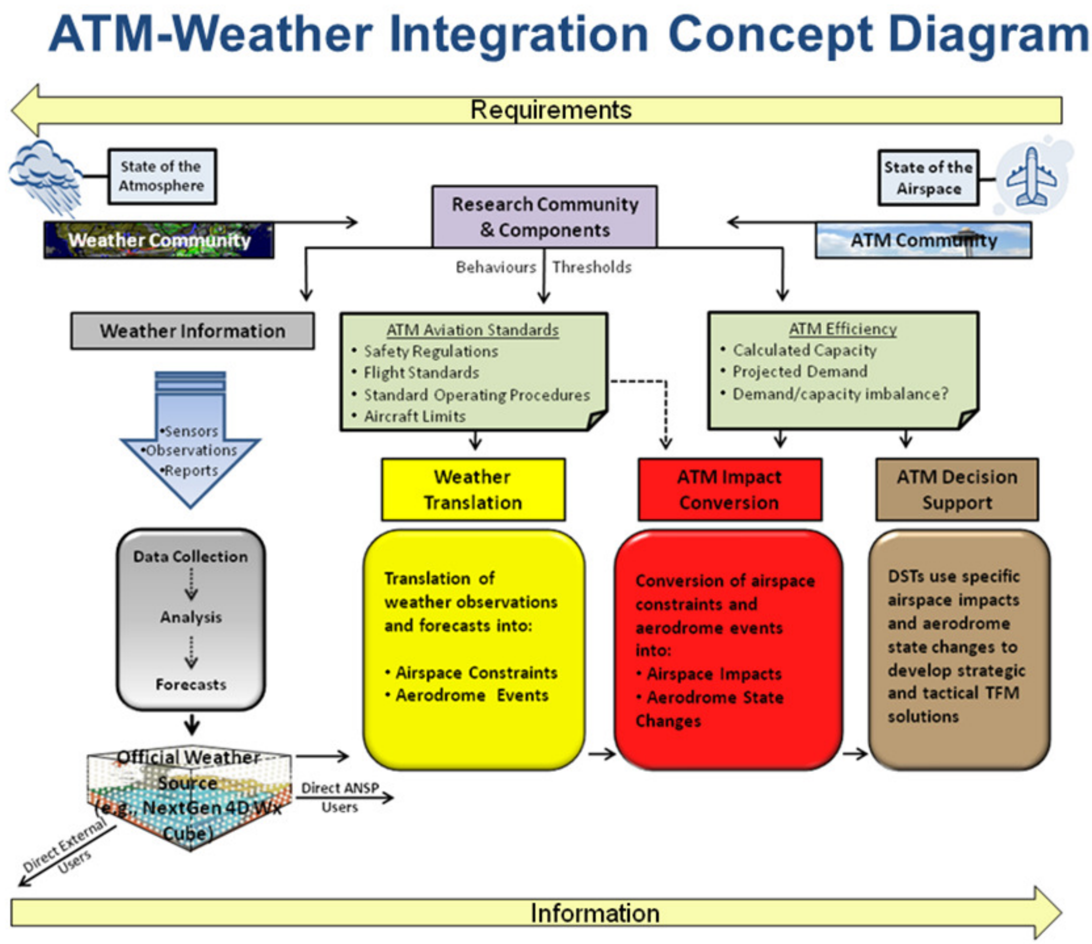


Figure 1. ATM-Weather Integration Concept Diagram.

Module N° B3-105: Better Operational Decisions through Integrated Weather Information (Tactical <40 Minutes)

Summary	This module is focused on developing advanced concepts and necessary technologies to enhance global ATM decision making in the face of adverse weather. This module builds upon the initial weather integration concept and capabilities developed under B1-105. A key emphasis is on tactical weather avoidance in the 0-40 minute timeframe, including making greater use of aircraft based capabilities to detect meteorological parameters (e.g. turbulence, winds, and humidity), and to display weather information to enhance situational awareness. This module considers the development of operational and performance requirements for meteorological information to support these advanced concepts, and the establishment of standards for global exchange of the information.	
Main Performance Impact	KPA-02 Capacity, KPA-04 Efficiency, KPA-06 Flexibility. KPA-09 Predictability, KPA-10 safety,	
Domain / Flight Phases	En-route, Terminal, Aerodrome	
Applicability Considerations	Applicable to air traffic flow planning, en-route operations, terminal operations (arrival/departure), and surface. Benefits accrue to both flows and individual aircraft. Aircraft equipage is assumed for ADS-B In/CDTI, aircraft-based weather observations and weather information display capabilities, such as EFBs.	
Global Concept Component(s)	Airport Operations and Management (AOM), Demand and Capacity Balancing (DCB), Aerodrome Operations (AO), Traffic Synchronization (TM) and Conflict Management (CM).	
Global Plan Initiatives (GPI)	GPI-19: Meteorological Systems; GPI-1: Flexible Use of Airspace; GPI-6: Air Traffic Flow Management; GPI-9: Situational Awareness; GPI-10: Terminal Area Design and Management; GPI-15: Match IMC and VMC Operating Capacity	
Reference Documents	World Meteorological Organization standards for weather information content and format. Others TBD	
Main Dependencies	B1-105	
Global Readiness Checklist		**Status (ready or date)**
	Standards Readiness	2028
	Avionics Availability	2028
	Infrastructure Availability	2028
	Ground Automation Availability	2028
	Procedures Available	2028
	Operations Approvals	2028

1 Narrative

1.1 General

This module is focused on developing advanced concepts and necessary technologies to enhance global ATM decision making in the face of adverse weather. The major components include a consistent, integrated set of meteorological information available to all users and ANSPs, advanced decision support tools that utilize the information to assess the potential operational impacts of the weather situation and decision support tools that develop candidate mitigation strategies for dealing with the impacts. This module builds upon the initial weather integration concept and capabilities developed under B1-105 "Enhanced Weather Decision Making Capability (Strategic)". A key emphasis is on tactical weather avoidance in the 0-40 minute timeframe, including making greater use of aircraft based capabilities to detect meteorological parameters (e.g. turbulence, winds, and humidity), and to display weather information to enhance situational awareness. Utilization of ADS-B In/CDTI for weather information display and avoidance is featured. Also, air-to-air concepts enabled by ADS-B will be developed where, for example, aircraft-based observations of turbulence are provided to neighbouring aircraft to enhance safety. ANSPs will also have access to this meteorological information and these decision support tools to enhance their ability to assist pilots in weather avoidance, when requested. This module will develop operational and performance requirements for meteorological information to support these advanced concepts, as well as standards for global exchange of the information, including from aircraft-to-ground, and air-to-air exchanges. It will also develop enhanced capabilities to improve weather-related decision making in the strategic timeframe. Extended capabilities will be developed to produce translations of weather information into characterizations of potential weather constrained airspace. ANSP and user decision support tools not only will directly ingest and use these characterizations, but the tools allow automation-to-automation negotiation of trajectories that take into account the constraint information. These capabilities benefit pre-flight planning, flow planning, and in-flight operations in the en-route, terminal and aerodrome domains. These negotiation capabilities will be globally interoperable to allow for seamless planning of trajectories for international flights. Standards to support these negotiation capabilities must be developed.

1.1.1 Baseline

The baseline for this module is the initial, enhanced weather decision making capabilities enabled by module B1-105. Decision support capabilities are available, and integrated with weather information, to assist ANSPs and users to make better decisions in the strategic timeframe (40 minutes and out). A consistent, integrated weather information base is available to all ANSPs and users, to inform ATM decision making.

1.1.2 Improvement brought by the module

This module provides extensions to this baseline, with emphasis on the tactical (0-40 minute) timeframe, and greater use of aircraft-based capabilities for weather awareness and avoidance. A major focus is on the provision of enhanced automation capabilities (building on B1-105) for developing characterizations of potential weather impacted airspace, and for using those characterizations to determine impact on ATM operations. This information will be provided for all planning horizons and flight domains. ANSP and user decision support tools not only will directly ingest and use these characterizations and resultant impact analyses, but the tools will allow automation-to-automation negotiation of trajectories and mitigation strategies that take into account the weather constraint information. These capabilities benefit pre-flight planning, flow planning, and in-flight operations in the en-route, terminal and aerodrome domains. The negotiation capabilities must be globally interoperable to allow for seamless planning of trajectories for international flights.

1.1.3 Other remarks

This module continues the evolution in procedures and automation capabilities, both ground-based and aircraft-based, for mitigating the effects of weather on flight planning, flight execution, and traffic flow planning.

1.2 Element 1: Enhanced Weather Information

This element is focused on the development of enhanced weather information for integration into ATM decision making. This includes an emphasis on increasing the availability of characterizations of potentially weather constrained airspace which may be directly integrated into ANSP and user decision making. This element also focuses on the development or revision of global standards for weather information content and format, given the migration to 4-D representations of weather information, versus current text and graphics.

1.3 Element 2: Weather-Integrated ATM Decision Support Tools

This element continues the evolution to the utilization of ATM decision support tools, used by ANSPs and users, which directly integrate the above weather information into their processing. Based on experiences gained from development and deployment of initial capabilities as part of module B1-105, extensions are developed to generate more efficient and operationally acceptable weather mitigation solutions. This element also develops direct automation-to-automation negotiation capabilities to streamline the development of mutually acceptable ATM decisions.

1.4 Element 3: Cockpit Weather Capabilities

This element will focus on aircraft-based capabilities that will assist pilots with weather avoidance, and thus enhance safety. Capabilities such as ADS-B In, air-to-air information exchange, and integration of weather into cockpit-based automation tools are considered. This element must focus on globally-harmonized standards development for weather information exchange to support these capabilities.

1.5 Connections to Other Modules/Elements

The development of this module should be coupled with the development of the following major modules (at a minimum) to ensure enhanced ATM operations in adverse weather:

- B3-5 - Full 4D TBO
- B3-10 - Complexity Management
- B3-15 - Integration AMAN/DMAN/SMAN
- B3-25 - Full FF-ICE
- B3-40 - “Full” 4D TBO

2 Intended Performance Operational Improvement/Metric to determine success

This module supports the following KPAs:

- Capacity – A more efficient use of en route airspace that is being impacted by weather, along with less conservative decisions about permitting aircraft to utilize the airspace, results in more aircraft being able to traverse the affected area. Similarly, terminal arrival/departure capacity will be enhanced by improved ability to plan for flows in and out of the airport.
- Efficiency – Users will be better able to plan and receive their preferred trajectory, based on increased knowledge of the anticipated weather situation.
- Predictability – With better planning of flights and flows in adverse weather, users’ preferred trajectories will be less impacted by re-routing actions, ground stops, and ground delays.
- Safety – Pilots will have improved access to weather information in the cockpit, thereby enhancing situational awareness. ANSPs will have the same weather information, and will thus be able to provide better assistance to pilots, if requested.
- Flexibility - Users will have enhanced, advanced knowledge of the anticipated weather situation, and will thus have greater flexibility in selecting the flight trajectory that best meets their needs, while avoiding the weather.

3 Necessary Procedures (Air & Ground)

For strategic actions, the necessary procedures basically exist for ANSPs and users to collaborate on weather-related decisions. Extensions to those procedures will be developed to reflect the use of increased decision support automation capabilities, including automation-to-automation negotiation. The use of ADS-B/CDTI and other cockpit capabilities to support weather avoidance will necessitate procedure development, including the roles of ANSPs. International standards for information exchange between systems to support these operations must be developed. This includes development of global standards for the delivery of weather information to aircraft.

4 Necessary Technology (Air & Ground)

For this longer-term module, the needed technology is still in development. With respect to ground-based technology, research is on-going into decision support tools that ingest weather information directly, and support the automated development of candidate mitigation strategies. Work is also needed to ensure a globally harmonized, common weather information base that is available to all ANSPs and users for decision making. Although aircraft-based capabilities such as ADS-B/CDTI and EFBs exist, applications are still being developed to support the objectives of this module.

5 Regulatory/standardisation needs and Approval Plan (Air & Ground)

This module requires the following:

- Development of global standards for weather information exchange, with emphasis on exchange of 4-D (X, Y, Z, and T [time]) gridded weather information.
- Regulatory agreement on what constitutes required weather information in the age of digital exchange, versus text and graphics.
- Certification decisions on aircraft-based weather display and dissemination. Dissemination includes air-to-ground for aircraft based observations (e.g. turbulence and humidity), as well as possible air-to-air exchange of those observations (e.g. turbulence information to nearby aircraft) via ADS-B.

6 Business Case specific to the module

The major qualitative business case aspects of this module are as follows:

- Capacity – Additional flights can be accommodated in en route airspace and in airport terminals because of more precise knowledge of weather location and timing.
- Efficiency – Users will be better able to plan and be granted their preferred trajectory, based on increased knowledge of the anticipated weather situation.
- Predictability – Users' planned trajectories will be less impacted by re-routing actions, ground stops, and ground delays. More efficient planning for fuel-on-board, and minimization of fuel use.
- Safety – A reduction of weather-related accident and injuries is anticipated.
- Flexibility – Users will have greater flexibility in selecting the flight trajectory that best meets their needs, while avoiding the weather.

7 Implementation and Demonstration Activities

7.1 Current Use

Since this module is in the category of Long Term Issues, there are no examples of current operational use. The FAA is conducting research on ADS-B In applications that relate to weather avoidance via cockpit functionality. Such research efforts will help to inform the work to be done under this module.

7.2 Planned or Ongoing Trials

No global demonstration trials are currently planned for this module. There is a need to develop such a plan as part of the collaboration process, and as an extension of other modules.

8 Main dependencies

This module is very dependent on the accomplishment of module B1-105. Also, there is a dependency on the development of future concepts and automation capabilities that will utilize the advanced weather information to inform decision making. The GPIs mentioned above (e.g. 1, 6, and 9) are assumed to provide impetus to develop those capabilities. The modules mentioned above (see section 1.5) may offer specific opportunities for joint development of weather integration concepts and capabilities, including standards development where needed.

APPENDIX B / APENDICE B

Module N° B0-25: Increased Interoperability, Efficiency and Capacity through Ground-Ground Integration

Summary	Supports the coordination of ground-ground data communication between ATSU based on ATS Interfacility Data Communication (AIDC) supports the coordination between ATSU based on ICAO Doc 9694 . It supports also the transfer of communication in data-link environment in particular for Oceanic ATSU. It is a first step in the ground-ground integration
Main Performance Impact	KPA-02 – Capacity; KPA-04 – Efficiency; KPA-07 – Global Interoperability; KPA-10 - Safety
Domain / Flight Phases	All flight phases and all type of ATS units
Applicability Considerations	Applicable to at least 2 ACCs dealing with en-route and/or TMA airspace. A greater number of consecutive participating ACCs will increase the benefits.
Global Concept Component(s)	CM - Conflict management IM - Information Management
Global Plan Initiatives (GPI)	GPI-16 Decision Support Systems
Reference Documents	• Doc 4444 Appendix 6 - ATS INTERFACILITY DATA COMMUNICATIONS (AIDC) MESSAGES • Doc ATN (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) • Doc *Manual of Air Traffic Services Data Link Applications* (Doc 9694).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* • EUROCONTROL documentation o EUROCONTROL Standard for On-Line Data Interchange (OLDI) o EUROCONTROL Standard for ATS Data Exchange Presentation (ADEXP)
Main Dependencies	NIL

Global Readiness Checklist		**Status (ready or date)**
	Standards Readiness	√
	Avionics Availability	No Requirement
	Infrastructure Availability	√
	Ground Automation Availability	√
	Procedures Available	√
	Operations Approvals	√

1 Narrative

1.1 General

Flights which are being provided with an ATC service are transferred from one ATC unit to the next in a manner designed to ensure complete 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.

Where it is carried out by telephone, the passing of data on individual flights as part of the co-ordination process is a major support task at ATC 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.

This is now fully integrated into the "ATS Interfacility Data Communications" (AIDC) messages in the PANS-ATM, 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).

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

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 radar/surveillance based separations.

Combined with data-link application it allows the coordination and transfer of control.

These improvements translate directly into a combination of performance improvements.

Information exchanges between flight data processing systems are established between air traffic control units for the purposes of notification, coordination and transfer of flights and for the purposes of civil-military coordination. These information exchanges rely upon appropriate and harmonised communication protocols to secure their interoperability. They apply to:

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

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

1.1.1 Baseline

The baseline for this module is classical coordination by phone and procedural and/or radar distance separations.

Prerequisites being part of the general baseline: an ATC system with flight data plan processing functionality, and a surveillance data processing system connected to the above.

1.1.2 Change brought by the module

The module makes available a set of messages to describe consistent transfer conditions via electronic means across centre boundaries.

1.1.3 Other remarks

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

1.2 Elements

The element consists of Implementation of the set of AIDC messages in the flight data plan processing system (FDPS) of the different ATS units and establishment of LoA to determine the appropriate parameters.

2 Intended Performance Operational Improvement/Metric to determine success

Access and Equity	---
Capacity	Reduced controller workload and increased data integrity supporting reduced separations translating directly to cross sector or boundary capacity flow increases. Metric: Throughput between two ACCs
Cost Effectiveness	
Efficiency	The reduced separation can also be used to offer more frequently to aircraft flight levels closer to the flight optimum; in certain cases, this also translates in reduced en-route holding. Metric: fuel consumption and flight time
Environment	---
Flexibility	---
Global Interoperability	Seamlessness: the use of standardised interfaces reduces the cost of development, allows controller to apply the same procedures at the boundaries of all participating centres and border crossing becomes more transparent to flights. Metric: number AIDC implementation between ACCs
Participation by the ATM community	---
Predictability	---
Safety	Better knowledge of more accurate flight plan information Metric: number of incidents at cross-border
Security	---

CBA	Increase of throughput at ATC unit boundary, reduced ATCo Workload will exceed FDPS software changes cost
Human performance	Appropriate HMI for ATCos Training for best use of the automation support

3 Necessary Procedures (Air & Ground)

Required procedures exist. They need local instantiation on the specific flows; the experience from other regions can be a useful reference.

Means of compliance: EUROCONTROL On Line Data Interchange (OLDI)

4 Necessary Technology (Air & Ground)

Technology is available. It is implemented in Flight Data Processing and could use the ground network standard AFTN-AMHS or ATN. Europe is presently implementing IP Wide Area Networks

There are no specific airborne requirements

5 Regulatory/standardisation needs and Approval Plan (Air & Ground)

ICAO material is available (PANS-ATM, ATN).

Regions should consider the possible mandating of AIDC. Means of compliance are also described in EUROCONTROL standards and EU regulations (Regulation (EC) No 552/2004 of the European Parliament and of the Council of 10 March 2004 on the interoperability of the European Air Traffic Management network (the interoperability Regulation).)

6 Implementation and Demonstration Activities

6.1 Current Use

Although already implemented in several areas, but there is a need to complete the existing standards to avoid system specific and bilateral protocol.

For oceanic data-link application, NAT and APIRG (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).

Implementations in other regions exists.

In Europe it is mandatory for exchange between ATS units.
http://europa.eu/legislation_summaries/transport/air_transport/l24070_en.htm

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 centre boundaries have been used for trials in Europe in 2010 in the scope of EUROCONTROL FASTI initiative.

To be completed when the complete picture is defined.

6.2 Planned or Ongoing Trials

Text to be included in next revision.

Module N° B0-30: Service Improvement through Digital Aeronautical Information Management

<table>
<tr><td>Summary</td><td colspan="2">Initial introduction of digital processing and management of information, by the implementation of AIS/AIM making use of AIXM, moving to electronic AIP and better quality and availability of data</td></tr>
<tr><td>Main Performance Impact</td><td colspan="2">KPA-03 - Cost-Effectiveness; KPA-05 – Environment; KPA-09 – Safety</td></tr>
<tr><td>Domain / Flight Phases</td><td colspan="2">All phases of flight</td></tr>
<tr><td>Applicability Considerations</td><td colspan="2">Applicable at State level, with increased benefits as more States participate</td></tr>
<tr><td>Global Concept Component(s)</td><td colspan="2">IM – Information Management</td></tr>
<tr><td>Global Plan Initiatives (GPI)</td><td colspan="2">GPI-18 Electronic information services</td></tr>
<tr><td>Reference Documents</td><td colspan="2">Aeronautical Information Services Manual (Doc 8126) incl AIXM and eAIP as per Edition 3
Aeronautical Chart Manual (Doc 8697)
Manuals on AIM quality system and AIM training</td></tr>
<tr><td>Main Dependencies</td><td colspan="2">NIL</td></tr>
<tr><td rowspan="7">Global Readiness Checklist</td><td></td><td>Status (ready or date)</td></tr>
<tr><td>Standards Readiness</td><td>√</td></tr>
<tr><td>Avionics Availability</td><td>√</td></tr>
<tr><td>Infrastructure Availability</td><td>√</td></tr>
<tr><td>Ground Automation Availability</td><td>√</td></tr>
<tr><td>Procedures Available</td><td>√</td></tr>
<tr><td>Operations Approvals</td><td>√</td></tr>
</table>

1 Narrative

1.1 General

The subject has been discussed at the 11th ANC which made the following recommendation:

Recommendation 1/8 — Global aeronautical information management and data exchange model

That ICAO:

a) when developing ATM requirements, define corresponding requirements for safe and efficient global aeronautical information management that would support a digital, real-time, accredited and secure aeronautical information environment;

b) urgently adopt a common aeronautical information exchange model, taking into account operational systems or concepts of data interchange, including specifically, AICM/AIXM, and their mutual interoperability; and

c) develop, as a matter of urgency, new specifications for Annexes 4 and 15 that would govern provision, electronic storage, on-line access to and maintenance of aeronautical information and charts.

The long term objective is the establishment of a network-centric information environment, also known as System Wide Information Management (SWIM).

In the short to medium term, the focus is on the definition and harmonised transition from the present Aeronautical Information Services (AIS) to Aeronautical Information Management (AIM). AIM envisages a migration from a focus on products to a data centric environment where aeronautical data will be provided in a digital form and in a managed way. This transition includes both static (AIP) and dynamic (NOTAM) data. This can be regarded as the first stage of SWIM, which is based on common data models and data exchange formats. The next (long term) SWIM level implies the re-thinking of the data services from a “network” perspective, which in the first level remains a centralised State service.

The aeronautical information services must transition to a broader concept of aeronautical information management, with a different method of information provision and management given its data-centric nature as opposed to the product-centric nature of AIS.

The expectations are that the transition to AIM will not involve many changes in terms of the scope of information to be distributed. The major change will be the increased emphasis on data distribution, which should place the future AIM in a position to better serve airspace users and ATM in terms of their information management requirements.

This is the first step towards SWIM. This first step is easier to make because it concerns static or low dynamic information which is being used by other functions but do not use other information, and it generates substantial benefits even for smaller States. It will allow to gain experience before moving to the further steps of SWIM.

1.1.1 Baseline

The baseline is the traditional Aeronautical Information service and processes, based on paper publications and NOTAMs.

AIS information published by the ICAO Member States has traditionally been based on paper documents and text messages (NOTAM) and maintained and distributed as such. In spite of manual verifications, this did not always prevent errors or inconsistencies. In addition, the information had to be recaptured from paper to ground and airborne systems, thus introducing additional risks. Finally, the timeliness and quality of more dynamic information could not always be guaranteed.

1.1.2 Change brought by the module

The module makes AIS move into AIM, with standardised formats based on widely used information technology standards (UML, XML/GML), supported by industrial products and stored on electronics devices. Information quality is increased, as well as that of the management of aeronautical information in general. The AIP moves from paper to electronic support.

2 Intended Performance Operational Improvement/Metric to determine success

Cost Effectiveness	reduced costs in terms of data inputs and checks, paper and post, especially when considering the overall data chain, from originators, through AIS, to the end users Metric: reduced overall cost at equivalent quality of service
Environment	reduced use of paper; also, more dynamic information should allow shorter flight trajectories, based on more accurate information about the current status of the airspace structure Metric: gains in paper volumes and dispatch
Global Interoperability	Essential contribution to interoperability
Safety	Reduction in the number of possible inconsistencies, as the module will allow to reduce the number of manual entries and ensure consistency among data through automatic data checking based on commonly agreed business rules Metric: incident occurrences

CBA	The business case for AIXM has been conducted in Europe and in the United States and has shown to be positive. The initial investment necessary for the provision of digital AIS data may be reduced through regional cooperation and it remains low compared with the cost of other ATM systems. The transition from paper products to digital data is a critical pre-requisite for the implementation of any current or future ATM or air navigation concept that relies on the accuracy, integrity and timeliness of the data.
Human Performance	

3 Necessary Procedures (Air & Ground)

No new procedures for ATC, but a revisited process for AIS. Full benefit requires new procedures for data users in order to retrieve the information digitally. E.g. for Airlines in order to enable the dynamic provision of the digital AIS data in the on-board devices, in particular Electronic Flight Bags.

4 Necessary Technology (Air & Ground)

The AIS data are made available to the AIS service through IT and to external users via either a subscription for an electronic access or physical delivery; the electronic access can be based on internet protocol services. The physical support does not need to be standardised.

5 Regulatory/standardisation needs and Approval Plan (Air & Ground)

No additional need.

6 Implementation and Demonstration Activities

6.1 Current Use

- **Europe**: the European AIS Database (EAD) became operational in June 2003. Electronic AIP (eAIP), fully digital versions of the paper document and based on a EUROCONTROL eAIP specification have been implemented (on-line or on a CD) in a number of States (e.g. Armenia, Belgium & Luxemburg, Hungary, Latvia, Moldova, Netherlands, Portugal, Slovak Republic, Slovenia, etc.). Both are essential milestones in the realization of the digital environment. The EAD had been developed using the Aeronautical Information Conceptual Model (AICM) and Aeronautical Information Exchange Model (AIXM).
- **United States**: TBC

- Other regions: Azerbaijan, Japan, Taiwan have implemented the eAIP. Mongolia: TBC

AIXM based system recently ordered several countries around the world, including Australia, Canada, South Africa, Brazil, India, Fiji, etc.

6.2 Planned or Ongoing Trials

The current trials in Europe and USA focus on the introduction of Digital NOTAM, which can be automatically generated and used by computer systems and do not require extensive manual processing, as compared with the text NOTAM of today. More information is available on the EUROCONTROL and FAA Web sites: http://www.EUROCONTROL.int/aim/public/standard_page/xnotam.html and http://notams.aim.faa.gov/fnsstart/.

Module N° B1-25: Increased Interoperability, Efficiency and Capacity though FF-ICE/1 application before Departure

Summary	Introduction of FF-ICE step 1, to implement ground-ground exchanges using common flight information reference model, FIXM, XML and the flight object used before departure	
Main Performance Impact	KPA-02 – Capacity; KPA-04 Efficiency; KPA-06 Flexibility; KPA-07 Interoperability; KPA-10 Safety,	
Domain / Flight Phases	All flight phases and all types of ATS units Planning phase for FF-ICE/1	
Applicability Considerations	Applicable to at least 2 ACCs dealing with en-route and/or TMA airspace. A greater number of consecutive participating ACCs will increase the benefits. Airspace user and airport	
Global Concept Component(s)	DCB – Demand capacity Balancing CM - Conflict management IM - Information Management	
Global Plan Initiatives (GPI)	GPI-6 ATFM GPI-7 Dynamic and flexible route management GPI-16 Decision Support Systems	
Reference Documents	• Same as B0-25 + • EUROCONTROL OLDI V4.2 • Eurocae ED-133 June 09 Flight Object Interoperability Specification • FF-ICE concept document	
Main Dependencies	B0-25 and B0-30	
Global Readiness Checklist		**Status** (indicate ready with a tick or input date)
	Standards Readiness	2016
	Avionics Availability	No requirement
	Infrastructure Availability	2017
	Ground Automation Availability	2017
	Procedures Available	2017
	Operations Approvals	2017

1 Narrative

1.1 General

The use of FF-ICE/1 permits a better sharing of Flight information before departure for improved Flight planning submission, pre-flight ATFM by facilitating the flight information sharing between all stakeholders (Airspace users, airport and ASP).

1.1.1 Baseline

The baseline for this module is automated standard through a set of messages and limited need for direct speech coordination and present process for submission of FPL through ICAO standardized FPL/2012 messages .

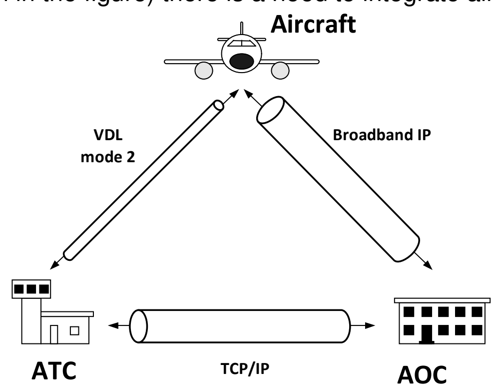
1.1.2 Change brought by the module

1.2 Element 1: FF-ICE/1 before departure

ICAO SARPs for FF-ICE/1 is being developed by ICAO groups between 2012-2015 after endorsement of Flight and Flow Information for a Collaborative Environment (FF-ICE) – A Concept at 12th ANC. It will facilitate the exchange of information associated to Flight plan, allowing more flexibility for flight data submission and publishing.

(Extract from Ref ATMRPP WP470) "The objective of FF-ICE/1 is to establish the basis for transition towards a full FF-ICE deployment. This basis consists of:

- Introduction of Unique Global Flight Identification: introduction of the GUFI
- Introduction of common data format i.e. FIXM in the context of the overall transition to XML for aeronautical information as shown in the following picture:
- Introduction of basic roles, rules and procedures for submission and maintenance of FF-ICE information including provisions for the early sharing of trajectory information.
- Systematic introduction of "Triangle" (Aircraft, AOC, ATC) recognising the constraint that the bandwidth between ATC and aircraft does not allow for (frequent) exchange of 4D trajectory information as foreseen in the FF-ICE concept. The figure below assumes a high bandwidth connection between AOC and aircraft. This may be the case for some operators but not for all. In addition (not shown in the figure) there is a need to integrate airports in the environment for



information sharing.

The Flight Object (FO) concept has been developed to specify the information on environments, flights and flows managed by and exchanged between FDPSs. FF-ICE is a subset of FO but includes, at conceptual level, the interface with the Airspace User (AOC and a/c). FO will be deployed in the target period of FF-ICE/1. FF-ICE/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 Air Space Users."

List of changes included in FF-ICE/1

1. Support for early provision of flight intention information.
2. Support for exchange of 4D Trajectory information between the AOC and the ANSP

3. New format for flight and flow information 5internet protocol and XML
4. Globally Unique Flight Identifier (GUFI)
5. FF-ICE/1 Information Elements (first list of Information elements)

1.3 Other remarks

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

2 Intended Performance Operational Improvement/Metric to determine success

Element 1: FF-ICE step1

Access and Equity	
Capacity	
Cost Effectiveness	
Efficiency	Better knowledge of aircraft capabilities allows trajectories closer to Airspace user preferred trajectories and better planning Metrics: fuel consumption and flight time
Environment	
Flexibility	
Global Interoperability	The use of new mechanism for FPL filling and information sharing will facilitate the Flight data sharing among the actors. Metric: number of implementation of FF-ICE-1 by ANSP, AU and AO.
Participation by the ATM community	FF-ICE/1 for Ground-Ground application will facilitate 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.. Metric: number of implementation of FF-ICE-1 by ANSP, AU and AO.
Predictability	
Safety	
Security	

CBA	
Human performance	

3 Necessary Procedures (Air & Ground)

Required procedures exist. They need local instantiation on the specific flows; the experience from other regions can be a useful reference.

Means of compliance: EUROCONTROL OnLine Data Interchange (OLDI) standard

FF-ICE/1 Manual, SARPS and concept of use to be developed.

4 Necessary Technology (Air & Ground)

There are no specific airborne requirements.

FF-ICE/1 SARPS, FIXM and Interface need to be used and require further development in ground systems. Flight Object industrial standards will be implemented in FDPSs.

Airspace users systems will need to be modified to support the provision of FF-ICE to ANSPs

5 Regulatory/standardisation needs and Approval Plan (Air & Ground)

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/1 SARPS should be developed and validated

6 Implementation and Demonstration Activities

6.1 Current Use

6.2 Planned or Ongoing Trials

For Element 1: Flight Object validation is taking place in the frame of the SESAR projects 10.2.5 et 4.3 and is planned between 2011 and 2013.

FF-ICE/1 could be considered as part of SESAR WP8 and WP14 in the development of AIRM.

Module N° B1-30: Service Improvement through Integration of all Digital ATM Information

Summary	Implementation of the ATM Information Reference Model (AIRM) integrating all ATM information using UML and enabling XML data representations and data exchange based on internet protocols. Second step of implementation of digital IM, with the WXXM for meteorological information.	
Main Performance Impact	KPA-01 Access & Equity; KPA-03 Cost-Effectiveness; KPA-10 Safety	
Domain / Flight Phases	All phases of flight	
Applicability Considerations	Applicable at State level, with increased benefits as more States participate	
Global Concept Component(s)	IM – Information Management	
Global Plan Initiatives (GPI)	GPI-18 Electronic information services	
Reference Documents	WXXM available in 2012	
Main Dependencies	B0-30, B0-60	
Global Readiness Checklist		**Status (ready or date)**
	Standards Readiness	2018
	Avionics Availability	NA
	Infrastructure Availability	2018
	Ground Automation Availability	2018
	Procedures Available	√
	Operations Approvals	2018

1 Narrative

1.1 General

The module captures two main actions which capitalise on the advances made in the previous block on the same subject. The module will implement the ATM Information Reference Model (AIRM) capturing all the types of information used by ATM in a consistent set of data and service models (using UML, GML/XML) and that can be accessed via internet protocol based tools. The module also implements a second step of digital information management, with the WXXM for meteorological information and possible flight and flow exchange data models. The further standardisation of aircraft performance data is also to be considered.

1.1.1 Baseline

The baseline at the implementation level is the use of AIXM for AIS data, resulting from module B0-30. The AIXM, the WXXM, and any other xxXM models are compatible with the AIRM.

1.1.2 Change brought by the module

This module expands the approach pioneered by AIXM to the other forms of information by providing the overall reference model framework, allowing each type of data to fit into a consistent picture, the implementation of AIXM providing the foundation for many data that refer to AIM data. It also proceeds with the additional capability to manage, distribute and proceed the weather, possibly flight & flow and aircraft performance related data. In addition to interoperable data, the module starts to provide interoperable information services as part of the transition to a Service Oriented Architecture.

2 Intended Performance Operational Improvement/Metric to determine success

Access and Equity	greater and more timely access to up-to-date information by a wider set of users
Cost Effectiveness	reduction of time to process a new piece of information; reduced use of paper; higher agility of the system to create new applications through the availability of standardised data Metric: reduction of service costs
Efficiency	
Environment	
Flexibility	
Global Interoperability	Essential for global interoperability
Participation by the ATM community	
Predictability	
Safety	reduced probability of error or inconsistency in/across data; reduced possibility to introduce additional errors by subsequent manual inputs Metric: incident occurrences
Security	

CBA	Business case to be established in the course of the projects defining the models and their possible implementation.
Human Performance	

3 Necessary Procedures (Air & Ground)

No new procedures for ATC, but a revisited process for management of information.

4 Necessary Technology (Air & Ground)

All users/producers of the information need to implement AIRM in support of their exchanges with other members of the ATM community.

5 Regulatory/standardisation needs and Approval Plan (Air & Ground)

The diverse elements of AIRM will be the subject of ICAO standards.

6 Implementation and Demonstration Activities

6.1 Current Use

None identified

6.2 Planned or Ongoing Trials

- **Europe**: SESAR is currently defining and validating the ATM Information Reference Model (AIRM) & Information Service Reference Model (ISRM) including the specific data models Weather Exchange model (WXXM), Flight Information Exchange Model (FIXM),…
- **US:** This is covered through the EA OV-7 and associated service model activities of the NextGen programme.
- US-Europe cooperation is in place on the joint development and maintenance of the data models AIXM/WXXM/FIXM

Module N° B1-31: Performance Improvement through the Application of System Wide Information Management (SWIM)

Summary	Implementation of SWIM services (applications and infrastructure) creating the aviation intranet based on standard data models, and internet-based protocols to maximise interoperability. With this module the right, up-to-date and accurate data is timely available to the right user with the required performance and quality. This is an enabler of the most advanced functionalities of the Global Operational Concept.	
Main Performance Impact	KPA-03 Cost-Effectiveness; KPA-05 Environment; KPA-10 Safety	
Domain / Flight Phases	All phases of flight	
Applicability Considerations	Applicable at State level, with increased benefits as more States participate	
Global Concept Component(s)	IM – Information Management	
Global Plan Initiatives (GPI)	GPI-18 Electronic information services	
Reference Documents	ICAO Global Concept	
Main Dependencies	B0-30, B0-60	
Global Readiness Checklist		**Status (ready or date)**
	Standards Readiness	2018
	Avionics Availability	NA
	Infrastructure Availability	2018
	Ground Automation Availability	2018
	Procedures Available	2018
	Operations Approvals	2018

1 Narrative

1.1 General

The goal is a net-centric operation where the 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 via applications running on any suitable personal device. The support provided by the ATM network will in all cases be tailored to the needs of the user concerned.

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 data 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.

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 / 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 advance end-user applications as it will provide extensive information sharing and the capability to find the right information wherever the provider is.

The phased approach to the deployment of SWIM has been developed to ensure that benefits start of be realised 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 aspects of data provision.

At each stage, the phased implementation of SWIM will consider the three inter-related dimensions (applications, information, infrastructure):

- 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 of airports and aircraft operators evolving to include more complex collaborations across the whole ATM business chain.
- 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.
- Infrastructure will be concerned mainly by the connectivity aspects: It will be built on existing legacy infrastructure as far as practicable until an IP based network communications 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).

The combination of the above three areas at particular stages of their common evolution constitute the ATM Capability Levels for Information Management.

1.1.1 Baseline

Module B0-30 will have created a nucleus of modern information management and provided experience to move forward in domains other than AIM. Module B1-30 will in parallel allow ATM information to be structured and managed in fully digital and consistent manner, using the same standards for their description. 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 is started with information not considered as safety critical and/or integrated with other data.

1.1.2 Change brought by the module

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.

2 Intended Performance Operational Improvement/Metric to determine success

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 Metric: reduction of costs at equivalent service
Efficiency	(indirect) Using better information allows operators and service providers to plan and execute better trajectories
Environment	further reduction of paper usage (indirect) more cost-efficient flights as the most up to data is available to all stakeholders in the ATM system
Safety	access protocols and data quality will be designed to reduce current limitations in these area Metric: incident occurrences
Security	access protocols and data quality will be designed to reduce current limitations in these area

CBA	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
Human Performance	

3 Necessary Procedures (Air & Ground)

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

4 Necessary Technology (Air & Ground)

The ground SWIM infrastructure and its oversight functions to allow the progressive connection of ATM stakeholder systems while meeting the necessary safety, security and reliability requirements.

5 Regulatory/standardisation needs and Approval Plan (Air & Ground)

Standards will be needed in terms of information management, addressing all aspects.

6 Implementation and Demonstration Activities

6.1 Current Use

- **Europe**: use of PENS as backbone for IP ground-ground communications, but currently with no SWIM application. Use of CFMU NOP Portal Web services and EAD AIM services.
- **US**: TBC

6.2 Planned or Ongoing Trials

- **Europe:**
    - SWIM Step1 infrastructure demonstration by the end of 2011
    - Planned Release 2 V&V SWIM-enabled exercises :
        - EXE-04.03-VP-022/ EXE-04.03-VP-026 “IOP Validation” : Support of part of the actual ATC-ATC Coordination by means of a new mechanism based in the Flight Object”
        - EXE-07.06.04-VP-538 “Slot Swapping” : DMEAN implemented improvement (slot swapping). Prototype of enhanced slot swapping function to cover the following requirements: extension to all flights departing from (or arriving to) the same airport (slot swapping between flights from different AOs)
        - EXE-07.06.04-VP-539 “UDPP extension to 4D BT FTS” : Extension to full 4D business/mission trajectory. Different alternative exchange models for collaborative prioritization of flights (compensation value, auction...). UDPP extended to en-route congestion. Fast time model implementing decision tools including different models for priority rules and collaborative prioritization (e.g. auction models, prioritization models, etc).
        - EXE-13.02.02-VP-460 “AIMQuick win (Step1)” : Validate the 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
- **US:** TBC

Module N° B2-25 Improved Coordination through multi-centre Ground-Ground Integration: (FF-ICE/1 and Flight Object, SWIM)

Summary	FF-ICE supporting Trajectory based Operations through exchange and distribution of information for multicentre operations using Flight Object implementation and Interoperability (IOP) standards. Extension of use of FF-ICE after departure supporting Trajectory based Operations. New system interoperability standards will support the sharing in ATM services that could involve more than two ATSUs.	
Timescale	2023	
Main Performance Impact	KPA-02 Capacity, KPA-04 Efficiency, KPA-06 Flexibility; KPA-07 Global Interoperability, KPA-10 Safety,	
Domain / Flight Phases	All flight phases and all type of ground stakeholders	
Applicability Considerations	Applicable to all ground stakeholders (ATS, Airports, Airspace Users) in an homogeneous areas, potentially global.	
Global Concept Component(s)	AUO –Airspace User Operations AO – Airport Operations DCB – Demand capacity Balancing CM - Conflict management IM - Information Management	
Global Plan Initiatives (GPI)	GPI-6 ATFM GPI-7 Dynamic and flexible route management GPI-16 Decision Support Systems	
Reference Documents	• FF-ICE Concept Document • FF-ICE FIXM SARPs to be developed • Eurocae ED133 Flight Object Interoperability Standard for distributed FDPS.	
Main Dependencies	Successor of B1-25, B1-31	
Global Readiness Checklist		**Status** (indicate ready with a tick or input date)
	Standards Readiness	2018
	Avionics Availability	No requirement
	Infrastructure Availability	2020
	Ground Automation Availability	2020
	Procedures Available	2020
	Operations Approvals	2020

1 Narrative

1.1 General

1.1.1 Baseline

The baseline for this module is coordination transfers and negotiation in B1-25

First step of FF-ICE/1 for ground application, during the planning phase before departure

1.1.2 Change brought by the module

Sharing of all the Flight and Flow information during Planning and Execution Flight Phase

1.2 Element:

FF-ICE/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 of the ground stakeholders using Flight Object implementation and IOP standard.

The module makes available a protocol to support exchange and distribution of information for multicentre operations.

SWIM will facilitate information sharing.

1.3 Other remarks

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/Metric to determine success

2.1 Element :

Access and Equity	
Capacity	reduced controller workload and increased data integrity
Cost Effectiveness	
Efficiency	Through more direct route and use of RTA to upstream centres..
Environment	
Flexibility	
Global Interoperability	Easier facility of system connexion and wide exchange of the information among the actors..
Participation by the ATM community	FF-ICE will facilitate the participation of all interested parties
Predictability	
Safety	
Security	

CBA	
Human performance	

3 Necessary Procedures (Air & Ground)

Need for new procedures for new set of application toward Trajectory Based operation

4 Necessary Technology (Air & Ground)

ATM ground systems needs to support IOP and SWIM concept.

There are no specific airborne requirements.

5 Regulatory/standardisation needs and Approval Plan (Air & Ground)

Eurocae ED133 is available for Flight data Processing. It address only ATSUs-FDP interoperability needs

Further standards are needed to support CDM application and Flight information sharing and access to all ground stakeholders

6 Implementation and Demonstration Activities

6.1 Current Use

6.2 Planned or Ongoing Trials

In SESAR Project 10.2.5, Flight Object Interoperability (IOP) System Requirement & Validation using Eurocae ED133 first demonstration and validation activities are planned during 2012-2014 period and first development in industrial systems are available from 2015.

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

SESAR R&D on SWIM are in WP14 SWIM technical architecture and WP8 Information management.

Module N° B2-31: Enabling Airborne Participation in Collaborative ATM through SWIM

Summary	This module allows the aircraft to be fully connected as an information node in SWIM, enabling full participation in collaborative ATM processes with access to voluminous dynamic data including meteorology. This will start with 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.	
Main Performance Impact	KPA-01 Access & Equity, KPA-04 Efficiency, KPA-05 Environment, KPA-08 Participation by the ATM Community, KPA-09 Predictability, KPA-10 Safety	
Domain / Flight Phases	All phases of flight	
Applicability Considerations	long-term evolution potentially applicable to all environments	
Global Concept Component(s)	IM – Information Management	
Global Plan Initiatives (GPI)	GPI-17 Implementation of data link applications GPI-18 Electronic information services	
Reference Documents	FF-ICE Manual (under development) ICAO Global Concept	
Main Dependencies	Successor of: B1-30, B1-31, B1-105, B1-50	
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

The Global concept envisages that the aircraft is an integral part of the collaborative, information-rich ATM environment. This ultimately makes it a regular node of the SWIM processes and infrastructure, able to participate in the 4D trajectory management and collaborative processes.

1.1.1 Baseline

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 Aeromacs, 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.

1.1.2 Change brought by the module

This module allows the aircraft to be fully connected as an information node in SWIM, enabling full participation in collaborative ATM processes with access to voluminous dynamic data including meteorology, initially 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.

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. The safety-critical aspects of ATM communications are covered by module B2-55 which may provide enough throughput for all ATM-related data exchanges.

2. Intended Performance Operational Improvement/Metric to determine success

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 optimise the trajectory
Environment	Better exploitation of meteorological information to optimise 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

CBA	The business case will be established in the relevant validation programmes.
Human Performance	

3. Necessary Procedures (Air & Ground)

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 Technology (Air & Ground)

The enabling technologies are under development. A number of them are provided by the other modules with which this one has dependencies.

5. Regulatory/standardisation needs and Approval Plan (Air & Ground)

Specifications are to be defined.

6. Implementation and Demonstration Activities

6.1 Current Use

- **None**

6.2 Planned or Ongoing Trials

- **Terra X:**TBC.

Module N° B3-25 Improved Operational Performance through the Introduction of Full FF-ICE

Summary	All data for all relevant Flights systematically shared between the air and ground systems using SWIM in support of collaborative ATM and Trajectory Based Operations.	
Timescale	Beyond 2028	
Main Performance Impact	KPA-02 Capacity, KPA-04 Efficiency, KPA-06 Flexibility, KPA-07 Interoperability, KPA-08 Participation by the ATM Community, KPA-10 Safety	
Domain / Flight Phases	All phases of flight from initial planning to post-flight	
Applicability Considerations	Air and ground	
Global Concept Component(s)	IM information management	
Global Plan Initiatives (GPI)	GPI-6 ATFM GPI-7 Dynamic and flexible route management GPI-16 Decision Support Systems	
Reference Documents	FF-ICE concept document and TBO documents	
Main Dependencies	After B2-31, B1-30	
Global Readiness Checklist		**Status** (indicate ready with a tick or input date)
	Standards Readiness	2022
	Avionics Availability	2025
	Infrastructure Availability	2025
	Ground Automation Availability	2025
	Procedures Available	2025
	Operations Approvals	2025

1 Narrative

1.1 General

Draft Brochure: FLIGHT & FLOW INFORMATION FOR A COLLABORATIVE ENVIRONMENT (FF-ICE) A Concept to Support Future ATM systems

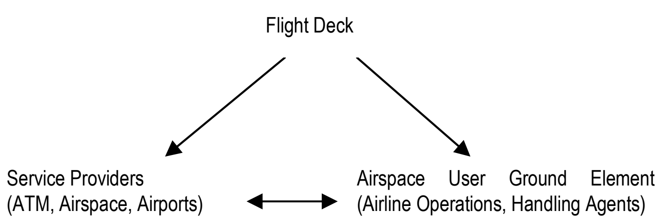
The Role of FF-ICE

As a product of the ICAO Global ATM 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.

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 emphasises the need for information sharing to enable significant benefits.

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 4-D trajectory.
FF-ICE ensures that definitions of data elements are globally standardised 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.

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



The Global ATM concept, implemented through regional programmes such as SESAR (Single European Sky ATM Research) in Europe, NextGen (Next Generation Air Transportation System) in North America and CARATS (Collaborative Action for Renovation of Air Traffic Systems) in Japan, 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:

- Entail systematic sharing of aircraft trajectory data between actors in the ATM process
- Ensure that all actors have a common view of a flight and have access to the most accurate data available
- Allow operations respecting the airspace users' individual business cases

The Need for Change

The Global ATM Concept envisages an integrated, harmonised and globally interoperable system for all users in all phases of flight. The aim is to increase user flexibility and maximise 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:

- Reduced reliance on voice radio communications for air/ground links
- Increased collaborative planning amongst ATM actors
- Providing facilities for real time information exchange
- Maximising benefits of advanced equipment and encouraging deployment of improved air and/or ground systems

1.1.1 Baseline

FF-ICE step 1 is implemented

1.1.2 Change brought by the module

New way to exchange trajectory data for better knowledge

1.2 Element:

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

2 Intended Performance Operational Improvement/Metric to determine success

2.1 Element :

Access and Equity	
Capacity	Y
Cost Effectiveness	Y
Efficiency	Y
Environment	Y
Flexibility	Y
Global Interoperability	Y
Participation by the ATM community	Y
Predictability	
Safety	Y
Security	

CBA	
Human performance	

3 Necessary Procedures (Air & Ground)

Publish and subscribe mechanism will allow real-time sharing of the FI for concerned and authorized actors.

The use of this data will be mainly used by system for decision making tools and further automation.

The sharing of information between aircraft and ground systems will enhanced the predictability.

4 Necessary Technology (Air & Ground)

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 phase .

5 Regulatory/standardisation needs and Approval Plan (Air & Ground)

6 Implementation and Demonstration Activities

6.1 Current Use

6.2 Planned or Ongoing Trials

Full-FF-ICE could be considered as the ultimate goal of the TBO and it is part of NextGen and SESAR R&D plan.

List of SESAR Projects: WP14 and WP8.