



| ICAO PARIS UNITING AVIATION

Our Journey towards SWIM Through ASBUs

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Regional Officer, ICAO

ACAO-ICAO EUR/NAT and MID ASBU Symposium
(Marrakech, Morocco, 10-13 December 2018)





- ASBU PIA 2 Modules
- SWIM Concept
- ATM Information Reference Model (AIRM)
- Status of AIXM Implementation (EUR & MID)
- Update on AIXM Development



PIA2 Schematic Diagram

Thread	Block 0	Block 1	Block 2	Block 3
AMET	B0-AMET	B1-AMET	-	B3-AMET
DATM	B0-DATM	B1-DATM	-	-
FICE	B0-FICE	B1-FICE	B2-FICE	B3-FICE
SWIM	-	B1-SWIM	B2-SWIM	-

Thread	Block 0	Block 1	Block 2	Block 3	Block 4
AMET	B0-AMET	B1-AMET	B2-AMET	B3-AMET	B4-AMET
DATM	-	B1-DAIM	B2-DAIM	-	-
FICE	B0-FICE	-	B2-FICE	B3-FICE	B4-FICE
SWIM	-	-	B2-SWIM	B3-SWIM	-



Today
11 Dec 2018





The Road towards SWIM

Where we started

B0-DATM

- WGS-84
- QMS
- AIRAC
- AIXM AIS Database
- eAIP
- Terrain & Obstacle Datasets (area 1 & 4)

Where we should be soon

B1-DAIM

- Quality-assured aeronautical information (WGS-84, WGS-84, AIRAC, Automation, SLA)
- Digital Datasets:
 - AIP datasets
 - Terrain datasets
 - Obstacle datasets
 - Aerodrome mapping
 - IFP datasets
- NOTAM improvements

We will transition to

B2-DAIM

- Dissemination of AI in SWIM environment
- AIM data requirements to support network operation
- AIM information requirements to support high airspace operation
- AIM information requirements tailored to UTM
- NOTAM replacement

B2-SWIM

- Information Service Provision
- Information Service Consumption
- SWIM registry
- A/G SWIM for non-safety critical information
- Global SWIM processes

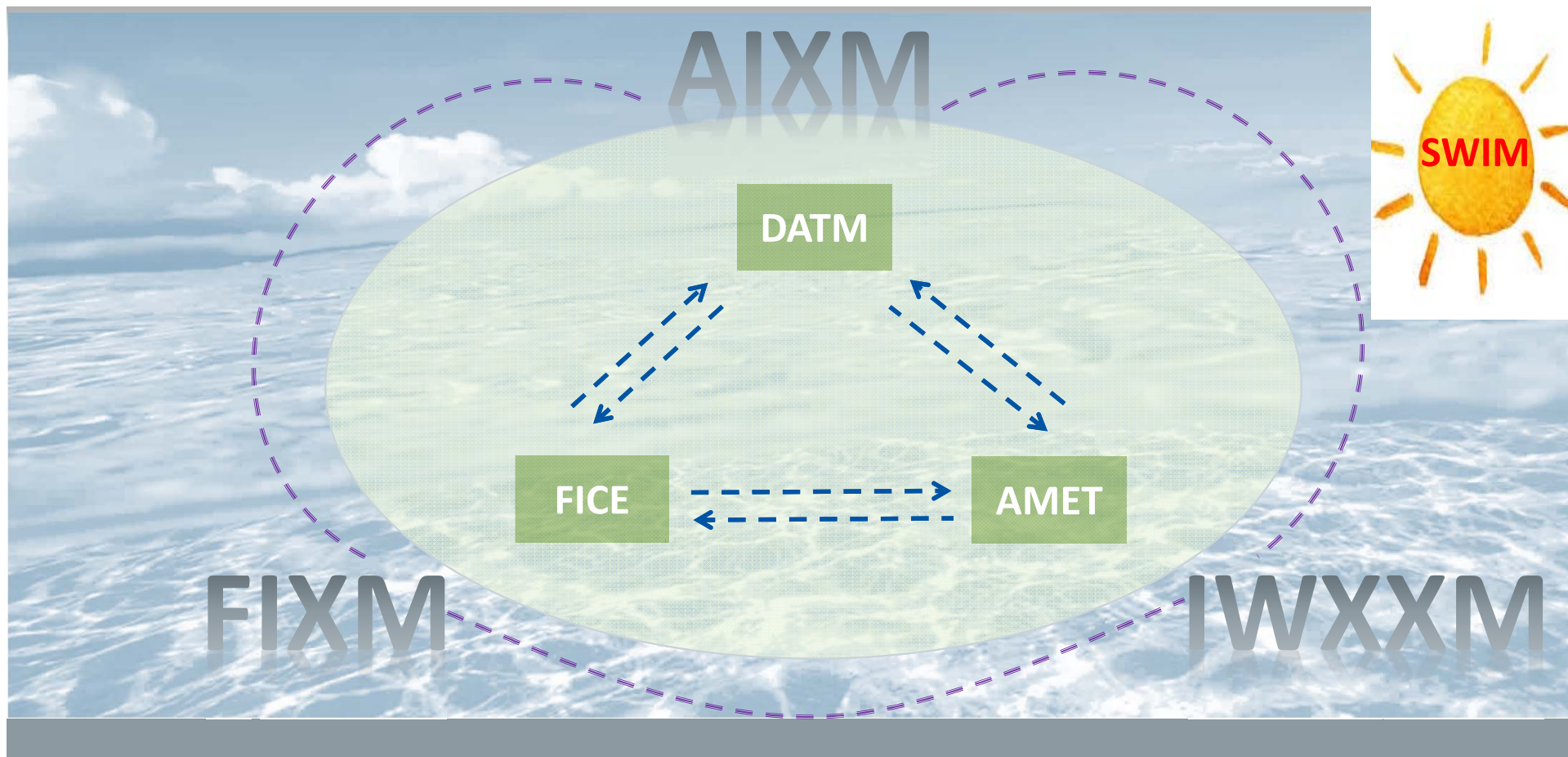
B3-SWIM

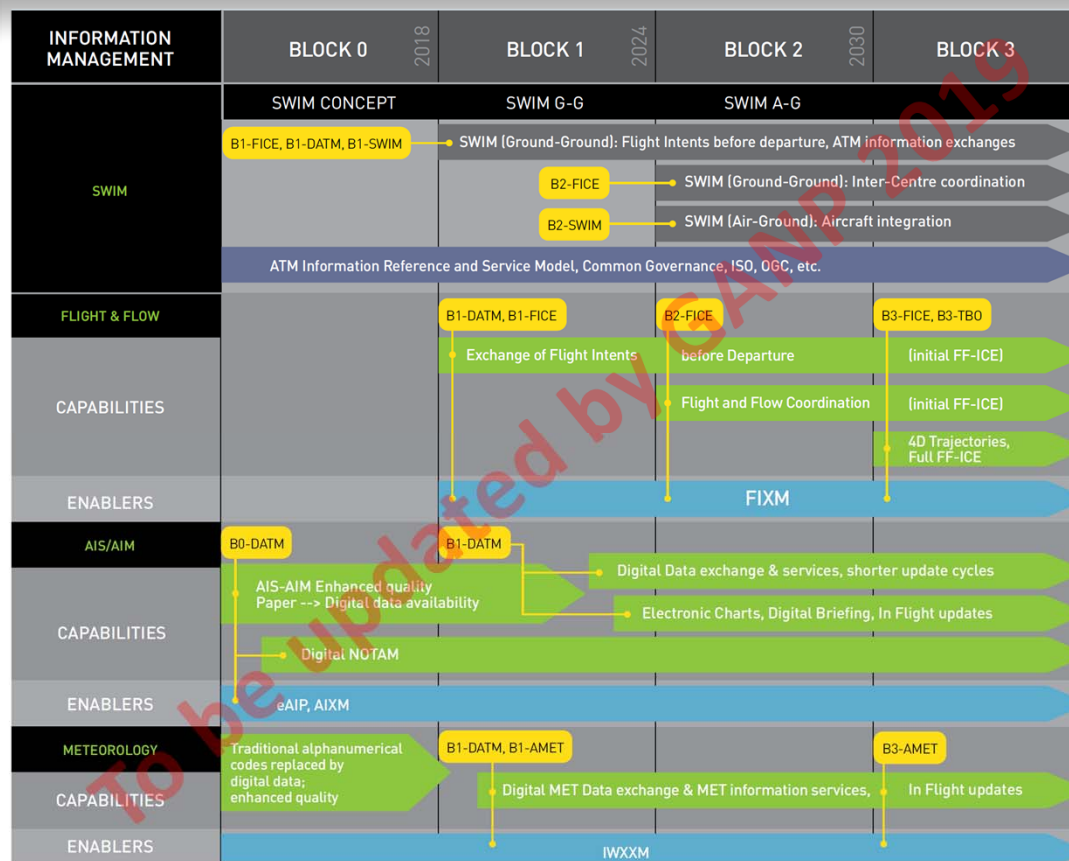
- A/G SWIM for safety critical information





SWIM = PIA2 Modules Integration







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

INTERIM ADVANCE EDITION
Doc 10039
AN/511

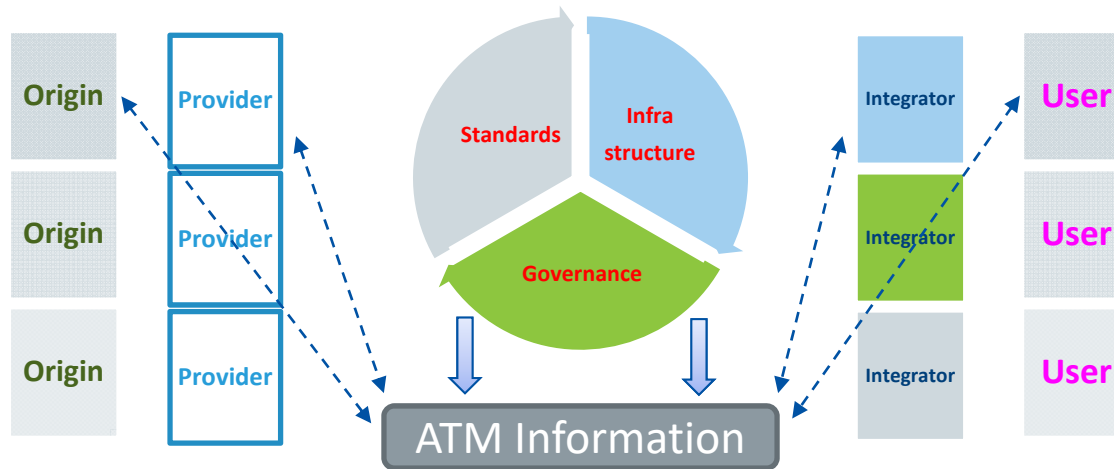


MANUAL ON SYSTEM WIDE INFORMATION MANAGEMENT (SWIM) CONCEPT

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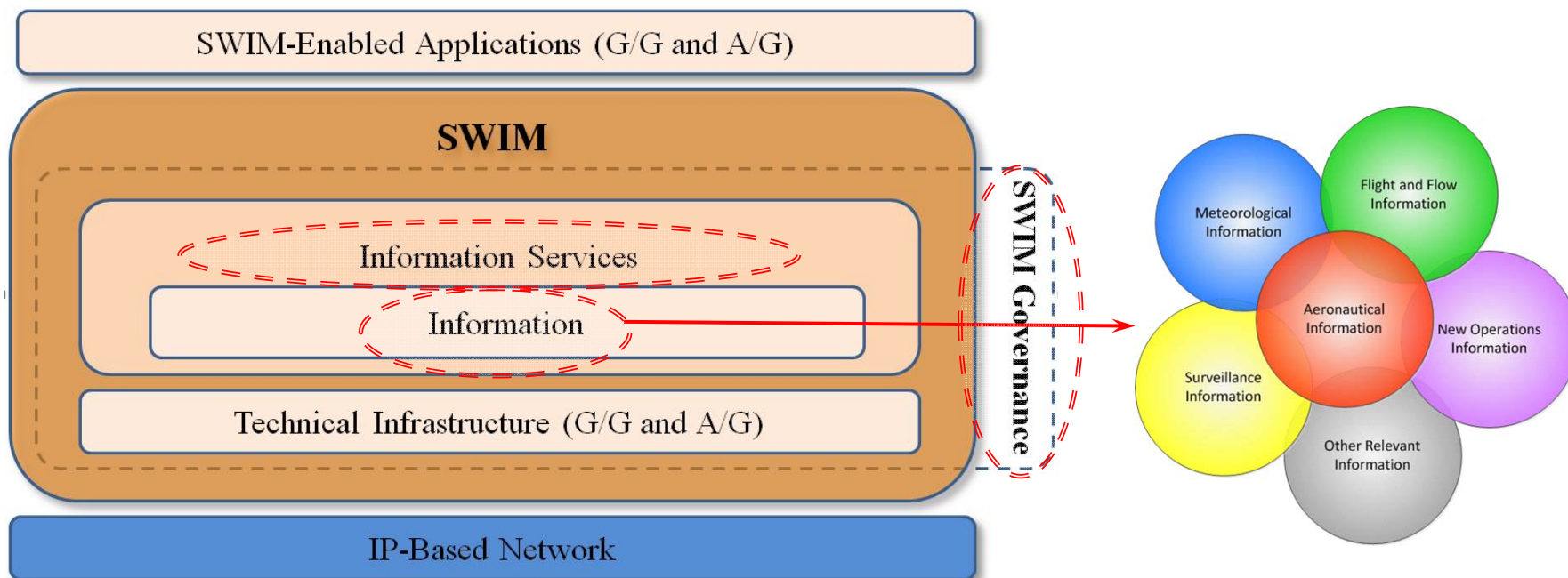
Advanced edition (unedited)

International Civil Aviation Organization



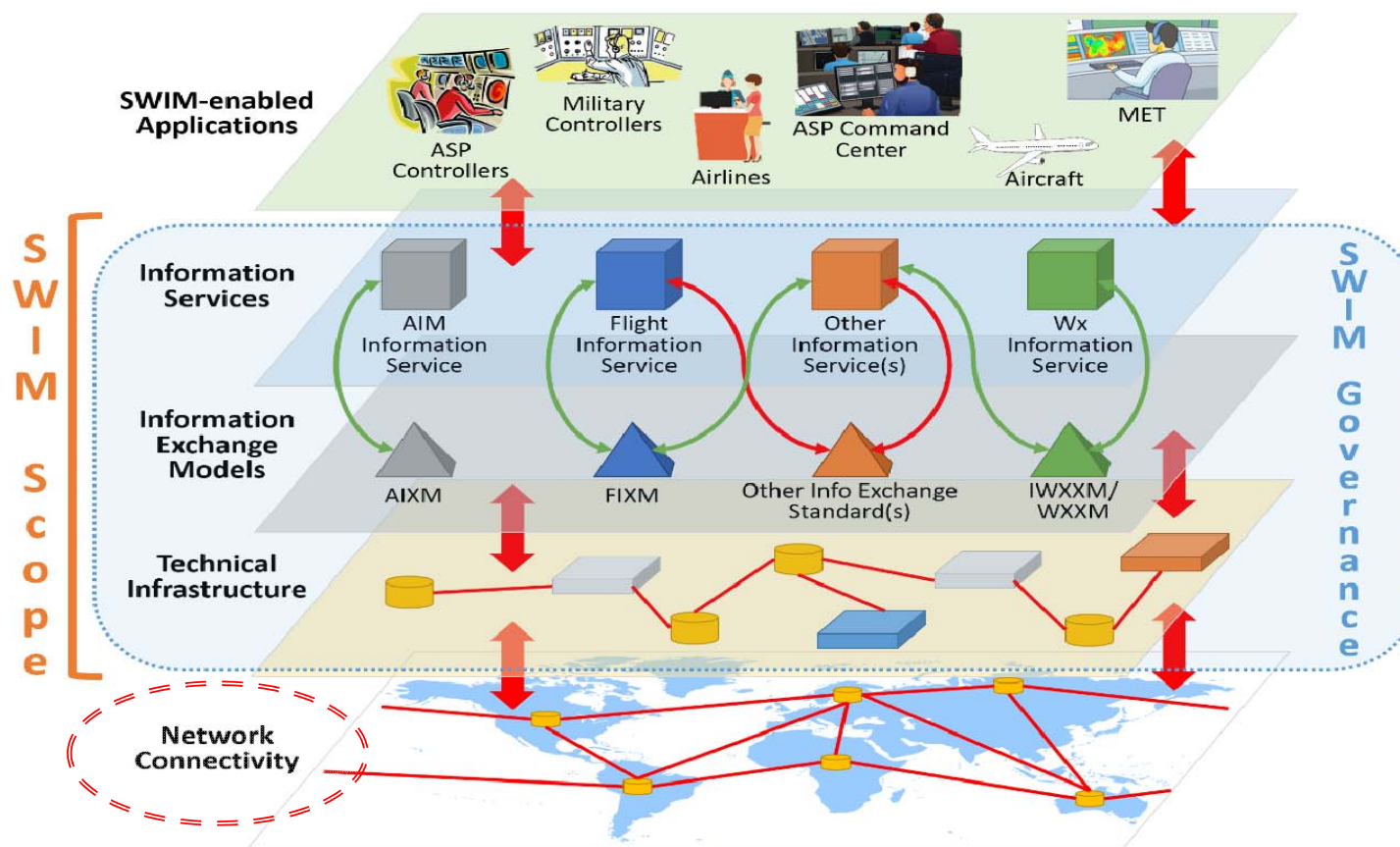


SWIM Components





Global Interoperability Framework (GIF)





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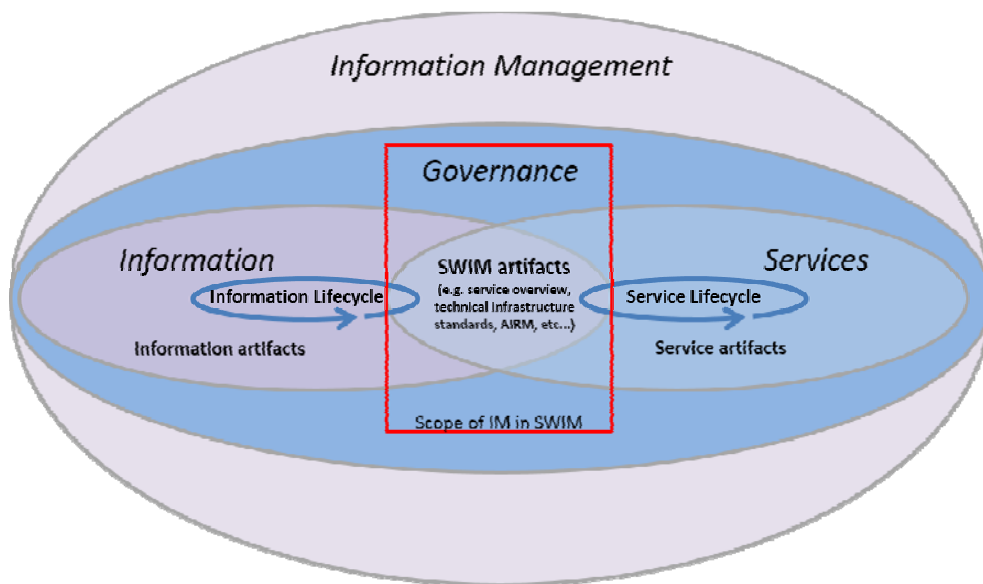
ATM Information Reference Model (AIRM)



ATM Information Reference Model (AIRM)

AIRM is a structured, traceable, unified, harmonized, common, digital representation based on standard modelling notation

The AIRM serves as a common reference model and content of record for ATM-specific information management artifacts.



The AIRM is used as a reference:

- For the common understanding of information and data exchanged through SWIM.
- To standardize SWIM information services.
- To define ATM related information (e.g. Exchange Models)



AIRM IS:

- ✓ A building block of the interoperability architecture
- ✓ Complementary to the exchange models (AIXM, FIXM, IWXXM) (but clearly delineated roles)
- ✓ A reference material based on ICAO SARPs
- ✓ To facilitate semantic interoperability
- ✓ Using an agreed set of international standards for basic types, such as free-text types, spatial types and temporal types to ensure that these common concepts are defined
- ✓ Independent of specific technologies, implementations, or other concrete details

AIRM IS NOT:

- × A database
- × An application
- × An exchange model



AIRM Structure

AIRM Contextual Model

general elements such as ATM Business Terms and publications which provide the scope

AIRM Conceptual Model

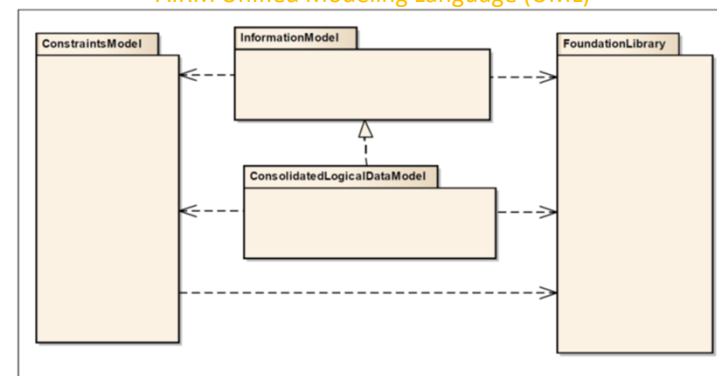
descriptions on a level that are generally understandable to a business user

AIRM Logical Model

detailed and structured elements needed to develop technical building blocks

Aircraft	Base Infrastructure	Meteorology
Air Traffic Operations	Flight	Surveillance
Airspace Infrastructure	"Common"	Stakeholders

AIRM Unified Modeling Language (UML)





Conceptual Model

RunwayDeclaredDistance

A conventional operational distance declared for a runway direction.

Source: EUROCONTROL-FAA AIXM v.5.1;

Status: Approved

urn: urn:x-ses:sesarju:airm:v420:ConceptualModel:Subjects:BaseInfrastructure:AerodromeInfrastructure:RunwayDeclaredDistance

Logical Model

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urn: urn:x-ses:sesarju:airm:v420:LogicalModel:Subjects:BaseInfrastructure:AerodromeInfrastructure:RunwayDeclaredDistance

Parent Class: TemporalEnabledEntity;

Properties:

Name	Definition
distance	The conventional operational distance declared for a runway direction.
distanceAccuracy	The accuracy of the value of a conventional operational distance declared for a runway direction.
type	The type of a conventional operational distance declared for a runway direction.
runwayCentrelinePoint	The runway centreline point marking the declared distance.

Type urn

ValDistanceType
CodeDeclaredDistanceType
SignificantPoint

ValDistanceType
The separation between two points.

Source: ISO 19103:2005;
Status: Approved
urn: urn:x-ses:sesarju:airm:v420:LogicalModel:DataTy

Parent Class: Measure;
Properties:

Name	Definition	Type	urn
uom	Unit of measure	CodeUomLengthType	

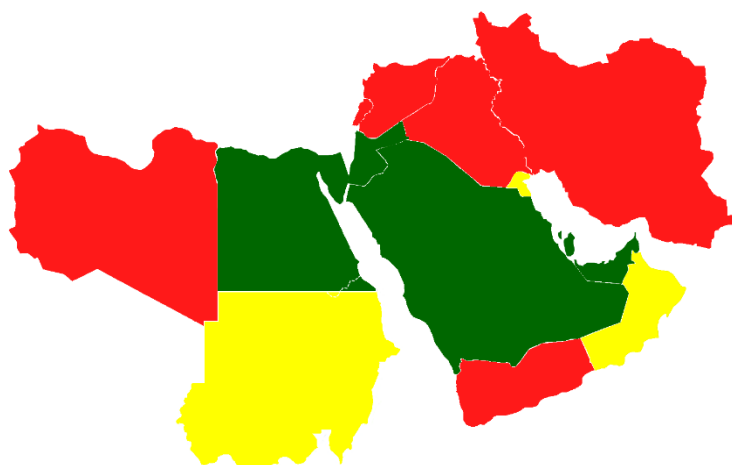


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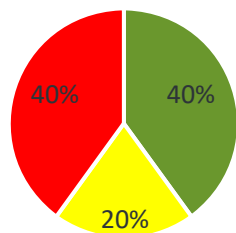
Status of Implementation of AIXM (EUR & MID)



AIXM Implementation in MID Region



Overall Status: 40%
6 States (out of 15)
3 States in Progress
(Ref. MID eANP)



State	Status	Remarks
BAHRAIN	Implemented	
EGYPT	Implemented	
IRAN	NI	
IRAQ	NI	
JORDAN	Implemented	Through EAD
KUWAIT	In progress	
LEBANON	NI	
LIBYA	NI	
OMAN	In progress	
QATAR	Implemented	
SAUDI ARABIA	Implemented	AIXM 5.1 in progress
SUDAN	In progress	
SYRIA	NI	
UAE	Implemented	
YEMEN	NI	

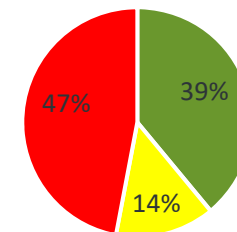


AIXM Implementation in EUR Region



State	Status	Remarks	State	Status	Remarks
ALBANIA	Implemented	AIXM 5.1 in progress	LITHUANIA	In progress	AIXM 5.1 in progress
ALGERIA	NI		LUXEMBOURG	In progress	
ARMENIA	Implemented	Through EAD	MALTA	NI	
AUSTRIA	In progress		MONTENEGRO	NI	
AZERBAIJAN	Implemented		MOROCCO	NI	
BELARUS	In progress		NETHERLANDS	NI	
BELGIUM	In progress		NORWAY	Implemented	
BOSNIA AND HERZEGOVINA	NI		POLAND	NI	
BULGARIA	Implemented	Through EAD	PORTUGAL	Implemented	
CROATIA	NI		REPUBLIC OF MOLDOVA	Implemented	
CYPRUS	Implemented	Through EAD	ROMANIA	NI	
CZECH REPUBLIC	In progress		RUSSIAN FEDERATION	NI	
DENMARK	NI		SERBIA	Implemented	Through EAD
ESTONIA	Implemented		SLOVAKIA	Implemented	
FINLAND	NI		SLOVENIA	Implemented	
FRANCE	Implemented	AIXM 5.1 in progress	SPAIN	NI	
GEORGIA	Implemented	Through EAD	SWEDEN	Implemented	
GERMANY	In progress		SWITZERLAND	In progress	
GREECE	NI		TAJIKISTAN	NI	
HUNGARY	Implemented		FYROM	NI	
ICELAND	NI		TUNISIA	NI	
IRELAND	NI		TURKEY	Implemented	Through EAD
ISRAEL	NI		TURKMENISTAN	NI	
ITALY	Implemented		UKRAINE	Implemented	
KAZAKHSTAN	Implemented		UNITED KINGDOM	Implemented	AIXM 5.1 in progress
KYRGYZSTAN	NI		UZBEKISTAN	NI	
LATVIA	Implemented	AIXM 5.1 in progress			

Overall Status: **39%**
 22 States (out of 56)
 8 States in Progress
 (Ref. EUR eANP)





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Update on AIXM

(by Eduard Porosnicu, EUROCONTROL)



V. 3&4 – for EAD (1998-2002)

- **AIXM 4.5 (2005)**
 - Entity/Relationship
 - Custom XML schema
 - Core AIP data
- **Usage**
 - European AIS Database (EAD) and European national systems
 - Around 20 other AIS national systems world-wide

V. 5 – for global digital AIM (2008)

- **AIXM 5.1(.1) (2010) (2016)**
 - UML model
 - Temporality Concept
 - GML schema
 - All aeronautical Information including Digital NOTAM
- **Usage**
 - see *AIXM Wiki*
(www.aixm.aero/confluence)





www.aixm.aero

AIXM
Aeronautical Information Exchange Model

Home Versions Usage and Implementation Support Governance Library About

Aeronautical Information Exchange Model

The objective of the Aeronautical Information Exchange Model (AIXM) is to enable the provision in digital format of the aeronautical information that is in the scope of Aeronautical Information Services (AIS). The AIS information/data flows that are increasingly complex and made up of interconnected systems. They involve many actors including multiple suppliers and consumers. There is also a growing need in the global Air Traffic Management (ATM) system for high data quality and for cost efficiency.

In order to meet the requirements of this increasingly automated environment, AIS is moving from the provision of paper products and messages to the collection and provision of digital data. AIXM supports this transition by enabling the collection, verification, dissemination and transformation of digital aeronautical data throughout the data chain, in particular in the segment that connects AIS with the next intended user.

The following main information areas are in the scope of AIXM:

- Aerodrome/Heliport including movement areas, services, facilities, etc.
- Airspace structures
- Organisations and units, including services
- Points and Nav aids
- Procedures
- Routes
- Flying restrictions

AIXM takes advantages of established information engineering standards and supports current and future aeronautical information system requirements.

This web site provides complete documentation for the AIXM versions in use, including information about coding guidelines, support for implementation and links towards other relevant resources.

LATEST NEWS

AIXM COMMUNITY

Forum | **AIXM**

- AIXM Forum - read only (*anonymous access*)
- AIXM Forum - post messages (*requires registration*)

AIXM/confluence

- Visit our collaboration area

GitHub

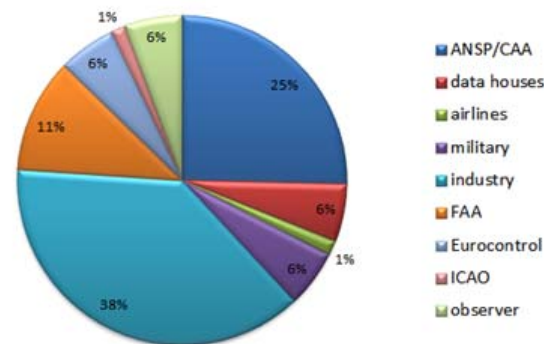
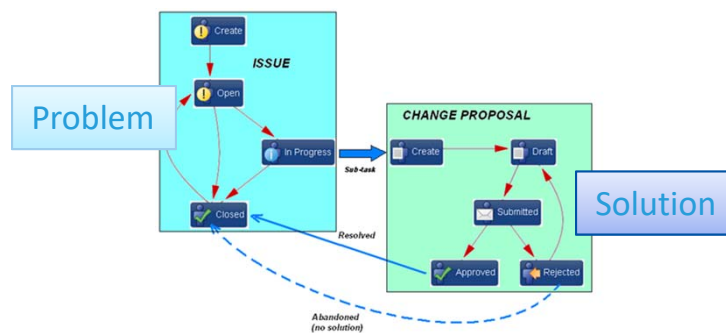
- Find AIXM related resources

QUICK LINKS

- AIXM 5.1 (UML navigator)
- AIXM 5.1.1 (UML navigator)
- ICAO AIS-AIMSG
- Open Geospatial Consortium (OGC)
- European Commission - ADQ Regulation 73/2010
- World Wide Web Consortium



- AIXM Change Control Board
 - Established based on the ICAO AIS-AIMSG recommendations
 - Regular reports to ICAO IMP
 - Membership implies acceptance of the Charter
 - <http://www.aixm.aero/page/governance>
 - Current distribution of members
 - 71 members from 51 organisations
 - including observers (FIXM)
 - FAA & Eurocontrol ensuring the secretariat and support



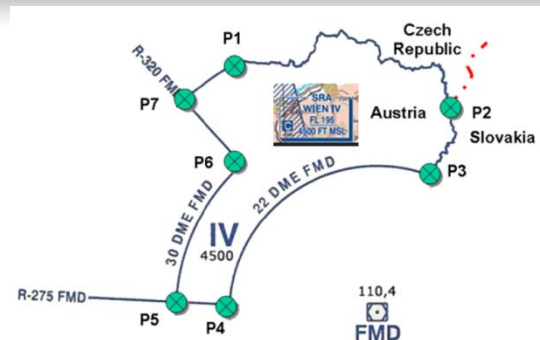


Dataset – Harmonized Coding Rules

- Revised Annex 15
 - Digital data sets

- AIP
- Obstacles
- Terrain
- Airport Mapping
- Instrument Procedures

www.aixm.aero/confluence



AXM Spaces

AXM (ICAO) AIP Data Set

Pages

SPACE SHORTCUTS

- <http://www.aixm.aero>
- AXM Coding - Overview

PAGE TREE

- Introduction
- Copyright notice
- Mapping PANS-AIM AIP Data Set to AXM
- Coding Guidelines
- Interoperability rules**
 - Format and distribution
 - AXM version
 - Common ICAO AIP Data Subset
 - Allowed feature types
 - Baseline data and updates

Pages / Overview

Interoperability rules

Created by EDUARD POROSNICU, last modified on 13 Sep 2017

Why necessary

Interoperability of systems using AXM is dependent on the definition of a **use case**

By design, AXM 5.x has the ability to support a variety of use cases, such as data origination, charting, static data coding, Digital NOTAM, etc. However, this required a certain openness to be embedded in the model. For example, there are no mandatory feature properties, no predefined feature keys (both natural and artificial keys can be used), etc. For a specific use case, such as provision by States of the ICAO Data Sets, this openness needs to be constrained with rules that limit the coding possibilities and ensure that the data is actually fit for the intended use. For example, AIP Data Sets are expected to be published by State AIS in accordance with the Annex 15 / PANS-AIM provisions. The level of coordination with the neighboring States can range from none to full coordination. By lack of coordination or due to operational needs, some data might be duplicated in the data sets provided by different States.

The objective of the interoperability rules identified here is to ensure that the end users, in particular data integrators, are able to **seamlessly merge the digital data coming from different States**. These rules also ensure that **States can exchange between themselves** the AIP and the other digital data sets specified by ICAO Annex 15.

Similar to the data coding rules, most of the interoperability rules can also be formulated as AXM Business Rules, using SBVR. This enables to verify a particular data set for compliance with these rules, both on the data providers and on the data user sides.

Key assumptions

It is assumed that the purpose of the AIP Data Set is to ensure as a minimum the static data necessary for efficiently and safely execute the following operations:

Rules and Recommendations

The following topics are subject to specific interoperability rules

- Format and distribution
- AXM version
- Common ICAO AIP Data Subset
- Allowed feature types
- Baseline data and updates
- CML Profile
- Minimal Metadata Requirements
- Feature identification and reference
- Use of nilReason
- Use of extensions
- Use of OTHER values
- Annotations with purpose 'WARNING'
- Other rules
- XML Usage Limitations
- Conformance testing



- Objectives:

- to enable the **provision of ICAO data sets** (except for terrain data), as specified in the new Annex 15 and PANS-AIM. This includes the development of guidance material for the provision of the data sets and of the associated metadata in a globally interoperable manner;
- to enable an initial global **implementation of Digital NOTAM**, including support for the new Runway Condition Report that becomes applicable in NOV 2020;
- to enable the provision of data that supports the deployment of “**performance based**” **ICAO concepts, such as PBN**, etc.
- to enable data provision for emerging concepts such as **free routes, large-scale use of RPAS**, etc.
- to ensure the **interoperability** of aeronautical data (AIXM) with flight data (FIXM) domain and with the MET data (iWXXM) domain;
- to introduce a **deprecation mechanism** for features/properties that are no longer used or are replaced by a new concept. A common approach with AIXM and FIXM is envisaged.
- to **correct issues and limitations** detected in the previous versions.



- Objectives:

- alignment with the ICAO SWIM requirements as developed by the ICAO Information Management Panel;
- enable the provision of new aeronautical data elements specified by ICAO, in particular in support of FF-ICE;
- enable the provision of aeronautical data in support to future ATM concepts, such as time based operations (TBO);
- ensure the interoperability of aeronautical data (AIXM) with the evolving needs of the flight data (FIXM) and MET data (iWXXM);
- correct issues and limitations detected in the previous versions;
- provide Guidance material for the implementation of AIS data services compliant with the SWIM concepts.



- ICAO Doc 9750 (Global Air Navigation Plan)
- ICAO Doc 10039 (Manual of SWIM)
- EUR eANP
- MID eANP
- www.eurocontrol.int
- www.airm.aero
- www.aixm.aero



- Data exchange/interoperability is a challenge that should be taken into consideration.
- Delay in the implementation of Block 0 Modules (B0-DATM).
- Availability of Global SWIM Provisions and guidance
- Data security/cyber security is a challenge that needs to be considered.



Recommendations

- Development of digital datasets is important to achieve interoperability and implement SWIM.
- Data exchange/interoperability be addressed by relevant bodies/Industries.
- Availability of Global SWIM Provisions be expedited.
- States/Stakeholders are encouraged to contribute to further SWIM developments, support global harmonization and standardization of SWIM;



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