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# A Regional Perspective on ATM Automation System Implementation

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# Regional Activities on ATM Automation System



## ICAO Asia Pacific Regional ATM Automation System Symposium (APAC RATMS) in 2018

- Attended by 96 participants from 13 States/Administrations, 2 International Organizations, and 10 technology/solution providers
- 35 presentations under 6 Agenda Items
- Facilitate and exchange best industry practice/experience
- Improving planning, implementation and transition
- Consider establishment of a regional working group/task force
  - Decision CNS SG/23/13 (SURICG/4/5) - Establishment of ATM Automation System Task Force (ATMAS TF)
- <https://www.icao.int/APAC/Meetings/Pages/2018-ATM-ASS.aspx>



# Seminar on Air Traffic Management Automation System

in conjunction with the ATMAS TF/1 meeting on 27 October 2020

- 179 participants from 18 States/Administrations, 4 International Organizations and industry partners
- Total 13 presentations in following areas:
  - Experience Sharing from CAA/ANSPs
  - New Technology and Approach from Industry
- Provided a platform for participants to exchange experience and keep abreast of the latest knowledge on the subject of air traffic management automation.
- <https://www.icao.int/APAC/Meetings/Pages/2020-ATMAS-Seminar.aspx>



## Discussions in ATMAS TF

ATMAS TF/1 in 2020 & ATMAS TF/2 in 2021

- Architecture of ATM Automation System
- ATMAS Implementation Planning
- Systems interoperability (OLDI, AIDC, FF-ICE, SWIM-IOP)
- Integration with ATFM, CDM and A-SMGCS capabilities
- New ATM Technologies application (RECAT, TBO, PBN, Extended AMAN)
- UTM/ATM integration
- DAPs applications
- Ground based safety net
- Cyber threats and mitigation measures



## Outcomes of ATMAS TF

- **ATMAS Implementation and Operations Guidance Document – ATMAS IGD (Advance Edition)**
  - Regional guidance material for systems planning, design, testing and implementation of ATMAS
  - To supplement SARPs, PANS and relevant provisions contained in ICAO documentation
  - A working team consisting of volunteers from China, Hong Kong-China, India, Japan, Malaysia, Philippines, Singapore, Thailand, and Vietnam contributes to document's content.
  - **Framework:**
    - Section 1 Introduction
    - Section 2 Reference Documents
    - Section 3 System Functional Baseline
    - Section 4 System Design
    - Section 5 System Software Management
    - Section 6 System Transition
    - Section 7 System Maintenance
  - Circulated to States for further comments in November 2021



## Outcomes of ATMAS TF (Cont'd)

- **ATMAS repository (On-going)**
  - establish a repository of the ATM automation systems implemented by States in APAC
- **Follow up AIDC implementation issues upon dissolution of APA TF**
  - upon the dissolution of APA TF, ATMAS TF would follow up AIDC implementation issues while ACSICG would handle communications-related issues (Decision CNS SG/25/16 )
  - integrate the APA TF ToR and tasks/action items
- **AIDC repository (On-going)**
  - maintain a common understanding between ATMAS TF and ACSICG on AIDC implementation status
  - establish the repository of the AIDC Implementation Status for APAC Region



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# ICAO Provisions

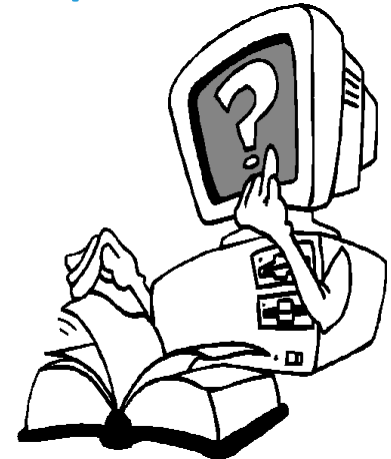


# ICAO provisions

- Annex 2,4,10,11,15,19,...
- PANS ATM/OPS
  - Doc 4444,8168
- GANP Suite
  - Doc 9750,
  - Doc 9854, 9882, 9883
- Doc 7030, 9673, 9985,...
- APAC Seamless ANS Plan

Standard?

Specification?





# Global Air Navigation Plan (Doc 9750)



- ICAO's highest air navigation strategic document
- An important planning tool for setting global priorities to drive the evolution of the global air navigation system.
- Current version - 6th Edition GANP (2019)
- Next updates on GANP
  - minor update (v6a) 2022
  - major update (v7) 2025 (AN Conference May 2024)

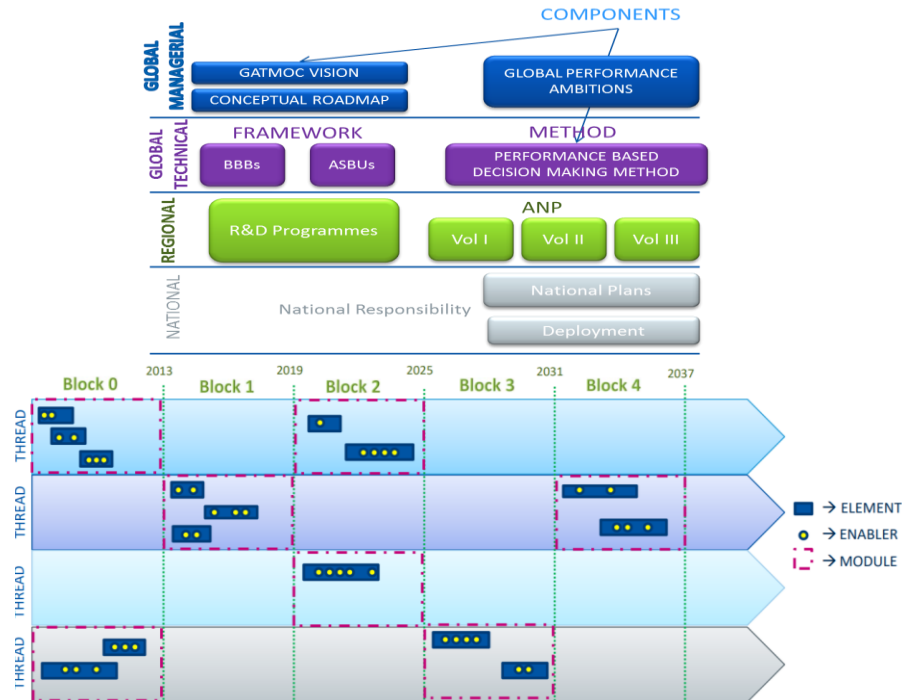
<https://www4.icao.int/ganportal/>

<https://www4.icao.int/ganportal/Tutorial>



# Updates on 6th Edition of GANP/ASBU

- The concept of Performance Improvement Areas(PIA) is no longer supported.
- Threads are grouped into **three categories: Operation, Information, and Technology.**
- Four Threads are omitted and five new are introduced, and seventeen remain the same.
- Number of Block 0 Elements were reduced from 69 to 52
- Number of Block 1 Elements were also reduced from 72 to 62.





# ASBU Threads

## Information

AMET - Meteorological information

DAIM - Digital Aeronautical Information Management

**FICE - Flight and Flow Information for a Collaborative Environment (FF-ICE)**

SWIM - System Wide Information Management

## CNS technology and services

### **ASUR - Surveillance systems**

COMI - Communication infrastructure

COMS - ATS Communication service

NAVS - Navigation systems

## Operational

ACAS - Airborne Collision Avoidance System (ACAS)

ACDM - Airport Collaborative Decision Making

APTA - Improve arrival and departure operations

CSEP - Cooperative Separation

FRT0 - Improved operations through enhanced en-route trajectories

GADS - Global Aeronautical Distress and Safety System (GADSS)

NOPS - Network Operations

OPFL - Improved access to optimum flight levels in oceanic and remote airspace

### **RATS - Remote Aerodrome Air Traffic Services**

RSEQ - Improved traffic flow through runway sequencing

### **SNET - Ground-based Safety Nets**

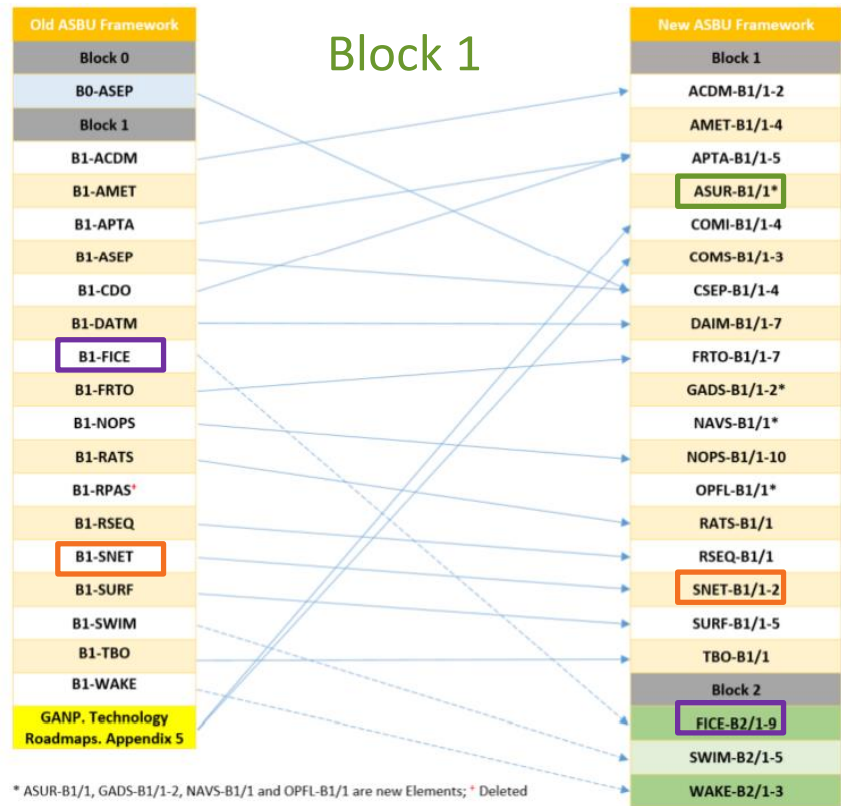
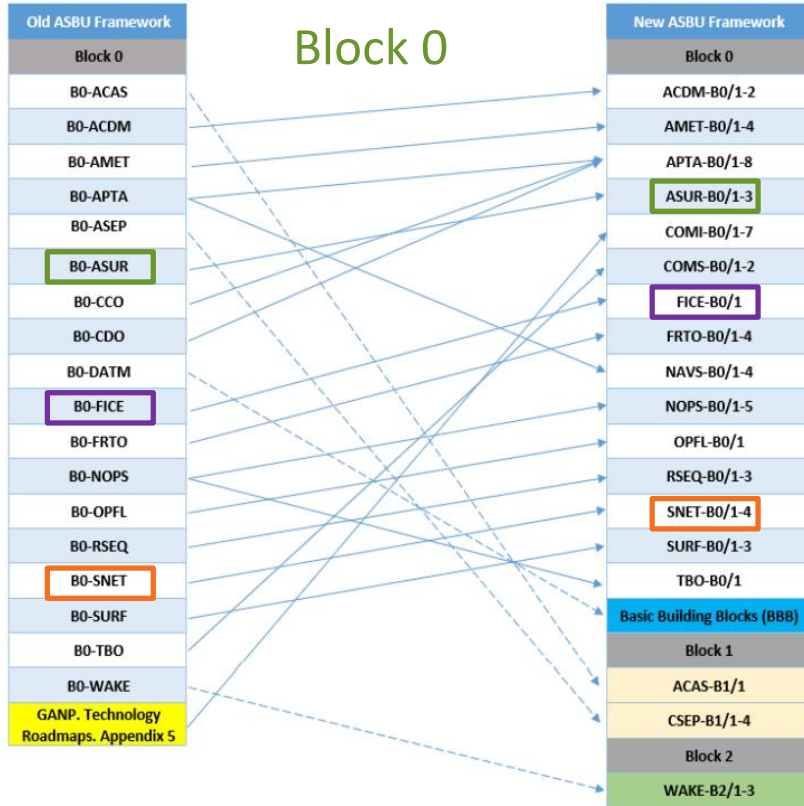
SURF - Surface operations

TBO - Trajectory-based operations

WAKE - Wake Turbulence Separation



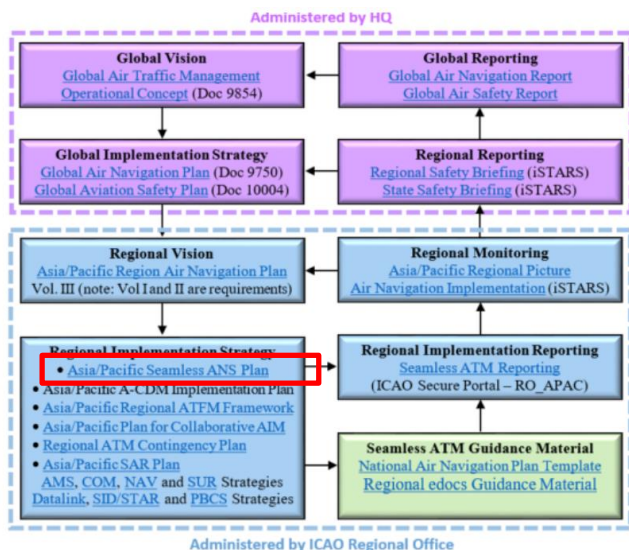
# Block 0 & 1 Evolution



\* ASUR-B1/1, GADS-B1/1-2, NAVS-B1/1 and OPFL-B1/1 are new Elements; \* Deleted



# APAC Seamless ANS Plan V3.0



- A vital part of the region’s implementation strategy, and linked to the global vision and planning.
- To align with the 6th Edition of GANP, APANPIRG/30 reviewed and adopted the Asia/Pacific Seamless ANS Plan Version 3.0 in November 2019.
  - Renamed from Asia/Pacific Seamless ATM Plan
  - Adding Block 1 elements to align with the 6th Edition of GANP
  - Increasing the Priority 1 elements from 10 to 16
  - Modifications on the Phase II, III, and IV of Preferred Aerodrome/Airspace and Route Specifications (PARS) and Preferred ANS Service Levels (PASL)
- Many indications about automation
- The next review year is 2022.
  - should be editorial only, except where significant issues have been identified by relevant ICAO APAC technical bodies



## 16 Priority 1 [ASBU Block 0 and 1] Elements

- a) Aeronautical Meteorology: AMET-B0/1 – 4;
- b) Aeronautical Information Management: DAIM-B1/1 – 6\*;
- c) Airport CDM: ACDM-B0/1 – 2;
- d) ANSP human and simulator performance (Regional);
- e) **ATS Inter-facility Datalink Communications: FICE-B0/1;**
- f) Ballistic launches/space re-entry management (Regional);
- g) Civil-Military Special Use Airspace (SUA) management (Regional);
- h) Civil-Military strategic and tactical coordination (Regional);
- i) Core data communications: VDL Mode O/A and AMHS COMI-B0/3, 7;
- j) Direct and Free Route Operations: FRTO-B0/1 – 4;
- k) Enhanced SAR systems (Regional);
- l) **Ground-based Surveillance: ASUR-B0/1 – 4;**
- m) Network Operations: NOPS-B0/1 – 5;
- n) Performance-based Navigation Approach Procedures: APTA-B0/1 – 2;
- o) Runway Sequencing: RSEQ-B0/1 – 2;
- p) **Safety Nets SNET-B0/1 – 4.**

Priority 1: critical upgrade assignment based on whether the implementation of an element could bring most benefit to the region or regional upgrade by States.



# ATM Automation System Requirements in ASBU, APAC Seamless ANS Plan & ATMAS IGD



## Flight and Flow Information for a Collaborative Environment (FF-ICE)

ASBU Thread	ASBU Element	Title	Preferred ANS Service Levels	Priority	ATMAS IGD
<b>FICE- Flight and Flow Information for a Collaborative Environment (FF-ICE)</b>	FICE-B0/1	Automated basic inter- facility data exchange (AIDC)	FICE-B0/1: Automated basic AIDC (PASL 7.26)	1	Chapter 3.1.9 ATS Inter-facility Data Communication Function



# Flight and Flow Information for a Collaborative Environment (FF-ICE)

ASBU	Seamless ANS Plan	ATMAS IGD
<p>FICE B0/1 - Automated basic inter-facility data exchange (AIDC) is intended to improve the efficiency of coordination and transfer of control between ATS units in order to <b>replace voice communication</b>.</p>	<ul style="list-style-type: none"><li>• <b>Enable AIDC (version 3 or later)</b>, or an alternative process that achieves at least the same level of performance as AIDC <b>consistent with FICE-B0/1</b>, unless alternate means of automated communication of ATM system track and flight plan data are employed.</li><li>• As far as practicable, the following AIDC messages types should be implemented: <b>ABI, EST, ACP, TOC, AOC</b>.</li></ul>	<ul style="list-style-type: none"><li>• Suggested to transmit ABI, EST, PAC, and other messages automatically according to the <b>AIDC handover</b> conditions and the status of the flight plan.</li><li>• Be able to trigger AIDC handover automatically</li><li>• Generally, the AIDC handover is mainly fulfilled by exchanging a variety of messages.</li></ul>



# Surveillance systems

ASBU Thread	ASBU Element	Title	Preferred ANS Service Levels	Priority	ATMAS IGD
ASUR-Surveillance systems	ASUR-B0/1	Automatic Dependent Surveillance – Broadcast (ADS-B)	ASUR-B0/1 – 3: ADS-B, MLAT, SSR-DAPS (PARS 7.8, 7.11, PASL 7.27, 7.28, 7.30)	1	Chapter 3.2.1 - Processing of enhanced surveillance data such as ADS-B
	ASUR-B0/2	Multilateration cooperative surveillance systems (MLAT)			
	ASUR-B0/3	Cooperative Surveillance Radar Downlink of Aircraft Parameters (SSR-DAPS)			



# Surveillance systems

GANP	Seamless ANS Plan	ATMAS IGD
<p>Block 0: Surveillance is provided supported by new technologies such as <b>ADS-B OUT and wide area multilateration (MLAT) systems</b>. These capabilities will be used in various ATM services.</p>	<ul style="list-style-type: none"><li>• should be used to provide coverage</li><li>• should be <b>integrated into operational ATC situation displays</b></li><li>• should implement the use of the standard non-discrete <b>Mode A code 1000</b></li><li>• should include the <b>processing and presentation Mode S or ADS-B downlinked aircraft parameters in ATC HMI</b></li><li>• enables <b>automated coupling with DAPs</b></li></ul>	<ul style="list-style-type: none"><li>• encouraged to be able to <b>process Mode S radar data, ADS-B data, WAM, and other surveillance data</b> which contain more target information, such as <b>DAP parameters and accuracy</b>, etc.</li><li>• Asia Pacific region adopts <b>“1000” as Mode S Conspicuity Code</b>.</li></ul>



# Ground-based Safety Nets

ASBU Thread	ASBU Element	Title	Preferred ANS Service Levels	Priority	ATMAS IGD
<b>SNET-Ground-based Safety Nets</b>	SNET-B0/1	Short Term Conflict Alert (STCA)	SNET-B0/1 – 4: STCA, MSAW, APW, APM (PASL 7.31)	1	Chapter 3.1.5
	SNET-B0/2	Minimum Safe Altitude Warning (MSAW)			
	SNET-B0/3	Area Proximity Warning (APW)			
	SNET-B0/4	Approach Path Monitoring (APM)			
	SNET-B1/1	Enhanced STCA with aircraft parameters	SNET-B1/1 – 2: Enhanced STCA with aircraft parameters and in complex TMAs (PASL 7.50)	2	Chapter 3.1.5.3
	SNET-B1/2	Enhanced STCA in complex TMAs			



# Ground-based Safety Nets

## GANP

### Block 0:

- An integral part of the ATM system using primarily ATS surveillance data.
- Goal: collision avoidance, warn the controllers of the unauthorized penetration
- **STCA, APW, MSAW and APM** are proposed.

### Block 1:

- Provided with airborne data enabling performance improvements (less nuisance alerts, earlier positive alerts).

## Seamless ANS Plan

- Enable basic conflict detection and conformance monitoring **STCA, MTCD, APW, APM and MSAW** consistent with FRT0-B0/4 and SNET-B0/1 – 4 (Priority 1).
- Route Adherence Monitoring (**RAM**) should be utilised when monitoring PBN route separations.
- Cleared Level Adherence Monitoring (**CLAM**) should be utilised to monitor RVSM airspace.
- should enable **Enhanced STCA** with aircraft parameters and in complex TMAs consistent with SNET-B1/1 – 2.

## ATMAS IGD

- Provides safety net to controllers with visual and aural indications, integrating surveillance data, flight plan data, and other operational data using different algorithms and rules.
- The safety net includes Emergency, **STCA, MSAW, APW, APMW, CLAM, RAM, MTCD**, etc.



# Other ASBU Threads in Seamless ANS Plan

ASBU Threads - GANP	Seamless ANS Plan	ATMAS IGD
SWIM - System Wide Information Management	<ul style="list-style-type: none"> <li>• Early implementation of AIM, including cooperative development of aeronautical databases and SWIM to support <b>interoperable</b> operations</li> </ul>	<ul style="list-style-type: none"> <li>• Chapter 3.2.5</li> <li>• Chapter 3.2.6</li> </ul>
ACDM - Airport Collaborative Decision Making	<ul style="list-style-type: none"> <li>• All international aerodromes should operate an A-CDM system for ACIS <b>integrated with the ATM network</b> function consistent with ACDM-B0/1 – 2 (Priority 1).</li> <li>• All international aerodromes should operate an A-CDM system integrated with the ATM network, and an AOP and where practicable an APOC consistent with ACDM-B1/1 – 2</li> </ul>	<ul style="list-style-type: none"> <li>• Chapter 3.2.5</li> <li>• Chapter 3.2.6</li> </ul>
RSEQ - Improved traffic flow through runway sequencing	<ul style="list-style-type: none"> <li>• All international aerodromes where ATFM facilities are required should be served by <b>AMAN/DMAN</b> facilities consistent with RSEQ-B0/1 – 2 (Priority 1).</li> <li>• All ATC units providing services to international aerodromes should operate extended arrival metering consistent with RSEQ-B1/1.</li> </ul>	<ul style="list-style-type: none"> <li>• Chapter 3.2.5</li> <li>• Chapter 3.2.6</li> </ul>
SURF - Surface operations	<ul style="list-style-type: none"> <li>• All ATC units providing services to international aerodromes should operate basic ATC surface operations tools, comprehensive situational awareness, situational awareness, alerting service consistent with SURF-B0/1 – 3.</li> <li>• All ATC units providing services to international aerodromes should operate advanced surface traffic management visual aids, pilot comprehensive awareness and runway alerting, enhanced ATC alerting, routing service to support ATC and enhanced vision systems (EVS) for taxiing and runway safety alerting logic consistent with SURF-B1/1 – 5. <i>Note1: <b>AMAN/DMAN arrival/departure management</b> needs to be integrated with advanced surface management systems: A-SMGCS with SMAN or ASDE-X.</i></li> </ul>	<ul style="list-style-type: none"> <li>• Chapter 3.2.5</li> <li>• Chapter 3.2.6</li> </ul>



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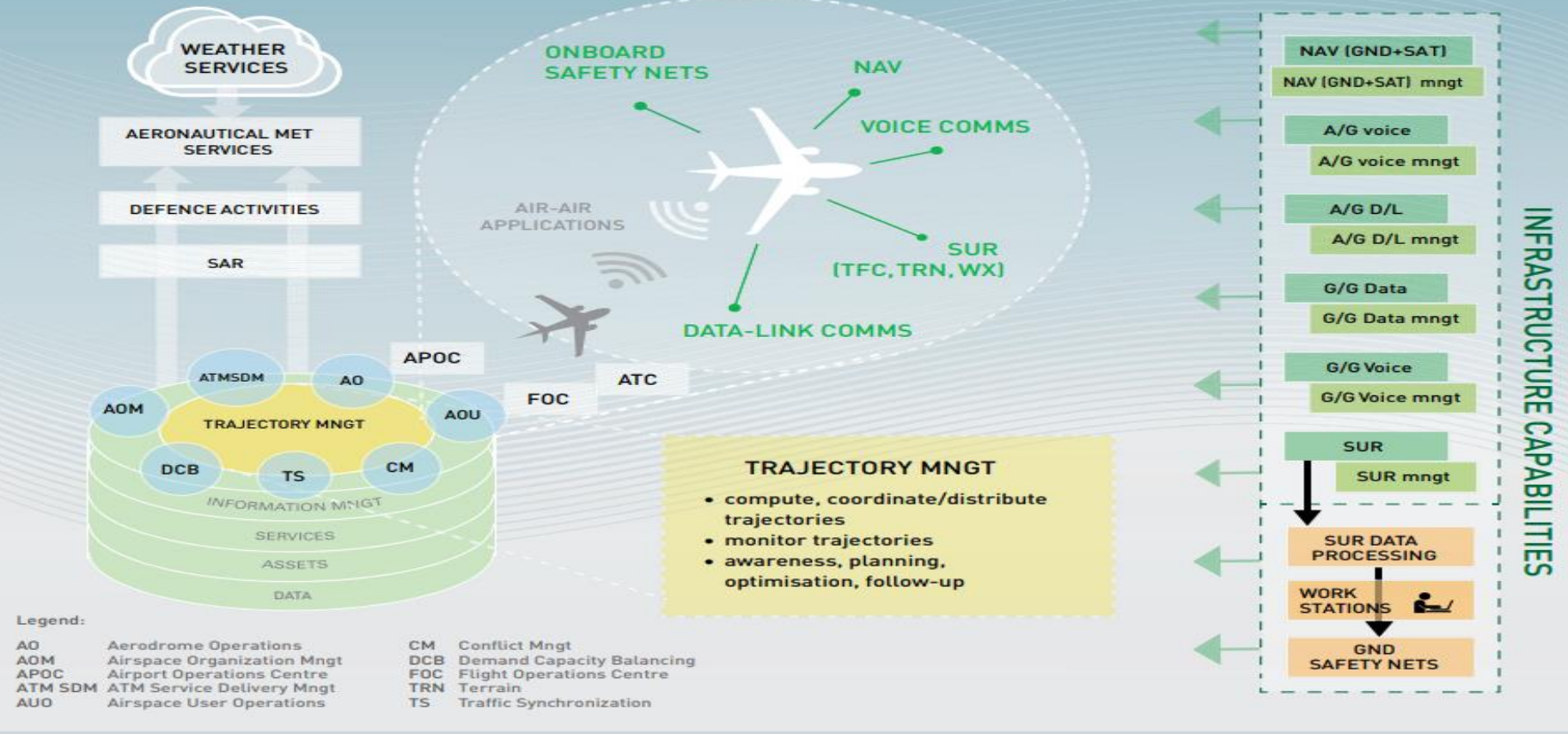


# ATM Automation Systems Tomorrow



## To be considered

- Interface transition (AMHS)
- Robustness in open connected environment (cybersecurity)
- Stability and Fallback Solution
- TBO: Trajectory-Based Operations (4D trajectory prediction)



“Air traffic management (ATM) considers the trajectory of a manned or unmanned vehicle during all phases of flight and manages the interaction of that trajectory with other trajectories or hazards to achieve the optimum system outcome, with minimal deviation from the user-requested flight trajectory, whenever possible.” – Doc 9854



# Automation Tomorrow

- Take most tasks and controller interventions as exception.
- Combine automated planning (and plan updates) in a look-ahead time horizon of up to several hours.
- Contribute to TBO to shift operations towards greater predictability with flight-impacting decisions being coordinated across concept components, with highest priority for separation provision.
  - Sharing of trajectory information leading to a common view as the Agreed Trajectory
  - Managing trajectory information using Collaborative Decision Making (CDM)
  - The Agreed Trajectory is used as common plan for the flight by providing a common intent to be achieved during execution of the flight.



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