



| ICAO CAPACITY & EFFICIENCY

Session 1

ICAO SARPS, DOCUMENTATION AND GLOBAL AND REGIONAL PLANS REGARDING  
THE IMPLEMENTATION OF AERONAUTICAL SURVEILLANCE AND AUTOMATED  
SYSTEMS FOR ATS OPERATIONS

# ICAO ASBU Implementation/ Surveillance and ATS Automation

**CAR/SAM Seminar/workshop on implementation of advance surveillance and automated  
systems**

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## Overview

- ✈ Air navigation implementation overview
- ✈ ASBU implementation overview
- ✈ Surveillance related ASBU modules
- ✈ Automated System related modules
- ✈ eANP CAR/SAM Volume III



# Air Navigation Implementation Overview





## Air Navigation Implementation Overview

### Global ATM Operational Concept Air Navigation Implementation Overview

### Global ATM Operational Concept

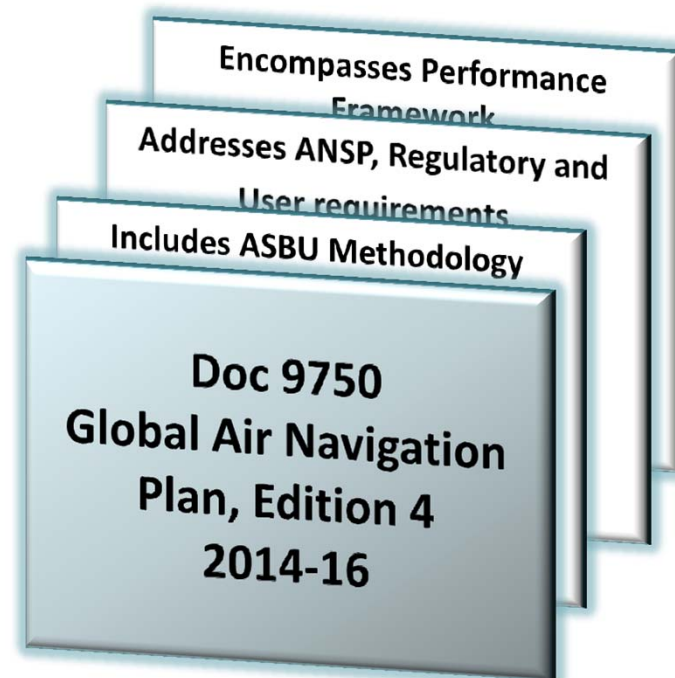
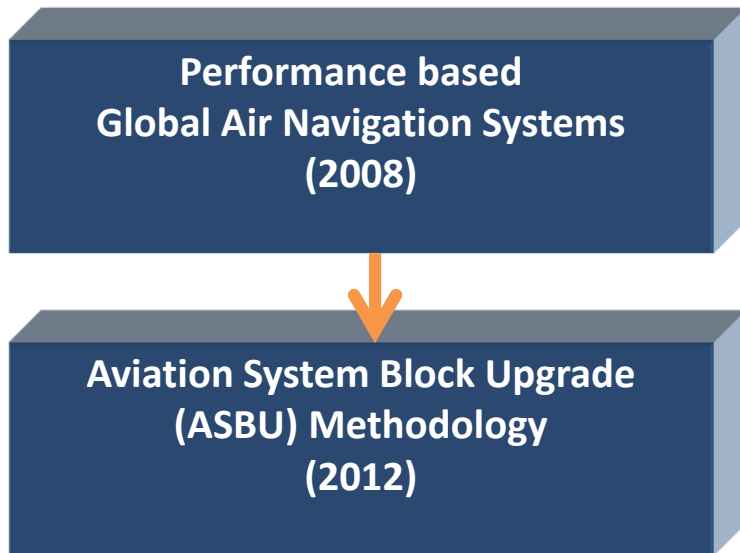
- ✈ The Global Air Traffic Management System Operational Concept;
  - ✈ describes how an integrated global air navigation system should operate
  - ✈ describes what is envisaged on the basis of services
  - ✈ describes how the services form an integrated system
  - ✈ utilizes an information rich environment, that solves most problems strategically, through a collaborative process
  - ✈ provides States and industry with clearer objectives for the design and implementation of ATM and supporting CNS systems
  
- ✈ ATM user expectations are drivers for change, requiring:
  - ✈ Safety case
  - ✈ Business case



**Technical Enablers**  
**Operational Enablers procedures**  
**Socio-economic Enablers**



# Air Navigation Implementation Overview





## Air navigation implementation overview

### ANConf/12 references

#### ✈ Recommendation 1/4 –Architecture

- ✈ ICAO to develop, for inclusion in the first update of the Global Air Navigation Plan (GANP) after the 38th Session of the ICAO Assembly, a global air traffic management logical architecture representation in support of the GANP and planning work by States and regions; and develop a breakdown of the logical architecture of the ground system to the level needed to best address the global interoperability issues.

#### ✈ Recommendation 1/11 – Automation roadmap

- ✈ ICAO to develop a global roadmap for the evolution of ground air traffic management automation systems in line with aviation system block upgrade implementation and develop performance-based system requirements for air traffic management automation systems.



## Air navigation implementation overview ANConf/12 references

### Recommendation 1/7 – ADS-B

That States:

- a) recognize the effective use of ADS-B and associated communication technologies in bridging surveillance gaps and its role in supporting future trajectory-based air traffic management operating concepts, noting that the full potential of ADS-B has yet to be fully realized;
- b) recognize that cooperation between States is key towards improving flight efficiency and enhancing safety involving the use of automatic dependent surveillance — broadcast technology; and

That ICAO:

- c) urge States to share ADS-B data to enhance safety, increase efficiency and achieve seamless surveillance

### Recommendation 1/9 – Space-based ADS-B

That ICAO:

- a) support the inclusion in the GANP, development and adoption of space-based ADS-B surveillance as a surveillance enabler;
- b) develop Standards and Recommended Practices and guidance material to support space-based automatic dependent surveillance — broadcast as appropriate; and
- c) facilitate needed interactions among stakeholders, if necessary, to support this technology.



## Air navigation implementation overview

### ANConf/12 references

#### Recommendations in support of the Global System-wide Information management (SWIM):

- REC 3/1 ICAO ASPM relative to performance improvement through
- REC 3/2 Develop
- REC 3/4 States an
- REC 3/8 States improvement through information

Industry to support the transition towards system-wide information management by providing appropriate systems supporting automation and the exchange of all relevant air traffic management data in a globally standardized manner; and States and all relevant stakeholders to contribute to further development and harmonization of performance-based information management.

#### Recommendation 6/1 – Regional performance framework – planning methodologies and tools

- That States and PIRGs:
- a) finalize the alignment of regional air navigation plans with the *Global Air Navigation Plan* (Doc 9750, 4);
  - b) initiating aviation system block upgrade Block to their operational needs, recognizing are ready for deployment;
  - c) as the primary tool to assist in the the agreed regional planning framework services and facilities;
  - d) **and industry personnel** during all stages of planning and implementation of aviation system block upgrade modules;
  - e) develop action plans to address the identified impediments to air traffic management modernization as part of aviation system block upgrade planning and implementation activities;





## Air navigation implementation overview

3th Edition

**Global Air Navigation Plan (Doc 9750)  
(GPI-9) SITUATIONAL AWARENESS**

Enhanced  
surveillance  
techniques (ADS-C  
or ADS-B)



reductions in separation minima and an  
enhancement of safety

increase in capacity

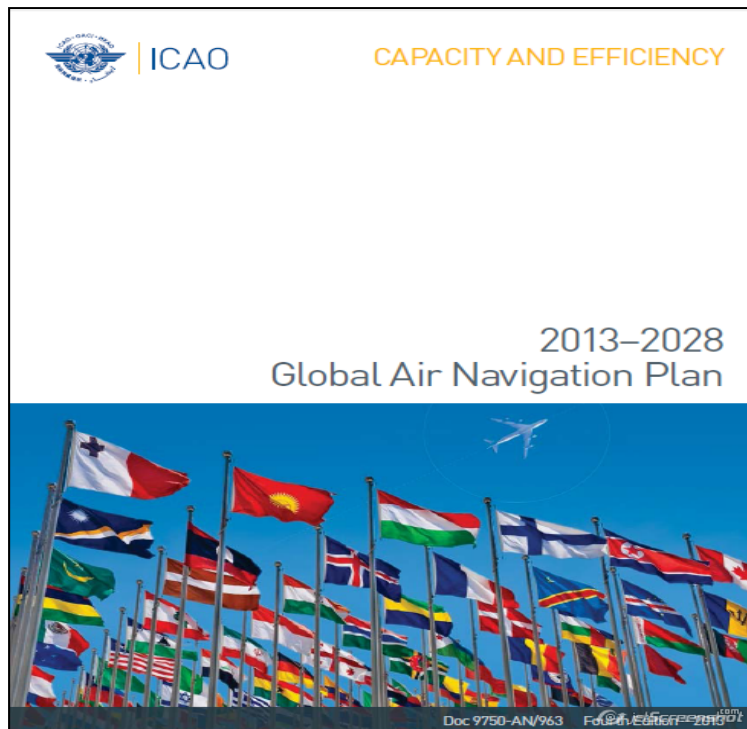
improved flight efficiency

COST-EFFECTIVE BASIS

- ✓ surveillance to areas where there is no primary or secondary radar
- ✓ in airspaces where radar is used, enhanced surveillance can bring further reductions in aircraft separation minima
- ✓ in high traffic density areas improve the quality of surveillance information (ground/ air), increasing safety levels.
- ✓ quality assured electronic terrain and obstacle data necessary to support the ground proximity warning systems with forward looking terrain avoidance function as well as a minimum safe altitude warning (MSAW) system



## Air navigation implementation overview



- ✓ ICAO's 15-year Plan
- ✓ ICAO's Ten Key Air Navigation Policy Principles
- ✓ Implementation: ASBU concept
- ✓ CNS/AIM/Avionic Roadmaps
- ✓ State's experience and practical implementation samples



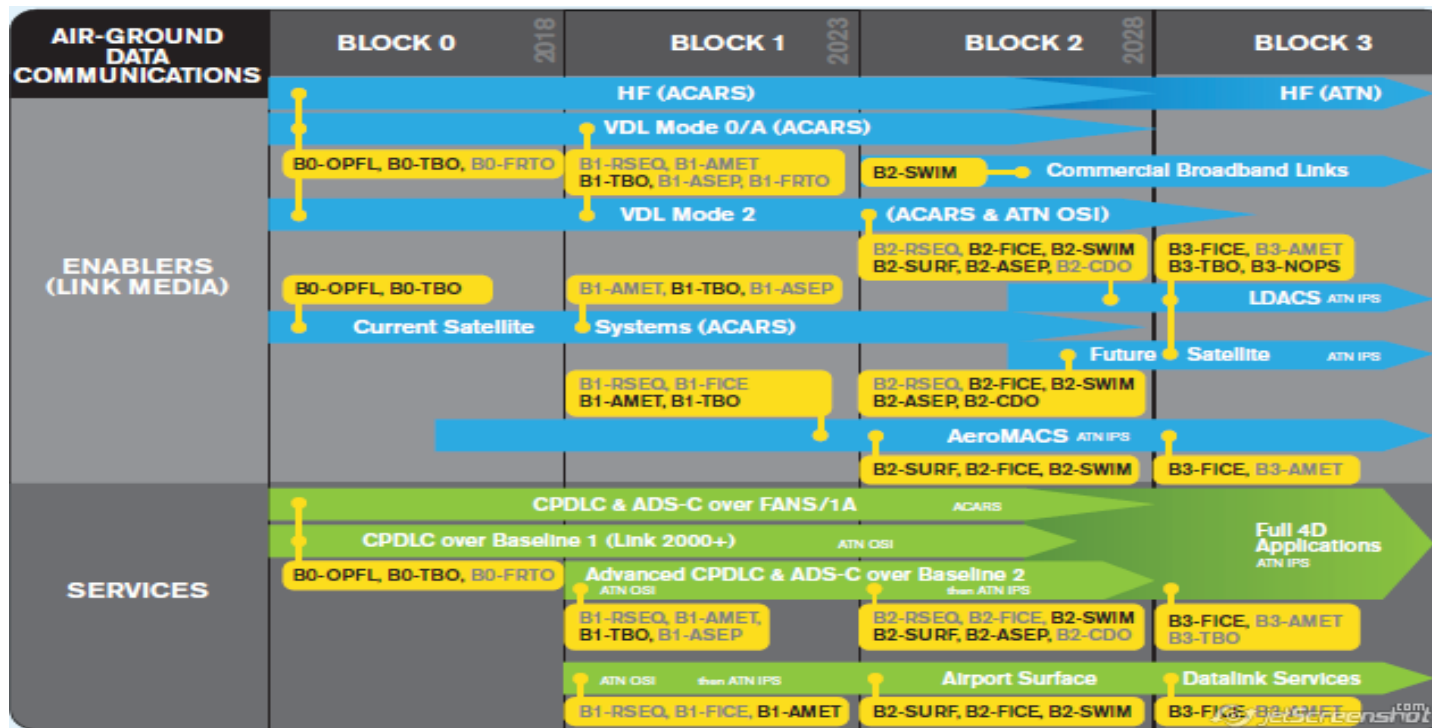
## Air navigation implementation overview

### Global Air Navigation Plan references

- ✈ The management of change pertinent to the block upgrade evolution should include human performance related considerations in the following areas:
  - ✈ a) Initial training, competence and/or adaptation of new/active operational staff.
  - ✈ b) New roles and responsibilities and tasks to be defined and implemented.
  - ✈ c) Social factors and management of the cultural changes linked to increased automation.
- ✈ Where automation is to be used, the human-machine interface needs to be considered from both a functional and ergonomic perspective
- ✈ the qualification requirements (training/ skills) form an integral part to the implementation of the ASBU modules
- ✈ Human performance needs to be embedded both in the planning and design phases of new systems and technologies as well as during implementation.
- ✈ Early involvement of operational personnel is also essential.

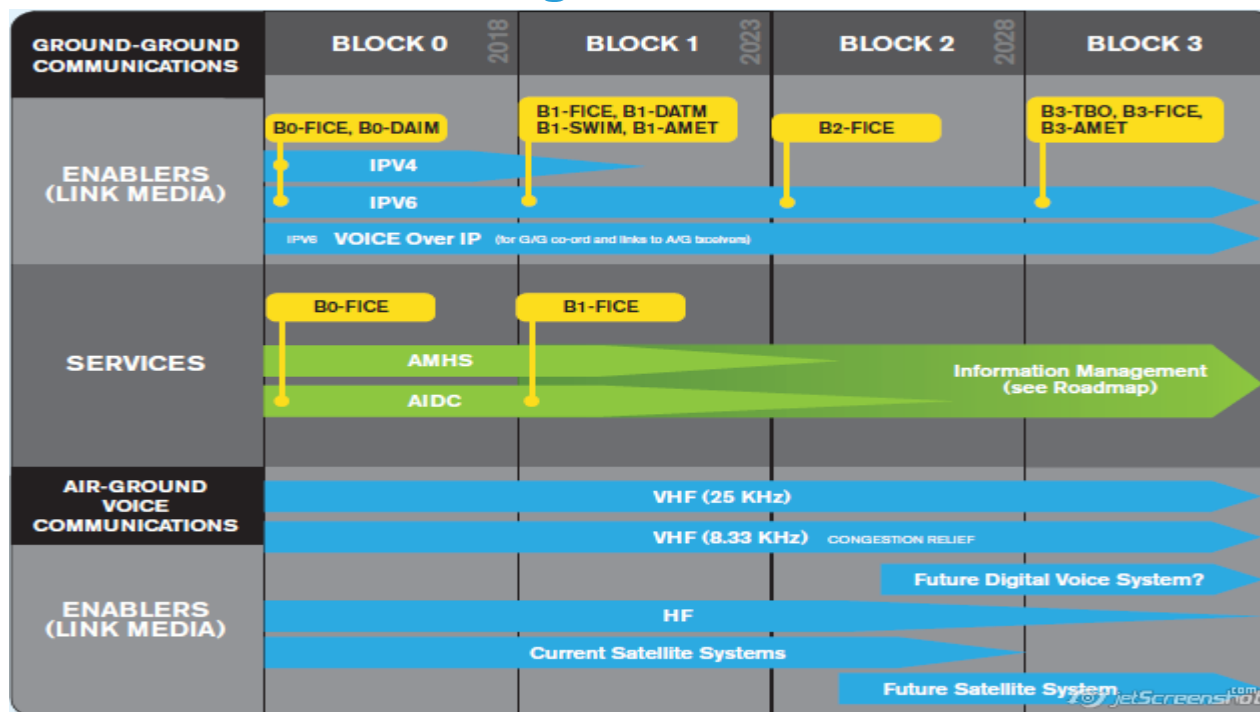


## Air navigation implementation overview Global Air Navigation Plan references





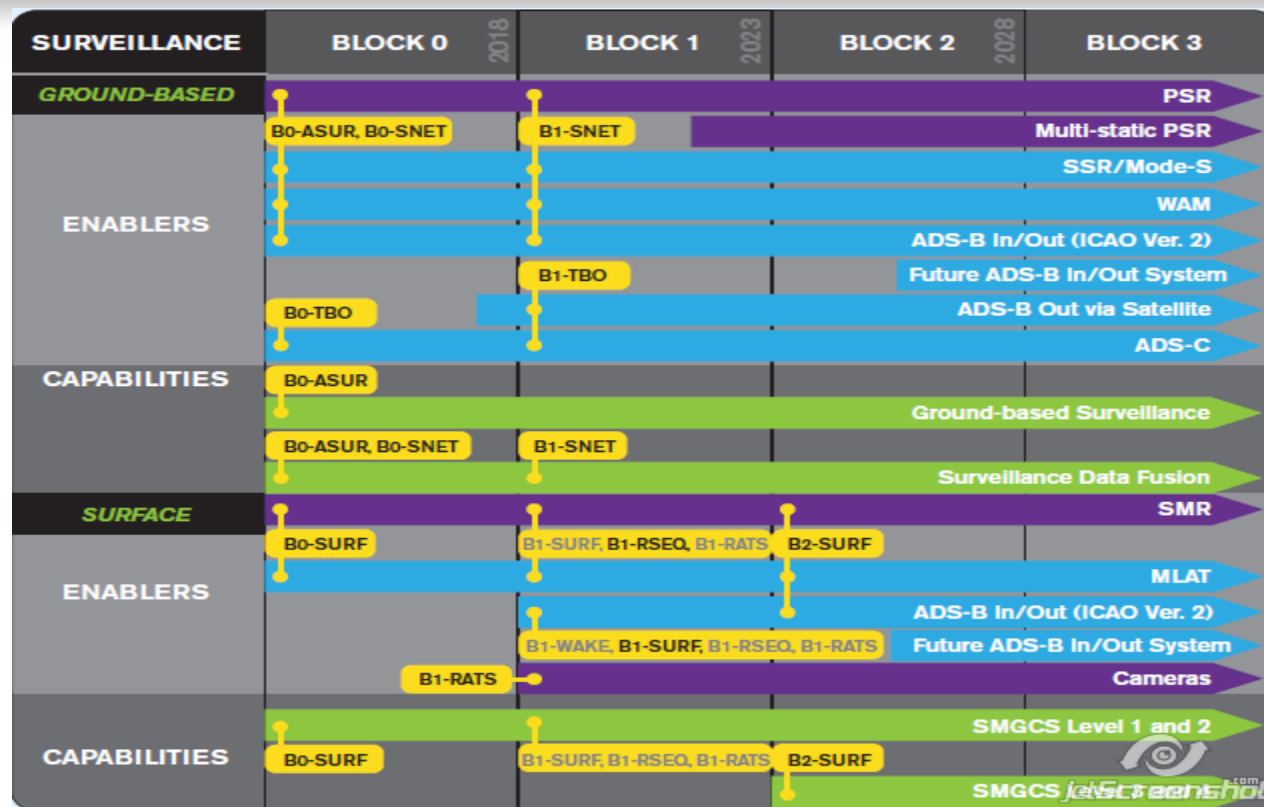
## Air navigation implementation overview Global Air Navigation Plan references





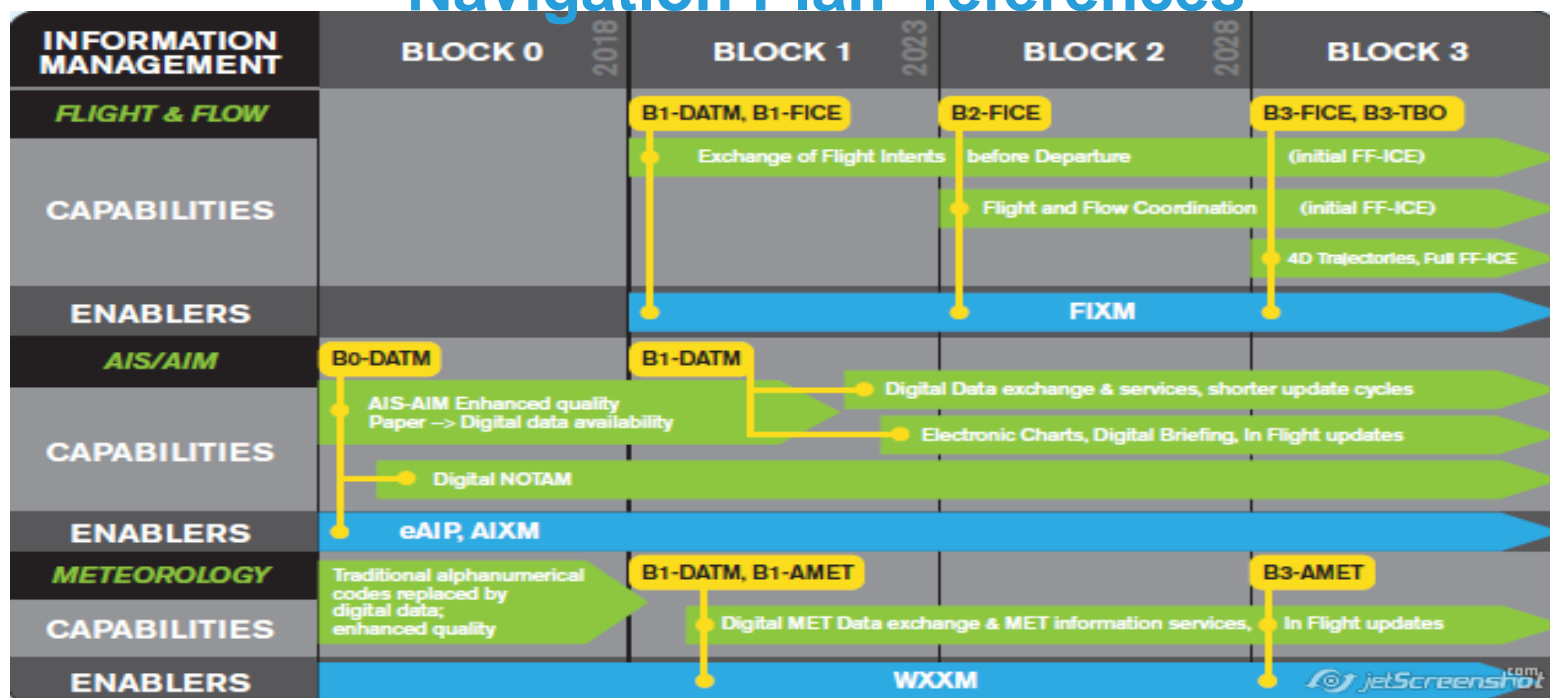
# Air navigation implementation overview

## Global Air Navigation Plan references



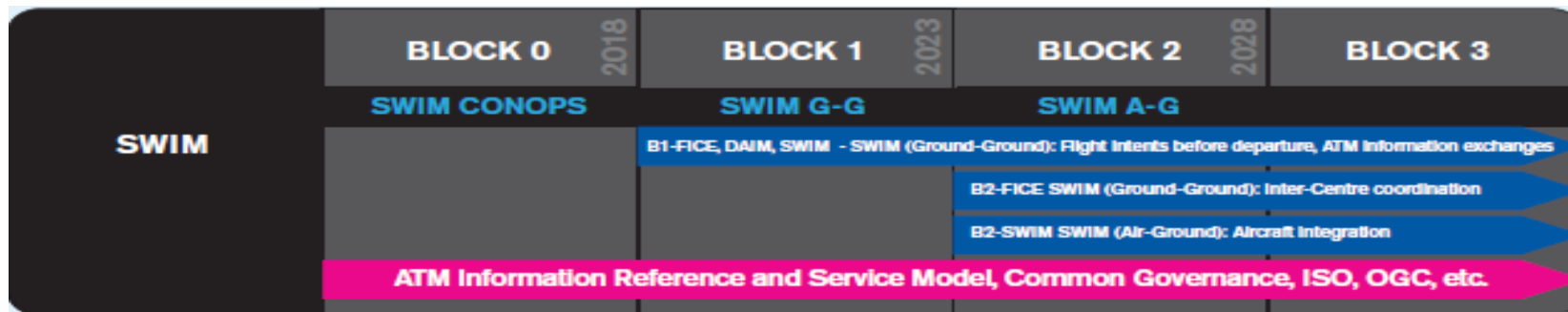


# Air navigation implementation overview: Global Air Navigation Plan references



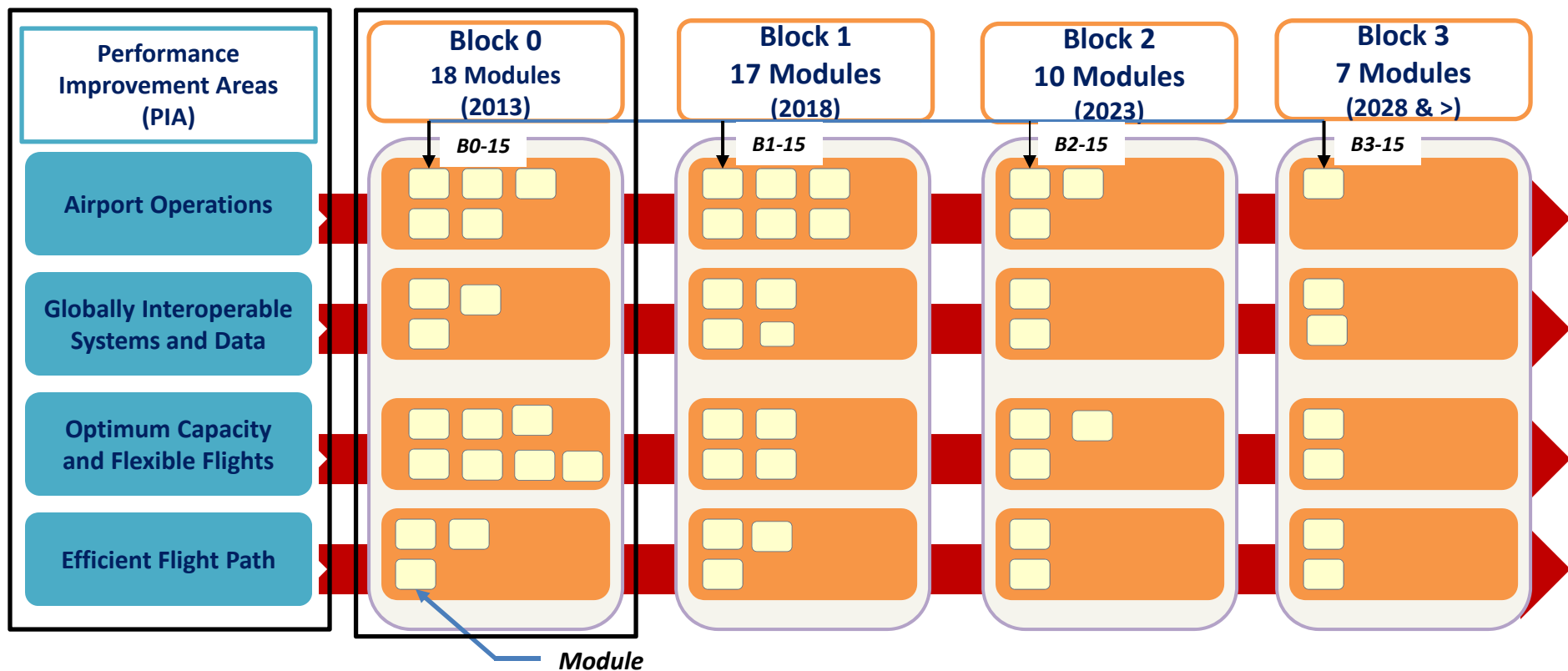


## Air navigation implementation overview Global Air Navigation Plan references





# ASBU Implementation Overview





## ASBU Implementation Overview --- Methodology

### Current methodology

- Scope covers only ground equipment for ANSPs
- Planning based on short and medium term
- Implementation process is through GPs

### ASBU methodology

- ✈ Scope extends to airspace users and regulators
- ✈ Planning based on short, medium and long terms
- ✈ Implementation process is through Blocks and corresponding modules

### ASBU Advantages

- Takes into account all related issues such as air/ground Systems, air/ground procedures, air/ground regulatory requirements and business case formulation,
- One stop planning at the same time flexible and scalable
- Modules provide a series of measurable, operational performance improvements, which could be introduced as needed



**Each Module is defined as follows:**

- ✈ Intended *Operational Improvement/Metric* to determine success
- ✈ Necessary *Procedures*/Air and Ground
- ✈ Necessary *Technology*/Air and Ground
- ✈ Positive *Business Case* per Upgrade
- ✈ *Regulatory Approval Plan*/Air and Ground
- ✈ *Well understood* by a Global Demonstration Trial
  - ✈ All synchronized to allow initial implementation
  - ✈ Won't matter **when or where** implemented



- Each Module is evaluated for its readiness
- If any component is not found to be ready it moves to a future Block for implementation
- Those Modules that are not specifically ready at a Block release are noted as “dates of readiness”
- States choose the modules that are applicable to their national needs and regional priorities



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## ASBU Implementation Overview Module Identifiers/ Number acronym

Old ASBU Modules Numbering System	New ASBU Modules Identifiers	
65	APTA	Airport Accessibility
70	WAKE	Wake Turbulence Separation
15	RSEQ	Runway Sequencing
75	SURF	Surface Operations
80	ACDM	Airport Collaborative Decision Making
81	RATS	Remote Air Traffic Services
25	FICE	FF/ICE
30	DATM	Digital Aeronautical Management
31	SWIM	System Wide Information Management
105	AMET	Advanced Meteorological Information
10	FRT0	Free Route Operations
35	NOPS	Network Operations
84	ASUR	Alternative Surveillance
85	ASEP	Airborne Separation
86	OPFL	Optimum Flight Levels
101	ACAS	Airborne Collision Avoidance Systems
102	SNET	Ground-Based Safety Nets
05	CDO	Continuous Descent Operations
40	TBO	Trajectory-Based Operations
20	CCO	Continuous Climb Operations
90	RPAS	Remotely Piloted Aircraft Systems



- Timing/sizing of the block upgrades are in response to
  - need for mature standards,
  - Integrated air and ground solutions and
  - Establishment of positive business cases
- Block “0” optimizes current onboard equipment and provides baseline
- Modules lacking specific maturity are purposefully placed in later blocks
- Block upgrades respond to issue of non-homogeneous areas

- Addresses ANSP, aircraft and regularity requirements
- Implementation through Block Upgrades ( 0, 1, 2, and 3) each comprising a number of modules
- Each module is explained in a standardized 4-5 pages template (checklist)
  - provide a series of measurable, operational performance improvements
  - Organized into flexible & scalable building blocks
  - Could be introduced as needed
  - all modules are **not** required in all airspaces

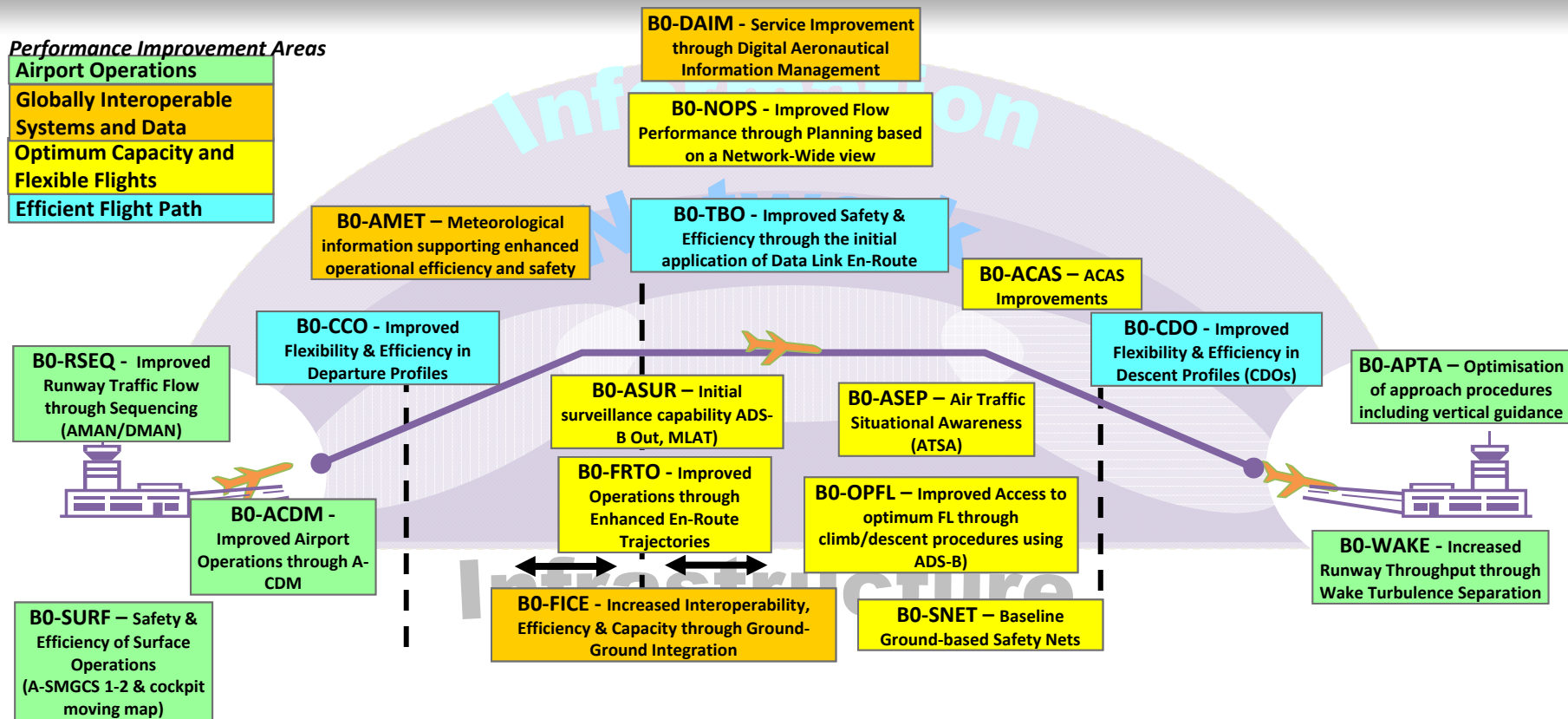
Block 0 will serve as the enabler and foundation for the envisioned future aviation systems.

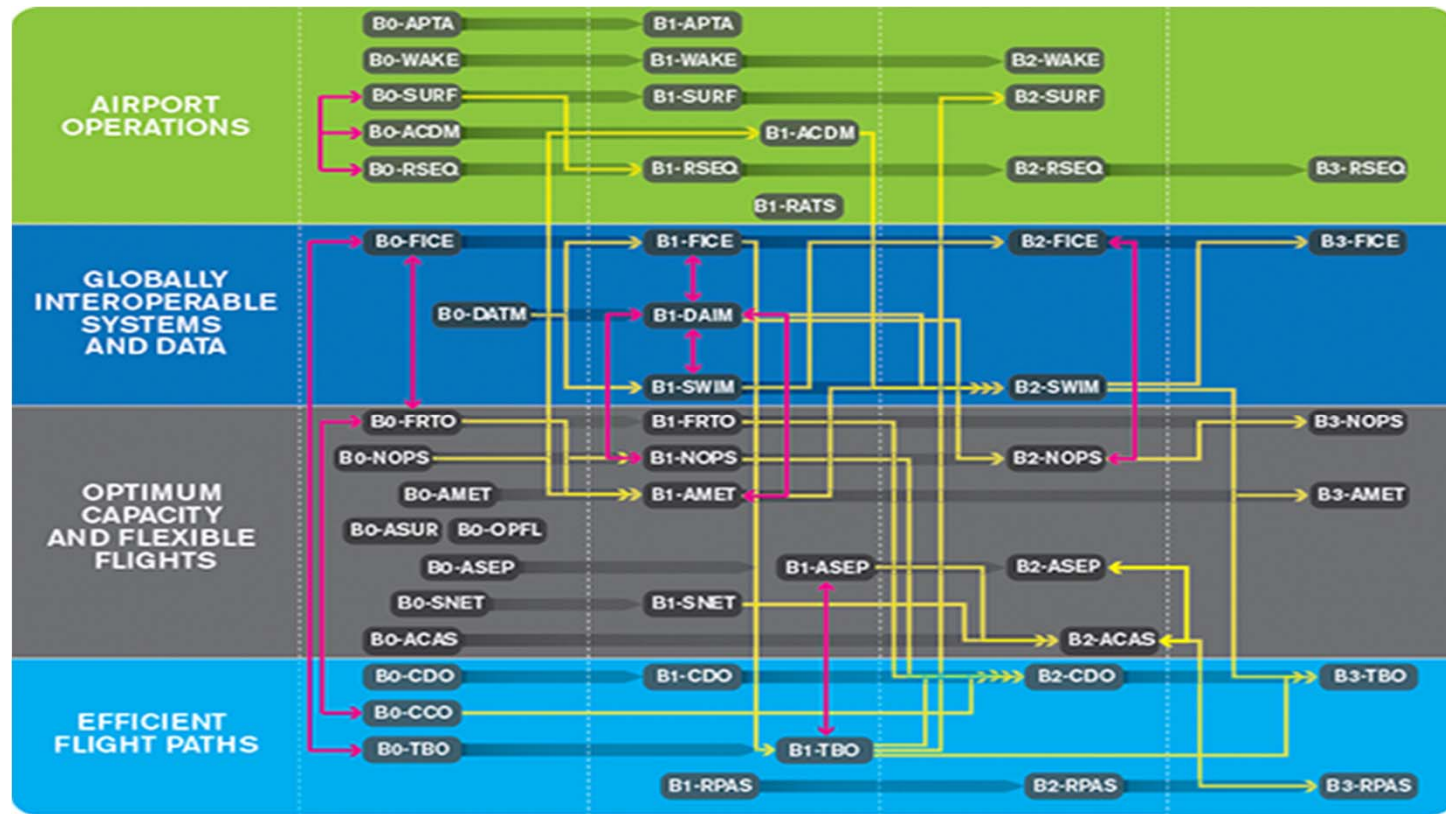




Performance Improvement Areas

- Airport Operations
- Globally Interoperable Systems and Data
- Optimum Capacity and Flexible Flights
- Efficient Flight Path







# ADS-B as key enabler of the ASBU implementation

## **B0-75 SURF** **Safety and Efficiency of Surface Operations (A-SMGCS Level 1-2)**

Airport surface surveillance for ANSP.

Basic A-SMGCS provides surveillance and alerting of movements of both aircraft and vehicles on the aerodrome thus improving runway/aerodrome safety. ADS-B information is used when available (ADS-B APT) and enhanced vision systems (EVS) is used for low visibility operations.

Linkage B0-SURF / B0-ACDM/ B0-RSEQ

A-SMGCS is applicable to any aerodrome and all classes of aircraft/vehicles. Implementation is to be based on requirements stemming from individual aerodrome operational and cost-benefit assessments.

ADS B APT, when applied is an element of A-SMGCS, is designed to be applied at aerodromes with medium traffic complexity, having up to two active runways at a time and the runway width of minimum 45 m.

Global readiness checklist	Status (indicate ready with a tick or input date)
Standards readiness	✓
Avionics availability	✓
Infrastructure availability	✓
Ground automation availability	✓
Procedures available	✓
Operations approvals	✓



# ADS-B as key enabler of the ASBU implementation

## B0-86: OPFL

### Improved access to Optimum Flight Levels through Climb/Descent Procedures using ADS-B

Enables an aircraft to reach a more satisfactory flight level for flight efficiency or to avoid turbulence for safety. The use of In Trail Procedure (ITP) facilitates en-route climb or descent to enable better use of optimal flight levels in environments where a lack of ATC surveillance and/or the large separation minima currently implemented is a limiting factor. The main benefit of ITP is fuel/emissions savings and the uplift of greater payloads.

This can be applied to routes in procedural airspaces.

The introduction of ITP and ADS-B based separation minima enable aircraft to climb or descend through the altitude of other aircraft when the requirements for procedural separation cannot be met.

ITP also provides safety benefits by providing a tool to manage contingency scenarios such as climbing or descend out of turbulence and potentially avoiding adverse meteorological conditions. Once the procedure has been field proven, it will also allow for a reduction in the contingency fuel carriage requirement.

Global readiness checklist	Status (ready now or estimated date).
Standards readiness	✓
Avionics availability	✓
Infrastructure availability	✓
Ground automation availability	✓
Procedures available	✓
Operations approvals	✓



# ADS-B as key enabler of the ASBU implementation

## B0-84 ASURF

### Initial surveillance capability ADS-B Out, MLAT

Ground surveillance supported by ADS-B OUT and/or wide area Multilateration systems will improve safety, especially search and rescue and capacity through separation reductions.

**Operating environment/ Phases of flight:** All airborne flight phases in continental or subsets of oceanic airspace and on aerodrome surfaces.

Introduces the opportunity to expand ATC radar equivalent service with two new surveillance techniques that can be used, separately or jointly: ADS-B and MLAT. These techniques provide alternatives to classic radar technology at a lower implementation and maintenance cost, thereby allowing to provide surveillance services in areas where they are currently not available for geographical or cost reasons. These techniques also allow, in certain conditions, a reduction of separation minima thereby potentially increasing the ability to accommodate larger volumes of traffic.

Global readiness checklist	Status (ready now or estimated date).
Standards readiness	✓
Avionics availability	✓
Infrastructure availability	✓
Ground automation availability	✓
Procedures available	✓
Operations approvals	✓



# ADS-B as key enabler of the ASBU implementation

### B0-85: ASEP

#### Air Traffic Situational Awareness (ATSA)

Two ATSA (Air Traffic Situational Awareness) applications which will enhance safety and efficiency by providing pilots with the means to achieve quicker visual acquisition of targets:

- AIRB (Enhanced Traffic Situational Awareness during Flight Operations).
- VSA (Enhanced Visual Separation on Approach).

ATSA provides a cockpit display of a graphical depiction of traffic to assist the pilot in out-the-window visual acquisition of traffic: AIRB and VSA

In some environments (e.g., United States) ground infrastructure provides automatic dependant surveillance rebroadcast (ADS-R) and traffic information service — broadcast (TIS-B).

The AIRB and VSA capabilities do not change roles and responsibilities for controllers and pilots.

The controllers remain responsible for the provision of separation between aircraft in compliance with the definition of the air traffic services.

Global readiness checklist		Status (ready now or estimated date).
	Standards readiness	✓
	Avionics availability	✓
	Infrastructure availability	✓
	Ground automation availability	N/A
	Procedures available	✓
	Operations approvals	2012



## ADS-B as key enabler of the ASBU implementation

### B0-102 – SNET

#### Increased Effectiveness of Ground-based Safety Nets

Provides improvements to the effectiveness of the ground-based safety nets assisting the Air Traffic Controller and generating, in a timely manner, alerts of an increased risk to flight safety (such as short terms conflict alert, area proximity warning and minimum safe altitude warning).

Monitors flights to provide timely alerts to air traffic controllers of potential risks to flight safety. Alerts from short-term conflict alert (STCA), area proximity warnings (APW) and minimum safe altitude warnings (MSAW) are proposed. Ground-based safety nets make an essential contribution to safety and remain required as long as the operational concept remains human centred.

This module corresponds to a baseline version of the safety nets as already implemented or being implemented in many areas.

The ground-based safety nets are providing alerts to the controller but no solution. The controller is expected to immediately assess the situation and if necessary take appropriate action.

Global readiness checklist	Status (ready now or estimated date).	
	Standards readiness	Not applicable
Avionics availability	√	
Infrastructure availability	√	
Ground automation availability	√	
Procedures available	√	
<b>Operations approvals</b>	<b>√</b>	



## Automation is essential for ASBU implementation

### B0-25 FICE

#### Increased Interoperability, Efficiency and Capacity through Ground-Ground Integration

Supports the coordination of ground-ground data communication between ATSU based on ATS Inter-facility Data Communication (AIDC) defined by ICAO Document 9694

Aimed at improving the flow of traffic by allowing neighbouring ATS units to exchange flight data automatically in the form of coordination and transfer messages.

Linkage with B0-TBO, B0-FRTO, FICE

Applicable to at least two area control centres (ACCs) dealing with en-route and/or terminal control area (TMA) airspace. A greater number of consecutive participating ACCs will increase the benefits.

Global readiness checklist	Status (ready now or estimated date).
Standards readiness	√
Avionics availability	Not applicable
Infrastructure availability	√
Ground automation availability	√
Procedures available	√
Operations approvals	√



## Automation is essential for ASBU implementation

### **B0-30 DATM**

#### **Service Improvement through Digital Aeronautical Information Management**

Transition from product centric to data centric. 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

continues the transition of AIS from traditional product provision to a digitally enabled service oriented environment with information exchange utilizing standardized formats based on widely used information technology standards (UML, XML/GML). This will be 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

Global readiness checklist		Status (ready now or estimated date)
	Standards readiness	2016
	Avionics availability	✓
	Ground systems availability	✓
	Procedures available	2016
	Operations approvals	✓



## Automation is essential for ASBU implementation

### **B0-40 TBO** **Improved Safety and Efficiency through the initial application of En-Route Data Link**

To implement an initial set of data link applications for surveillance and communications in ATC, supporting flexible routing, reduced separation and improved safety.

Linkage with B0/FICE

Requires good synchronization of airborne and ground deployment to generate significant benefits, in particular to those equipped. Benefits increase with the proportion of equipped aircraft.

For ground systems, the necessary technology includes the ability to manage ADS-C contract, process and display the ADS-C position messages. CPDLC messages need to be processed and displayed to the relevant ATC unit. Enhanced surveillance through multi-sensor data fusion facilitates transition to/from radar environment.

Global readiness checklist	Status (ready now or estimated date)
Standards readiness	✓
Avionics availability	✓
Ground systems availability	✓
Procedures available	✓
Operations approvals	✓





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