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
(Panama City, Panama, 22 to 25 September 2015)

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Regional Officer/ Communication, Navigation and Surveillance
ICAO NACC Office
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

Vision

Strategy

Tactics

Action

The concepts to implement the safety and capacity/efficiency strategic objectives (Global ATM Operational Concept)

Global Air Navigation Plan

Global Aviation Safety Plan

Global Performance ASBU approach

Global Safety Initiatives (GSI)

Global and regional work plans (eANP) and action plans (States)
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

- Aviation System Block Upgrade (ASBU) Methodology (2012)

Doc 9750
Global Air Navigation Plan, Edition 4
2014-16

Encompasses Performance Framework
Addresses ANSP, Regulatory and User requirements
Includes ASBU Methodology
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.
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.
Recommendations in support of the Global System-wide Information management (SWIM):

- REC 3/1 ICAO ASBU relating to performance improvement through the application of SWIM
- REC 3/2 Development of SWIM Concept
- REC 3/4 States and Industry to support SWIM
- REC 3/8 States actions relating to service improvement through AIM as well as digital ATM information

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 Fourth Edition of the Global Air Navigation Plan (Doc 9750, GANP) by May 2014;

b) Focus on implementing aviation system block upgrade Block 0 Modules according to their operational needs, recognizing that these modules are ready for deployment;

c) Use the eANPs as the primary tool to assist in the implementation of the agreed regional planning framework for air navigation services and facilities;

d) Involve regulatory 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.

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.
Air navigation implementation overview

3th Edition
Global Air Navigation Plan (Doc 9750)
(GPI-9) SITUATIONAL AWARENESS

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

- ✓ 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

- COST-EFFECTIVE BASIS
  - Reductions in separation minima and an enhancement of safety
  - Increase in capacity
  - Improved flight efficiency
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

- **FLIGHT & FLOW**
  - **INFORMATION MANAGEMENT**
    - **BLOCK 0**
      - B0-DATM
    - **BLOCK 1**
      - B1-DATM
      - B1-FICE
      - B2-FICE
      - Exchange of Flight Intents
      - Flight and Flow Coordination
    - **BLOCK 2**
      - B3-FICE, B3-TRO
      - (initial FF-ICE)
      - 4D Trajectories, Full FF-ICE
    - **BLOCK 3**
      - FIXM

- **CAPABILITIES**
  - **AIR/AIM**
    - B0-DATM
    - B1-DATM
    - AIS-AIM Enhanced quality
    - Paper -> Digital data availability
    - Digital NOTAM
    - Electronic Charts, Digital Briefing, In Flight updates
  - **MeteOROLOGY**
    - B1-DATM, B1-AMET
    - Digital MET Data exchange & MET information services
    - In Flight updates
    - Traditional alphanumeric codes replaced by digital data enhanced quality

- **ENABLERS**
  - eAIP, AIXM
  - WOXIM
Air navigation implementation overview
Global Air Navigation Plan references

<table>
<thead>
<tr>
<th>SWIM</th>
<th>BLOCK 0</th>
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<td>2018</td>
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<td>SWIM A-G</td>
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<td>B1-FICE, DAIM, SWIM (Ground-Ground): Flight Intent before departure, ATM Information exchanges</td>
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<td>B2-FICE SWIM (Ground-Ground): Inter-Centre coordination</td>
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<td>B2-SWIM SWIM (Air-Ground): Aircraft integration</td>
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<td>ATM Information Reference and Service Model, Common Governance, ISO, OGC, etc.</td>
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</table>
Performance Improvement Areas (PIA)

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

ASBU Implementation Overview

- Block 0: 18 Modules (2013)
- Block 1: 17 Modules (2018)
- Block 2: 10 Modules (2023)
- Block 3: 7 Modules (2028 & >)

Modules:
- B0-15
- B1-15
- B2-15
- B3-15
**ASBU Implementation Overview**

**Current methodology**
- Scope covers only ground equipment for ANSPs
- Planning based on short and medium term
- Implementation process is through GPIs

**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
<table>
<thead>
<tr>
<th>Old ASBU Modules Numbering System</th>
<th>New ASBU Modules Identifiers</th>
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<tr>
<td>65 APTA</td>
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<td>70 WAKE</td>
<td>Wake Turbulence Separation</td>
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<td>15 RSEQ</td>
<td>Runway Sequencing</td>
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<td>75 SURF</td>
<td>Surface Operations</td>
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<td>80 ACDM</td>
<td>Airport Collaborative Decision Making</td>
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<td>81 RATS</td>
<td>Remote Air Traffic Services</td>
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<td>25 FICE</td>
<td>FF/ICE</td>
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<td>30 DATM</td>
<td>Digital Aeronautical Management</td>
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<td>31 SWIM</td>
<td>System Wide Information Management</td>
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<td>105 AMET</td>
<td>Advanced Meteorological Information</td>
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<td>10 FRTO</td>
<td>Free Route Operations</td>
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<td>84 ASUR</td>
<td>Alternative Surveillance</td>
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<td>85 ASEP</td>
<td>Airborne Separation</td>
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<tr>
<td>86 OPFL</td>
<td>Optimum Flight Levels</td>
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<tr>
<td>101 ACAS</td>
<td>Airborne Collision Avoidance Systems</td>
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<tr>
<td>102 SNET</td>
<td>Ground-Based Safety Nets</td>
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<td>05 CDO</td>
<td>Continuous Descent Operations</td>
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<td>40 TBO</td>
<td>Trajectory-Based Operations</td>
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<td>20 CCO</td>
<td>Continuous Climb Operations</td>
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<tr>
<td>90 RPAS</td>
<td>Remotely Piloted Aircraft Systems</td>
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</table>
• 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 equipage and provides baseline
• Modules lacking specific maturity are purposefully placed in later blocks
• Block upgrades respond to issue of non-homogeneous areas

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

• 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
ADS-B as key enabler of the ASBU implementation

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

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<td>Operations approvals</td>
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**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.

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**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**

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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.

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</table>
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 term 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.

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</table>
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.

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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

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</table>
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**

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Volume III contains dynamic/flexible plan elements related to the implementation of the air navigation system and its modernization in line with the ICAO Aviation System Block Upgrades (ASBUs) and associated technology roadmaps described in the Global Air Navigation Plan (GANP).

Appendix B - Main Planning Table Template

<table>
<thead>
<tr>
<th>Block</th>
<th>ASBU modules and elements</th>
<th>Performance Improvement Area</th>
<th>Applicable or not in Region (Yes/No)</th>
<th>Regional planning elements</th>
<th>Enablers</th>
<th>Priority allocated in Region</th>
<th>Target(s) in Region</th>
<th>Indicator(s) / Metric(s)</th>
<th>Supporting Planning Document (ARNP, other)</th>
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