

# The ATM Digital Ecosystem

**D-AIM D-NOTAM - ATCFM solution** 

The new horizon based on SWIM

Date: XX/XX/2024

**ICAO NACC** 

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group





The aviation industry is undergoing a transformative leap into an era defined by the convergence of digital infrastructures, shaping the future of air traffic management marked by hyper-connectivity, and data-centric systems.

This challenge calls for a collaborative effort to navigate together through the goal of innovation in the Aviation Digital Ecosystem – where aircraft, airport operations and air traffic management are all inter connected. And when we break this down a bit further, we can see more clearly how these connections all play a role in improving the operational efficiency, sustainability, and more.

## Main Driver for Strategic evolution (2020-2035)



- European Capacity & Resilience challenge
- Airspace Architecture Study (AAS) and related Transition Plan
- **Decoupling** of service provision from local infrastructure
  - **Digital transformation** (not limited to ATFM DCB): new infrastructure allowing air traffic and data service providers, irrespective of national borders, to plug in their operations where needed
  - Virtual centres implementation and delegation of ATS services
  - Changes in the way that technologies are developed and deployed, as well as in the way services are provided.
  - Improved interoperability Levels: SOA/microservices approach, SWIM adoption, open standards
  - New business models: ATM data distribution services: certified private service providers and ANSPs (e.g. ATFM
  - ADSP, FDP Services)
- Subscription to public-service cloud-based data service (CCS)
- Al intelligence and incresed automation levels (e.g. Weather on Capacity service, TMI)

## Main Driver for Strategic evolution (2020-2035)









Future architecture of the European airspace

European AAS & Transition Plan

Transition plan

#### iNM CFT Eurocontrol

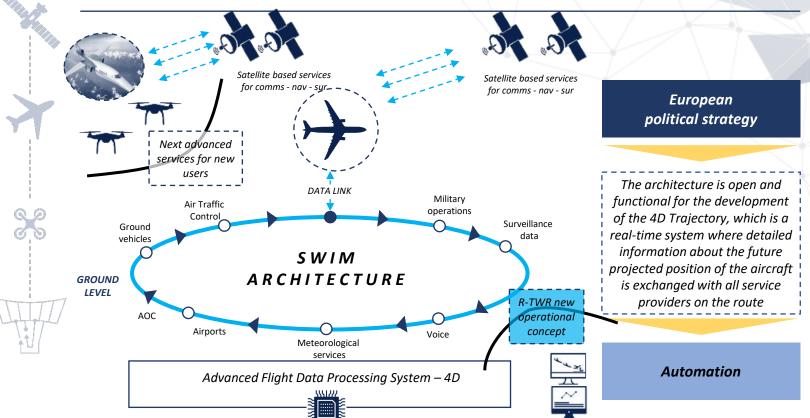




# The technology infrastructure is a fundamental enabler for the development of the automation among the services in the digital ecosystem of ATM industry



ATM technology infrastructure target model

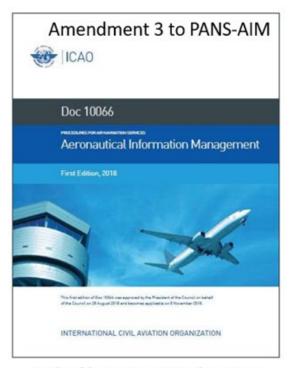


Source: EUROCONTROL, SESAR JU

#### STANDARD FORMATS HELPS INTEROPERABILITY

. . .





Applicable on 28 November 2024

Appendix 2

CONTENTS OF THE AERONAUTICAL INFORMATION PUBLICATION (AIP)

PART 1 - GENERAL (GEN)

GEN 3. SERVICES

Editorial Note. - Insert new section.

GEN 3.7 Information services

GEN 3.7.1 System-wide Information Management (SWIM) Registry(ies)/Information Service Overview(s)

When SWIM registries are used, the corresponding Uniform Resource Locator (URL) of each registry is provided. Otherwise, a list of the URLs where information service overviews can be found is provided.

Note.— SWIM registries provide a list of available information services with corresponding information service overviews.

## SWIM - Mapping with IDS AIRNAV SOLUTIONS vs CP1



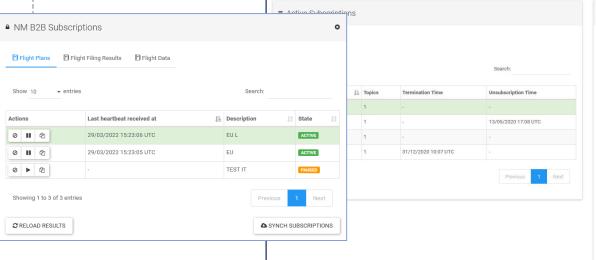
1	SWIM Families	IDS AirNav Solution
	5.3.1 - Aeronautical Information Exchange	<ul> <li>Data Distribution Services for:</li> <li>Aeronautical Feature Services</li> <li>Aerodrome Mapping Services</li> <li>CRONOS for:</li> <li>Digital NOTAM</li> </ul>
3	5.4.1 - Meteorological information exchange	CRONOS & UBIMEX (iWXXM support)
	5.5.1 - Cooperative network information exchange	B2B Gateway (NM Integration) CRONOS Evolution (FF-ICE support)
	5.6.1 - Flight Information Exchange	B2B Gateway (NM Integration) CRONOS Evolution (FF-ICE support)

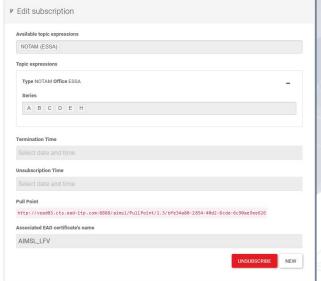
## **SWIM – CRONOS Interoperability**



#### **CRONOS** allows integration with SWIM services like:

- EAD AIM-SL > for communication and exchange of "dynamic" aeronautical information (TAM) with EAD
- EAD PAMS > for the download of Aeronautical Information Publications and Charts from EAD
- Eurocontrol NM B2B > for the preparation, filing, and management ATS packages by means of Network Manager B2B
- **SWIM over AMHS** > for the exchage of the IWXXM packages using X.400 with FTBP





## **CRONOS Flight Plan Module and Eurocontrol NM B2B**



an enav group company



- Flight Plan Preparation services help an Airspace User to request the most efficient Flight Trajectory, based on criteria such as
  - Distance
  - Fuel
  - Charges
  - Duration
  - operational airspace structure
  - Airspace availability: actual traffic synchronization
  - Callsign de-confliction
- <u>Flight Plan Filing</u> services help an Airspace User to request the proper addressing and distribution
- Flight Plan Management regulates the effective operation start







- Route Assistance
- Validate FlightPlan
- Propose Routes



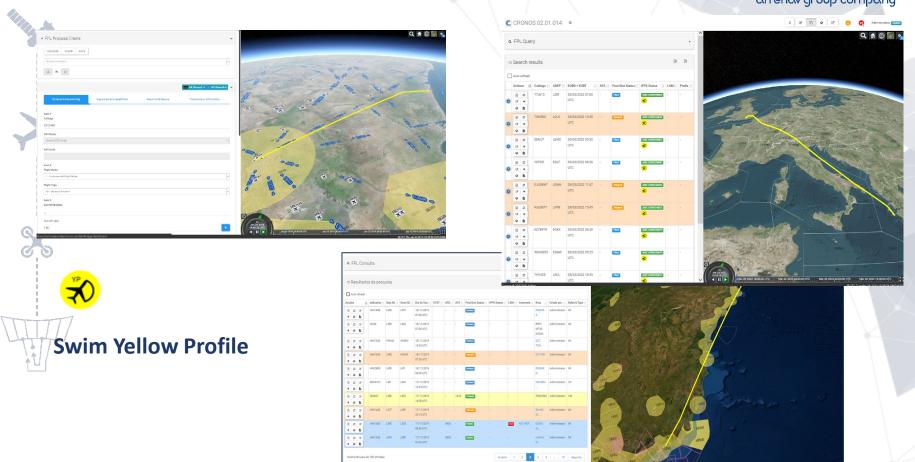
- File New Flight
- File Flight Updates
- Retrieve Filing Status



- Query Flights by Keys
- Retrieve Flights
- Submit Flight Confirmation
- Slot Improvements

## **CRONOS Flight Plan Module and Eurocontrol NM B2B**

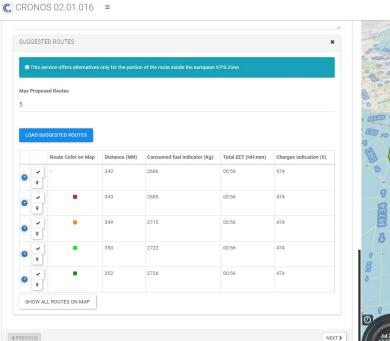


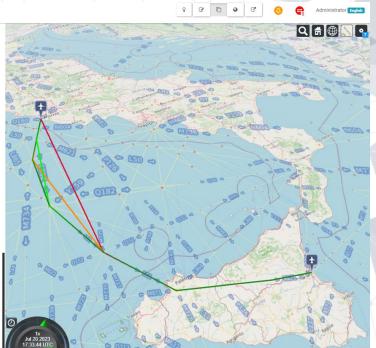


## **CRONOS / Eurocontrol NM Service interoperability**



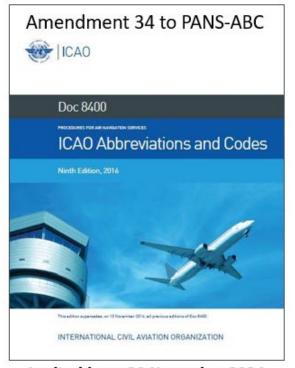






## Flight Information Exchange (CP1 AF5.6.1)





Applicable on 28 November 2024

E

eFPL Filed flight plan exchanged via flight and flow — information for a collaborative environment (FF-ICE) services

F

FPL Filed flight plan exchanged via aeronautical fixed service (AFS)

Preliminary flight plan

#### THE NOTAM CODE — DECODE

WG Glider flying, paragliding or hang gliding gld fly/paragliding/hang gliding

...

WP Parachute jumping exercise, paragliding or hang gliding pje/paragliding/hang gliding



PFP

## **SWIM/FF-ICE** services and CP1



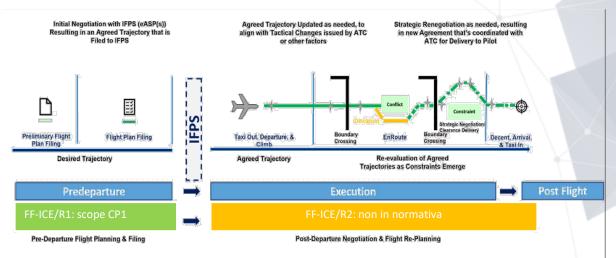
The Release 1 (FF-ICE/R1) refers to the pre-flight phase and includes:

- The submission of the flight plan in the new eFPL format (after a validation by the AUs)
- The distribution services of the flight plan and related updates, which will have to be implemented by the ATM operating systems (primarily FDP)

The CP1 regulation introduces the requirements for the implementation of FF-ICE R1 services:

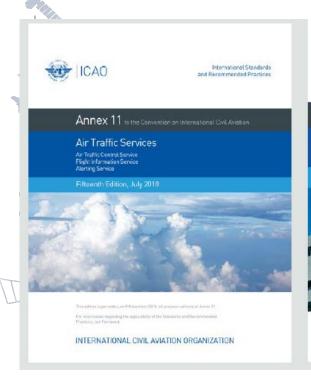
- regulating the use of certain services by the Stakeholders, including the ANSPs and the operational use of the data acquired
- First phase of the transition from ICAO FPL 2012 to eFPL

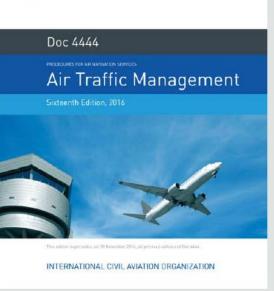
The Release 2 (FF-ICE/R2), provides for exchanges of information in the "execution" phase and "strategic" negotiation of the flight plan. It's not in the scope of CP1



## **Traffic complexity and ATCFM measure**





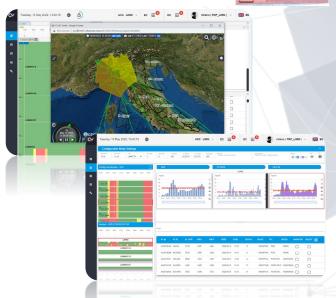




## **Traffic complexity Tool – Main functionalities**

- 3.1.2 Management of predefined airspace configurations
- 4.1.1 Enhanced Short Terms ATFCM Measures
- 4.3.1 Automated Support for Traffic Complexity Assessment
- Provides updated information on demand status for each sector configuration basing on traffic from local systems (FDPs\*) or remote systems (NM B2B services, A-CDM\*);
- Provides ranked configurations of ACC room considering rostering, traffic and airspace availability;
- Identify and select ATFCM measures to manage traffic volumes flights;
- Estimate traffic complexity within sector in selected timeframe





# IDS AIRNAV Solution NOTAM – D-NOTAM to support CP1 requirements AF 5.3.1





#### **Traditional NOTAM Management System**

- NOTAM, OPMET, FPL management & dissemination
- minSDO AIXM Database
- Briefing Functionality
- High Availability & Replication
- AMHS / AFTN Interface



#### **Digital System**

- Digital NOTAM management
- Full SDO AIXM5.1
- FIXM in FPL management
- Advanced Briefing
- SWIM interfaces

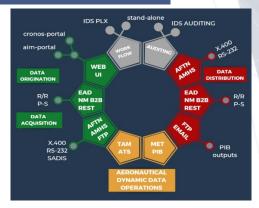








- Quality on NOTAM Proposal (ADQ)
- Advanced Briefing Functionality
- AIXM FIXM iWXXM
- SWIM AMHS AFTN networks
- High Availability Architecture
- Dual Environment

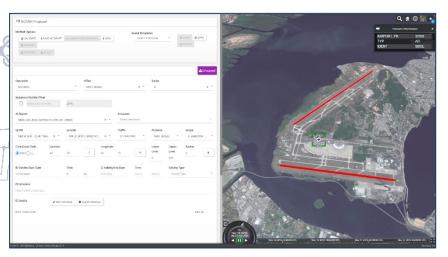


All Rights Reserved

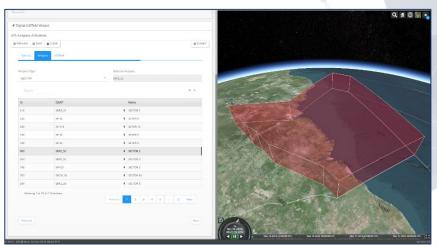
## **TAM Capabilities – AF 5.3.1 compliant**



- Dual Environment for traditional and D-NOTAM
- NOTAM Proposal Approval Process
- NOTAM Dissemination via different channels
- TAM lists, querying and reporting
- Templates management
- Replacement and Cancelation
- ICAO Rules and data consistency validation
- SDO Linkage
- Auditing and traceability



- Aeronautical Event Approval Process
- D-NOTAM Dissemination
- D-NOTAM Event Lists, Querying and Reporting
- Scenarios Formats
- Eurocontrol Rules
- Event AIXM51 > TAM conversion
- Auditing and traceability
- Collection & Distribution via AFTN, AMHS, or Publish-Subscribe
- Web GIS visualization of Aeronautical Data



### **CRONOS TAM Module**



# Global Reporting Format (GRF) Digital Operational Reporting Information System

Easy Access Rules for Aerodromes
Reporting of the Runway Surface Conditions

Publication Date: Aug 12th 2022



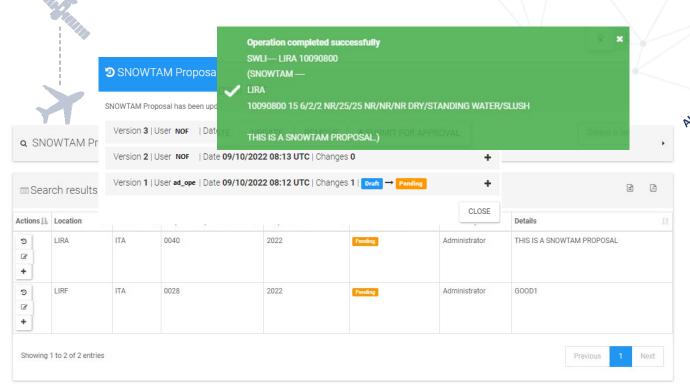


EU Reg. no. 139/2014



#### **CRONOS TAM Module**

## **Global Reporting Format (GRF) Workflow**





## MET Capabilities – AF 5.4.1

IDS Air Nav

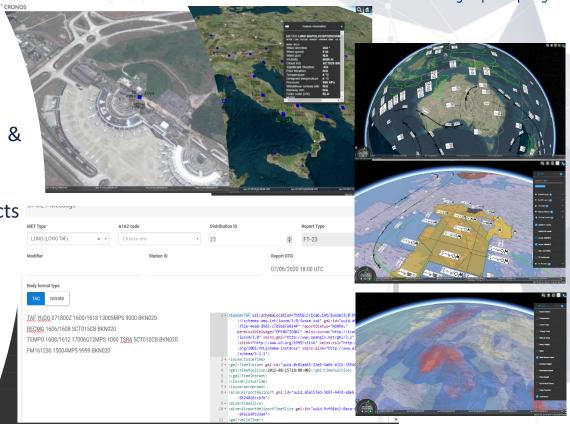
OPMET – TAC from AMHS, AFTN

OPMET – IWXXM from SWIM Gateway

OPMET automatic bulletin collection & distribution

Storage and visualization of MET Products





#### **INTEGRATED BRIEFING ... NOT ONLY FOR AIS-TAMS**





#### AERONAUTICAL INFORMATION SERVICES

Pre-Flight Information Bulletin

Aeronautica Militare Italiana

Profice di Mare

Report Name ARANCINO (LICC-LSGG)
Report Type STANDARD ROUTE
Service Type FULL
Message types: OPMET, CHARTS

Validity (UTC) 15 DEC 2021 08:58 - 15 DEC 2021 10:58 Height Limits (lower/ First: 100/340 Other: 000/340 Last: 000/340

upper) Route

Departure Aerodrome LICC
Arrival Aerodrome LSGG
Alternate Arrival LFLS - LOWI

Aerodromes

Alternate En-Route
Aerodromes

LIBV - LIRF - LIPC - LIPS

En-route FIRs LIRR - LIMM - LFMM - LSAS - LOVV - LIBB

#### AERODROME (DEPARTURE): LICC (CATANIA/Fontanarossa)

#### ME

METAR LICC 150920Z 23005KT 200V260 CAVOK 13/08 Q1023=

TAF LICC 150500Z 1506/1606 VRB06KT CAVOK=

#### AERODROME (ARRIVAL): LSGG (GENEVE)

#### MET

METAR LSGG 150850Z VRB01KT 0500 R04/0700N R22/0650N FG VV002 02/02 Q1031 NOSIG=

TAF L8GG 1508252 1509/1615 VRB02KT 0400 FG VV001 TX03/15142 TX00/16082 TX04/16142 BECMG 1510/1513 3000 BR 0VC008 PROB30 1515/1520 6000 BRN012=

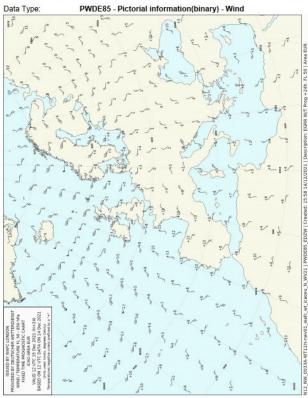
#### AERODROME (ARRIVAL ALTERNATE): LFLS (GRENOBLE ISERE)

#### ME

METAR LFLS 150900Z AUTO 00000KT 6000 NSC M00/M00 Q1029 NOSIG=

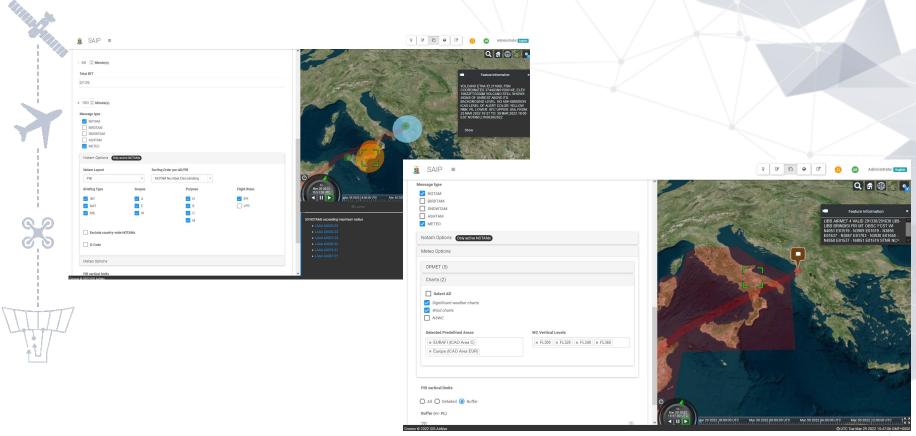
Data Type: PGDE15 - Pictorial information(binary) - Significant weather SIGWX





## **DIGITAL BRIEFING ... NOT ONLY IN PAPER FORMAT**





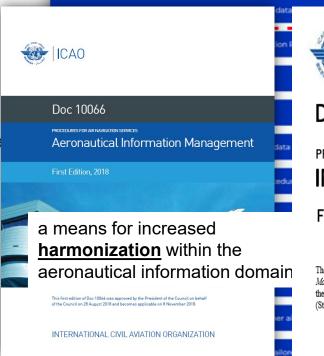


## Global Air Navigation Plan



Digital Aeronautical Information Management (DAIM)







Doc 10199

PROCEDURES FOR AIR NAVIGATION SERVICES

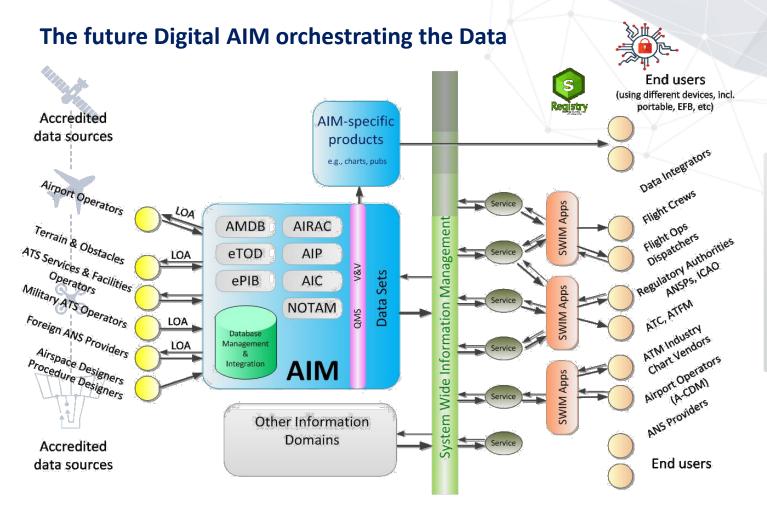
#### INFORMATION MANAGEMENT

First Edition, 2024

The first edition of the Procedures for Air Navigation Services — Information Management (PANS-IM, Doc 10199) contained in this document was approved by the Council of ICAO on 18 March 2024 for applicability on 28 November 2024. (State letter AN 2/36.1-24/39 refers.)

DAIM-82/5

NOTAM replacement





#### Certificate



#### Digital data Exchange : AIM portal







**Automatic Change Request creation** 

from AIXM5.1 file

midesignator>BIAR AFIS</aixmidesignator

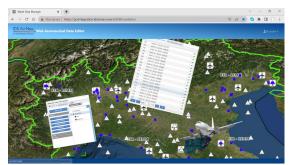


caixm:AirspaceLayerClass gml:id="uuid.13e6e5b2-e12e-477c-8329-a98530784236"



#### WADE

- Aeronautical Data editor
- Access to AeroDB for visualization and data editing
- Integrated WF, task processing and management
- → Automatic generation of data changes from file
  - Import/export AIXM5.1 data

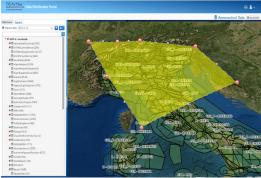






#### **Data Distribution Portal/Service**

- → GIS Data distribution
   filtering & Export
   AIXM5.1, AIP Data Set
- Integration with service distribution (SWIM)



## Benefits for AIS/AIM using AIXM via SWIM



Functions	Possible improvements	Potential benefits
Digitalization of aeronautical information	Automate the processing of NOTAM (Notice to Airmen) information	<ul> <li>Automate coordinate tracking on the ASD and trigger alerts/notifications from digital NOTAMs to improve safety and efficiency.</li> </ul>
	Improve training scenarios and simulations	<ul> <li>It uses AIXM data to create realistic training scenarios for pilots and ATCs, improving their readiness through simulated environments that reflect real-world conditions.</li> </ul>
Close interaction between unmanned aerial systems (new entrant UAS) and ANS service providers	Real-time communication of airspace constraint states for UAS operations beyond line of sight (BVLOS)	<ul> <li>Automated sharing of airspace constraints in real-time with UAS operators to manage operations safely without receiving positive air traffic control</li> </ul>
Exchange of digital information  Dataset, Integrated Briefing and Exchange of aeronautical information through electronic charts	Standardized aeronautical data format, optimized cross-system data exchange, real-time data sharing, and Efficient integration of data into electronic charts from different sources.	<ul> <li>It improves aviation safety and efficiency by simplifying data exchange and providing up-to- date aviation information to pilots and aircraft operators. Ensure accurate and timely presentation of aeronautical data through simplified map data integration.</li> </ul>

## **Benefits for ATMs using FIXM via SWIM**



Data Elements	Areas for improvement
Calculated Take-Off Time (CTOT)	<ul> <li>Optimize CTOT sharing within a SWIM environment to improve business continuity, asset management for airport operations, airspace users, passengers, and ATC operations, resulting in improved ATFM compliance and outcomes.</li> </ul>
Calculated Time (CTO)	<ul> <li>CTO enables flexibility of routes and reduces waiting patterns, resulting in reduced delays, fuel consumption, greenhouse gas emissions, and operating costs. In a SWIM environment, seamless sharing of CTOT ensures greater compliance and better ATFM outcomes.</li> </ul>
Target Off Block Time (TOBT)	<ul> <li>Accurate TOBT forecasts improve the passenger experience and reduce taxiway congestion Predictable and less stressful journeys, fewer delays, and minimized risk of aircraft delays due to taxiing.</li> </ul>
Target Take Off Time (TTOT)	<ul> <li>Use TTOT in a SWIM environment for precise sequencing of starts, reduced runway congestion and fuel consumption, and improved ATFM compliance and results. Share TTOT seamlessly to extend tactical planning for short-haul flights, further improving ATFM compliance and outcomes</li> </ul>
GUFI vs Callsign	<ul> <li>The ICAO alphanumeric callsign can be easily used by the ANSP and the airport operator uses the IATA callsign by referring to a common GUFI</li> <li>This improves in-flight safety by reducing the similar-sounding call sign without manually referencing flights from the ICAO alphanumeric call sign to the IATA call sign</li> </ul>

## Benefits for Aeronautical Met using IWXMM through SWIM



Data Elements	Areas for improvement
Terminal Aerodrome Forecast (TAF)	<ul> <li>Operational contingencies: Airlines use TAF for contingency planning. If a significant weather event is forecast, airlines can prepare for potential diversions, alternative routes, or additional fuel reserves</li> <li>Optimal Altitude Selection – TAF includes data on predicted cloud heights and turbulence levels, helping flight crews select the optimal cruise altitude for a smoother and more fuel-efficient flight</li> </ul>
Significant Weather Information (SIGMET)	<ul> <li>Integration with cockpit systems: Aircraft equipped with advanced avionics systems can receive and display SIGMET information directly in the cockpit, allowing pilots to make real-time decisions based on the latest weather data</li> <li>Precise geographic information: SIGMETs include precise geographic coordinates and altitudes where hazardous conditions occur, allowing pilots and ATC to accurately pinpoint affected areas</li> </ul>

## CP1 AF-5 (SWIM): FF-ICE and eFPL



- The AF-5 family defines the requirements for the use of the Network Manager's (NM) FF-ICE services
- ANSPs are impacted by the use of Extended Flight Plan (eFPL) data in their operating systems
- The eFPL is a new flight plan format, based on the FIXM data model and accessible through NM's B2B services.
- When fully operational, the eFPL will replace the use of the ICAO FPL 2012 (no date has yet been set for the decommissioning of the old format)

ANSPs need to upgrade their ground systems to process and receive eFPL, but also to make operational use of it

In particular, for ANSPs, the use of 3 B2B services of the NM is envisaged:

- **Publication Service:** allows you to obtain the FF-ICE flight plan, based on specific filters on events
- Flight Data Request Service: Allows you to obtain information about a particular FF-ICE flight plan
- Notification Service: B2B NM service that supports sending notifications of flight-related events (currently departure and arrival events only)
- .. and for AROs
- Filing Service: allows the submission of the flight plan in eFPL format

**Deadline 31/12/25** 

## Conclusion



To improve information sharing in an increasingly data-rich environment, it is necessary to improve the conventional system of information sharing:

- FPL2012 -> eFPL FF-ICE
- AFTN, FIXM, AIXM, and IWXXM email exchanges via SWIM

Collectively, improve the accuracy of data sharing among aviation stakeholders to enable insight into trajectory-based operations (TBOs) and gate-to-gate optimization

## **CRONOS** implementations







## Achievements and plan with our customers



→ September 2022:

CRONOS Flight Module and its SWIM B2B service interface received Technical Acceptance by Eurocontrol Network Manager

- → Italian Air Force deployment of «SAIP» platform as enabler for internal re-organization (FPL & NOTAM management system)
- → ENAV went live with Notam / D-NOTAM February 2023







NM B2B WEB SERVICES - USE CASES

**Business documentation for Flight Plan Filing** 

## **IDS AIRNAV CRONOS – SWIM program**



#### LFV ISAVIA NAVIAIR ADQ 15 - L-CAPS:

- commissioning of NOTAM, OPMET, Briefing system:
- fully Integrated aeronautical dynamic data management system
- Interoperable with IDS PLX, AeroDB, Auditing, Identity Manager
- REST API for other services' interoperability
- **AFTN** Interface
  - NOTAM, OPMET, PIB modules
- Integrated with ECTRL-Network Manager
- PIB Library EAD AIMSL integrated
  - Min-SDO Geography import from AIXM5.1

#### **AVINOR N-AIS replacement and SWIM program:**

- commissioning of NOTAM, OPMET, Briefing system:
- fully Integrated aeronautical dynamic data management system
  - REST API for other services' interoperability
- **AFTN** Interface
- **NOTAM, OPMET, PIB modules** 
  - **Integrated with ECTRL-Network Manager**
- PIB Library EAD AIMSL integrated
  - Min-SDO Geography import from AIXM5.1













# Information Management as a component of the future ATM Operational Concept











**ATM** 



UTM

#### Air Traffic Management

- CNS/ATM/MET systems
- ATC Simulation systems

#### **Ummanned Traffic Management**

Solution for UTM Management

#### Air Traffic Flow Management

- Demanding/Capacity Balance
- Sectorization

#### Airspace Management

Civil/Military Coordination

#### **Aeronautical Information Management**

- NOTAM-D-Notam ,FPL,MET,PIB
- SWIM

**ASM** 

**ATFM** 

AMHS

#### **Aeronautical Information Services**

- Aeronautical Charting/Publishing
- Flight Procedure and Airspace Design

#### **Aeronautical**

- Airspace Design/Management
- Flight Procedure Design
- Feasibility and Master Plan
- Safety & Security Services
- Aeronautical Publication

### Services

#### Engineering

- CNS/ATM System Inst.
- Solution Customization
- Validation/Testing
- System Integration
- On site Support



**AIM** 





# THANKS FOR YOUR ATTENTION

