ICAO Aviation System Block Upgrades (ASBU)
Regional Performance Objectives & Technology Roadmaps

Prosper Zo’o Minto’o
Acting Regional Director
Eastern and Southern African Regional Office

ICAO ASBU REGIONAL WORKSHOP/SEMINAR
Addis Ababa, Ethiopia, 17-19 November 2014
Outline

- Overview of Aviation System Block Upgrades (ASBU)
- Technology Roadmaps
- Economic Aspects
- Global & Regional Planning Process
- AFI Regional Requirements (Focus on Technology & Information Management)
  - Regional Performance Objectives (SP AFI RAN 2008)
  - Air Navigation System Implementation Plan - Alignment with ASBU Methodology (APIRG/19 & APIRG/EO)
Outline

✓ Overview of Aviation System Block Upgrades (ASBU)

• Technology Roadmaps
• Economic Aspects
• Global & Regional Planning Process
• AFI Regional Requirements (Focus on Technology & Information Management)
  – Regional Performance Objectives (SP AFI RAN 2008)
  – Air Navigation System Implementation Plan - Alignment with ASBU Methodology (APIRG/19 & APIRG/EO)
Today’s Challenges

• Current and projected traffic growth

• Air traffic growth expands two-fold every 15 years
  
  – Growth can be a double-edged sword: How to achieve both safety and operational improvements?
Continuous growth of air traffic

Note: world total scheduled services

Revenue Passenger-Kilometres (billion)

- 1945
- 1950
- 1955
- 1960
- 1965
- 1970
- 1975
- 1980
- 1985
- 1990
- 1995
- 2000
- 2005
- 2010
- 2015

- Oil crisis
- Iran-Iraq war
- Gulf crisis
- Asian crisis
- 9/11 terrorist attack
- SARS
- World recession

5.7 trillion

+5.2% growth rate vs. 2012

Revenue Passenger-Kilometres in 2013*

*preliminary results
Air Transport in 2013*

- 3.1 billion passengers carried, +5% vs 2012
- 5.7 trillion Revenue Passenger-Kilometres, +5.2% vs 2012
- 32 million aircraft departures, vs 31 million in 2012
- 184 billion Freight Tonne-kilometres, +1% vs 2012

Note: world scheduled services

*preliminary results
Aircraft Movement Shares by Route Group 2012 and 2032
Africa-Europe, Africa-Middle East, Africa-North America, Africa-Asia/Pacific, Intra-Africa

Source: ICAO
Today’s Challenges

• Training and re-training of personnel
• Insufficient **financial and human resources** worldwide
• Existing **deficiencies**
• Political, institutional and legal challenges
Tomorrow’s Needs

Global framework is needed to ensure:

• Safety is maintained and enhanced
• ATM improvement programmes are harmonized
• Barriers to future efficiency and environmental gains are removed, at reasonable cost
Global Air Navigation Plan: Innovation and Best Practices

CREATE A PLAN
GANP

• To support a globally harmonized air navigation system, ICAO has developed the fourth edition of the GANP to
  – provide clear guidance on the guiding operational targets and supporting technologies, avionics, procedures, standards and regulatory approvals needed to realize them.
  – establish a framework for incremental implementations based on the specific operational profiles and traffic densities of each State.
• This is accomplished through the Aviation System Block Upgrades (ASBUs), a consensus-driven framework which forms the basis of the revised GANP.
ICAO’s Role in ATM Modernization

“Increase the capacity and improve the efficiency of the global civil aviation system”

- Through the GANP, offer a long-term vision to assist all aviation stakeholders, and ensure continuity and harmonization among modernization programmes.

- Through the Aviation System Block Upgrades (ASBU), provide a consensus-driven modernization strategy for integrated planning.
GANP- Contents (DOC 9750)

Strategic Objective: Capacity and Efficiency

Executive summary
Introduction: Presentation of GANP
Chapter 1: ICAO’s Ten Key Air Navigation Policy Principles
Chapter 2: Implementation
Chapter 3: Aviation System Performance
Appendices:
  Appendix 1 Global Air Navigation Plan Evolution and Governance
  Appendix 2 Aviation System Block Upgrades
  Appendix 3 Hyperlinked Online Support Documentation
  Appendix 4 Frequency Spectrum Considerations
  Appendix 5 Technology Roadmaps
  Appendix 6 Module Dependencies
  Appendix 7 Acronym Glossary
GANP Policy Principles

1. Commitment to the Implementation of ICAO’s Strategic Objectives and KPAs
2. Aviation Safety is the highest priority
3. Tiered Approach to Air Navigation Planning
4. Global Air Traffic Management Operational Concept (GATMOC)
5. Global Air Navigation Priorities
6. Regional and State Air Navigation Priorities
7. Aviation System Block Upgrades (ASBUs), Modules and Roadmaps
8. Use of ASBU Blocks and Modules
9. Cost Benefit and Financial issues
Aviation System Block Upgrades

- What is an ‘Aviation System Block Upgrade’ (ASBU) Module?
- 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
ASBU Performance Improvement Areas & Blocks

Performance Improvement Areas

Airport Operations

Globally Interoperable Systems and Data

Optimum Capacity and Flexible Flights

Efficient Flight Path

Block 0 (2013)

Block 1 (2018)

Block 2 (2023)

Block 3 (2028 onward)

Module
**Performance Improvement Area 3:**
**Optimum Capacity and Flexible Flights – Through Global Collaborative ATM**

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<th>Block 0</th>
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| **B0-FRTO**
Improved Operations through Enhanced En-Route Trajectories
To allow the use of airspace which would otherwise be segregated (i.e. military airspace) along with flexible routing adjusted for specific traffic patterns. This will allow greater routing possibilities, reducing potential congestion on trunk routes and busy crossing points, resulting in reduced flight length and fuel burn. | **B1-FRTO**
Improved Operations through Optimized ATS Routing
Introduction of free routing in defined airspace, where the flight plan is not defined as segments of a published route network or track system to facilitate adherence to the user-preferred profile. | | |
| **B0-NOPS**
Improved Flow Performance through Planning based on a Network-Wide view
Collaborative ATFM measures to regulate peak flows involving departure slots, managed rate of entry into a given piece of airspace for traffic along a certain axis, requested time at a waypoint or an FIR/sector boundary along the flight, use of miles-in-trail to smooth flows along a certain traffic axis and re-routing of traffic to avoid saturated areas. | **B1-NOPS**
Enhanced Flow Performance through Network Operational Planning
ATFM techniques that integrate the management of airspace, traffic flows including initial user driven prioritization processes for collaboratively defining ATFM solutions based on commercial/operational priorities. | **B2-NOPS**
Increased user involvement in the dynamic utilization of the network
Introduction of CDM applications supported by SWIM that permit airspace users to manage competition and prioritization of complex ATFM solutions when the network or its nodes (airports, sectors) no longer provide capacity commensurate with user demands. | **B3-NOPS**
Traffic Complexity Management
Introduction of complexity management to address events and phenomena that affect traffic flows due to physical limitations, economic reasons or particular events and conditions by exploiting the more accurate and rich information environment of a SWIM-based ATM. |
| **B0-ASUR**
Initial Capability for Ground Surveillance
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. This capability will be expressed in various ATM services, e.g. traffic information, search and rescue and separation provision. | | | |
Performance Improvement Area 2: 
Globally Interoperable Systems and Data – Through Globally Interoperable System Wide Information Management

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</table>
| B0-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 in ICAO Doc 9694. |
| B1-FICE | Increased Interoperability, Efficiency and Capacity through FF-ICE, Step 1 application before Departure
Introduction of FF-ICE Step 1, to implement ground-ground exchanges using common flight information reference model, FIXM, XML and the flight object used before departure. |
| B2-FICE | Improved Coordination through multi-centre Ground-Ground Integration: (FF-ICE/1 and Flight Object, SWIM)
FF-ICE supporting trajectory-based operations through exchange and distribution of information for multicentre operations using flight object implementation and IOP standards. |
| B3-FICE | Improved Operational Performance through the introduction of Full FF-ICE
All data for all relevant flights systematically shared between air and ground systems using SWIM in support of collaborative ATM and trajectory-based operations. |
| B0-DATM | Service Improvement through Digital Aeronautical Information Management
Initial 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. |
| B1-DATM | Service Improvement through Integration of all Digital ATM Information
Implementation of the ATM information reference model integrating all ATM information using UML and enabling XML data representations and data exchange based on internet protocols with WXXM for meteorological information. |
| B1-SWIM | Performance Improvement through the application of System-Wide Information Management (SWIM)
Implementation of SWIM services (applications and infrastructure) creating the aviation intranet based on standard data models, and internet-based protocols to maximize interoperability. |
| B2-SWIM | Enabling Airborne Participation in collaborative ATM through SWIM
Connection of the aircraft an information node in SWIM enabling participation in collaborative ATM processes with access to rich voluminous dynamic data including meteorology. |
| B0-AMET | Meteorological information supporting enhanced operational efficiency and safety
Global, regional and local meteorological information provided by world area forecast centres, volcanic ash advisory centres, tropical cyclone advisory centres, aerodrome meteorological offices and meteorological watch offices in support of flexible airspace management, improved situational awareness and collaborative decision-making, and dynamically-optimized flight trajectory planning. |
| B1-AMET | Enhanced Operational Decisions through Integrated Meteorological Information (Planning and Near-term Service)
Meteorological information supporting automated decision processes or aids involving: meteorological information, meteorological translation, ATM impact conversion and ATM decision-making support. |
| B3-AMET | Enhanced Operational Decisions through Integrated Meteorological Information (Near-term and Immediate Service)
Meteorological information supporting both air and ground automated decision support aids for implementing weather mitigation strategies. |
## Performance Improvement Area 1:
Airport Operations

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| **B0-APTA**
Optimization of Approach Procedures including vertical guidance
This is the first step toward universal implementation of GNSS-based approaches. | **B1-APTA**
Optimised Airport Accessibility
This is the next step in the universal implementation of GNSS-based approaches. | **B2-WAKE** (*)
Advanced Wake Turbulence Separation (Time-based)
The application of time-based aircraft-to-aircraft wake separation minima and changes to the procedures the ANSP uses to apply the wake separation minima. | **B3-RSEQ**
Integrated AMAN/DMAN
Fully synchronized network management between departure airports and arrival airports for all aircraft in the air traffic system at any given point in time. |

| **B0-WAKE**
Improved Runway Throughput through Optimized Wake Turbulence Separation
Improved throughput on departure and arrival runways through the revision of current ICAO wake vortex separation minima and procedures. | **B1-WAKE**
Increased Runway Throughput through Dynamic Wake Turbulence Separation
Improved throughput on departure and arrival runways through the dynamic management of wake vortex separation minima based on the real-time identification of wake vortex hazards. | **B2-RSEQ**
Linked AMAN/DMAN
Synchronized AMAN/DMAN will promote more agile and efficient on-route and terminal operations. | **B3-RSEQ**
Improved Traffic Flow through Sequencing
(A-MAN/DMAN)
Time-based metering to sequence departing and arriving flights. |

| **B0-SURF**
Safety and Efficiency of Surface Operations (A-SMGCS Level 1-2)
Airport surface surveillance for ANSP. | **B1-SURF**
Enhanced Safety and Efficiency of Surface Operations - SURF, SURF IA and Enhanced Vision Systems (EVS)
Airport surface surveillance for ANSP and flight crews with safety logic, cockpit moving map displays and visual systems for taxi operations. | **B2-SURF**
Optimized Surface Routing and Safety Benefits
(A-SMGCS Level 3-4 and SVS)
Taxi routing and guidance evolving to trajectory based on ground/cockpit monitoring and data link delivery of clearances and information. Cockpit synthetic visualization systems. | **B3-ACDM**
Improved Airport Operations through Airport-CDM
Airport operational improvements through the way operational partners at airports work together. |

| **B0-ACDM**
Improved Airport Operations through Airport-CDM
Airport operational improvements through the way operational partners at airports work together. | **B1-ACDM**
Optimized Airport Operations through Airport-CDM
Airport operational improvements through the way operational partners at airports work together. | **B2-RATS**
Remotely Operated Aerodrome Control
Remotely operated Aerodrome Control Tower contingency and remote provision of ATS to aerodromes through visualization systems and tools. | 11/18/2014 |
### Performance Improvement Area 3:
**Optimum Capacity and Flexible Flights – Through Global Collaborative ATM**

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| **B0-ASEP**  
Air Traffic Situational Awareness (ATSA)  
Two ATSA 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)  

| B1-ASEP  
Increased Capacity and Efficiency through Interval Management  
Interval Management (IM) improves the management of traffic flows and aircraft spacing. Precise management of intervals between aircraft with common or merging trajectories maximizes airspace throughput while reducing ATC workload along with more efficient aircraft fuel burn. |

| B2-ASEP  
Airborne Separation (ASEP)  
Creation of operational benefits through temporary delegation of responsibility to the flight deck for separation provision with suitably equipped designated aircraft, thus reducing the need for conflict resolution clearances while reducing ATC workload and enabling more efficient flight profiles. |

| B0-OPFL  
Improved access to Optimum Flight Levels through Climb/Descent Procedures using ADS-B  
This prevents an aircraft being trapped at an unsatisfactory altitude and thus incurring non-optimal fuel burn for prolonged periods. The main benefit of ITP is significant fuel savings and the uplift of greater payloads. |

| B0-ACAS  
ACAS Improvements  
To provide short-term improvements to existing airborne collision avoidance systems (ACAS) to reduce nuisance alerts while maintaining existing levels of safety. This will reduce trajectory perturbation and increase safety in cases where there is a breakdown of separation. |

| B2-ACAS  
New Collision Avoidance System  
Implementation of Airborne Collision Avoidance System (ACAS) adapted to trajectory-based operations with improved surveillance function supported by ADS-B aimed at reducing nuisance alerts and deviations. The new system will enable more efficient operations and procedures while complying with safety regulations. |

| B0-SNET  
Increased Effectiveness of Ground-based Safety Nets  
This Module 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). |

| B1-SNET  
Ground-based Safety Nets on Approach  
This Module enhances the safety provide by the previous Module by reducing the risk of controlled flight into terrain accidents on final approach through the use of Approach Path Monitor (APM). |
### Performance Improvement Area 4:
Efficient Flight Paths – Through Trajectory-based Operations

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<tr>
<td><strong>R0-CDO</strong></td>
<td><strong>R1-CDO</strong></td>
<td><strong>R2-CDO</strong></td>
<td><strong>R3-CDO</strong></td>
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<tr>
<td>Improved Flexibility and Efficiency in Descent Profiles (CDO)</td>
<td>Improved Flexibility and Efficiency in Descent Profiles (CDO) using VNAV</td>
<td>Improved Flexibility and Efficiency in Descent Profiles - Continuous Descent Operations (CDOs) using VNAV, required speed and time of arrival</td>
<td>Improved Flexibility and Efficiency in Departure Profiles - Continuous Climb Operations (CGO)</td>
</tr>
<tr>
<td>Deployment of performance-based airspace and arrival procedures that allow the aircraft to fly their optimum aircraft profile taking account of airspace and traffic complexity with continuous descent operations (CDOs).</td>
<td>Deployment of performance-based airspace and arrival procedures that allow the aircraft to fly their optimum aircraft profile taking account of airspace and traffic complexity with Optimized Profile Descents (OPDs).</td>
<td>Deployment of performance-based airspace and arrival procedures that optimize the aircraft profile taking account of airspace and traffic complexity including optimized profile descents (OPDs), supported by trajectory-based operations and self-separation.</td>
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<tr>
<td><strong>R0-TBO</strong></td>
<td><strong>R1-TBO</strong></td>
<td><strong>R2-TBO</strong></td>
<td><strong>R3-TBO</strong></td>
</tr>
<tr>
<td>Improved Safety and Efficiency through the initial application of Data Link En-Route</td>
<td>Improved Traffic Synchronization and Initial Trajectory-Based Operation</td>
<td>Full 4D Trajectory-based Operations</td>
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<tr>
<td>Implementation of an initial set of data link applications for surveillance and communications in ATC.</td>
<td>Improve the synchronization of traffic flows at en-route merging points and to optimize the approach sequence through the use of 4DTRAD capability and airport applications, e.g. D-TAXI, via the air-ground exchange of aircraft derived data related to a single controlled time of arrival (CTA).</td>
<td>Trajectory-based operations deploys an accurate four-dimensional trajectory that is shared among all of the aviation system users at the core of the system. This provides consistent and up-to-date information system-wide which is integrated into decision support tools facilitating global ATM decision-making.</td>
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<tr>
<td><strong>R0-CCO</strong></td>
<td><strong>B1-RPAS</strong></td>
<td><strong>B2-RPAS</strong></td>
<td><strong>B3-RPAS</strong></td>
</tr>
<tr>
<td>Improved Flexibility and Efficiency in Departure Profiles - Continuous Climb Operations (CGO)</td>
<td>Initial Integration of Remotely Piloted Aircraft (RPA) Systems into non-segregated airspace</td>
<td>RPA Integration in Traffic</td>
<td>RPA Transparent Management</td>
</tr>
<tr>
<td>Deployment of departure procedures that allow the aircraft to fly their optimum aircraft profile taking account of airspace and traffic complexity with continuous climb operations (CCOs).</td>
<td>Implementation of basic procedures for operating RPA in non-segregated airspace including detect and avoid.</td>
<td>Implements refined operational procedures that cover lost link (including a unique squawk code for lost link) as well as enhanced detect and avoid technology.</td>
<td>RPA operate on the aerodrome surface and in non-segregated airspace just like any other aircraft.</td>
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Block 0 in Perspective

- 4 Performance Improvement Areas
  - Airport Operations (5 modules)
  - Globally interoperable systems & data (3 modules)
  - Optimum capacity & flexible flights (7 modules)
  - Efficient flight path (3 modules)

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

• Block 0 initiatives must leverage on existing on-board avionics

• 3 Priorities have been agreed to by the Global community:
  – Performance Based Navigation (PBN)
  – Continuous Descent Operations (CDO)
  – Continuous Climb Operations (CCO)
Outline

• Overview of Aviation System Block Upgrades (ASBU)
  ✓ Technology Roadmaps
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Technology Roadmaps

- The ASBUs are supplemented by Communications, Navigation, Surveillance, Avionics and Information Management Roadmaps.
- The ASBUs and associated technology roadmaps are an integral part of the GANP.
- The GANP represents a rolling, fifteen–year strategic methodology which leverages existing technologies and anticipates future developments based on State/Industry agreed operational objectives.
- This will enable sound investment strategies and help to generate the required commitment to the Plan from States, equipment manufacturers, operators and service providers.
<table>
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<tr>
<th>Enablers</th>
<th>2018</th>
<th>2023</th>
<th>2028</th>
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<tr>
<td><strong>Conventional</strong></td>
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<tr>
<td>ILS/MLS</td>
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<tr>
<td>Retain to support precision approach and to mitigate GNSS outage</td>
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<tr>
<td>DME</td>
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<tr>
<td>Optimize existing network to support PBN operations</td>
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<td>VOR/NDB</td>
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<tr>
<td>Rationalize based on need and equipage</td>
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<tr>
<td><strong>Satellite-based</strong></td>
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<td>Core GNSS Constellations</td>
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<tr>
<td>Single frequency (GPS/GLONASS)</td>
<td>Multi-Freq/Multi-Constellation (GPS/GLONASS/Beidou/Galileo)</td>
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<td>GNSS Augmentations</td>
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<td>SBAS</td>
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<td>GBAS Cat I</td>
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<td>GBAS Cat II/III</td>
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<td>Multi-Freq GBAS/SBAS</td>
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<td><strong>Capability</strong></td>
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<td><strong>PBN</strong></td>
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<td>(see PBN Roadmap)</td>
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<td>B0-APTA, B0-CDO, B0-FRTO</td>
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<td>B1-FRTO, B1-TBO</td>
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<td>B2-CDO</td>
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<td>B3-CDO, B3-FRTO</td>
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<td><strong>Precision Approach</strong></td>
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<td>ILS/MLS</td>
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<tr>
<td>GBAS Cat I</td>
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<tr>
<td>Cat I/II/III SBAS LPV 200</td>
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<td>B0-APTA</td>
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<td>B1-APTA</td>
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<tr>
<td><strong>CAT I/II/III Landing</strong></td>
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<tr>
<td>GBAS Cat II/III</td>
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<td>2018</td>
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<td><strong>En-Route Oceanic</strong></td>
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<td>and Remote Continental</td>
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<td><strong>RNAV FRTO (RNP FRTO)</strong></td>
<td>RNP 4</td>
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<td><strong>RNAV 5</strong></td>
<td>RNP 2</td>
<td>Advanced RNP</td>
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<td><strong>RNAV 2</strong></td>
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<td>RNP 0.3 (Helicopter only)</td>
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<td><strong>RNAV 1</strong></td>
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<td><strong>Basic RNP 1</strong></td>
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<td><strong>Advanced RNP</strong></td>
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<td><strong>RNP 4</strong></td>
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<td><strong>RNP 2</strong></td>
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<td><strong>RNP 0.3</strong></td>
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<td><strong>RNP APCH (SBAS: LPV, BARO VNAV: LNAV/VNAV, Basic GNSS: LNAV)</strong></td>
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<td><strong>RNP AR APCH</strong> (where beneficial)</td>
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*Migration path based on Region/States requirements*
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<th>Capability</th>
<th>Ground-Based</th>
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<tr>
<td><strong>Surface</strong></td>
<td><strong>Capability</strong></td>
<td><strong>Ground-Based</strong></td>
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<tr>
<td>B0-SURF</td>
<td>B1-SURF, B1-RSEQ,</td>
<td>B0-ASUR, B0-SNET, B0-TBO</td>
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<tr>
<td>B1-RTRWR</td>
<td>B1-WAKE, B1-SURF,</td>
<td>B1-SNET, B1-TBO</td>
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<tr>
<td></td>
<td>B1-RSEQ, B1-RTWR</td>
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<td></td>
<td>B2-SURF</td>
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<tr>
<td>SMR</td>
<td>MLAT</td>
<td>PSR</td>
</tr>
<tr>
<td>ADS-B In/Out (ICAO Ver. 2)</td>
<td>Cameras</td>
<td>MultiStatic PSR</td>
</tr>
<tr>
<td>SMGCS Level 1 and 2</td>
<td></td>
<td>SSR/Mode-S</td>
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<tr>
<td>SMGCS Level 3 and 4</td>
<td></td>
<td>WAM</td>
</tr>
<tr>
<td>Ground-based surveillance</td>
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<td>ADS-B In/Out (ICAO Ver. 2)</td>
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### Avionics

<table>
<thead>
<tr>
<th>Block</th>
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<tbody>
<tr>
<td><strong>FANS 1/A with Comm, Nav integration (through ACARS)</strong></td>
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<tr>
<td><strong>Block 0</strong></td>
<td><strong>B0-OPFL, B0-TBO, B0-FRT0</strong></td>
<td><strong>B1-RSEQ</strong></td>
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<tr>
<td><strong>FANS 2/B with Comm integration (through ATN B1)</strong></td>
<td></td>
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<tr>
<td><strong>Block 1</strong></td>
<td><strong>B1-RSEQ, B1-TBO</strong></td>
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<tr>
<td><strong>FANS 3/C with CNS Integration (via ATN B2)</strong></td>
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<tr>
<td><strong>Block 2</strong></td>
<td><strong>B2-SURF, B2-ASEP, B2-CDO</strong></td>
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<td><strong>B3-ASEP, B3-CDO</strong></td>
</tr>
<tr>
<td><strong>Aircraft access to SWIM</strong></td>
<td></td>
<td></td>
<td><strong>B3-FICE, B3-AMET, Traffic Computer</strong></td>
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<tr>
<td><strong>Block 3</strong></td>
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### Surveillance

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<tbody>
<tr>
<td><strong>Block 0</strong></td>
<td><strong>B0-ASEP, B0-OPFL</strong></td>
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<tr>
<td><strong>Block 1</strong></td>
<td><strong>B1-SURF, B1-ASEP, B1-SNET</strong></td>
<td><strong>B2-SURF, B2-ASEP, B2-ACAS</strong></td>
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<tr>
<td><strong>Block 2</strong></td>
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<td><strong>B3-ASEP</strong></td>
</tr>
<tr>
<td><strong>Surveillance Integration (via ATN B2)</strong></td>
<td></td>
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<tr>
<td><strong>Block 3</strong></td>
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### Information Management

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<th>Block 2</th>
<th>2028</th>
<th>Block 3</th>
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<tbody>
<tr>
<td><strong>SWIM CONOPS</strong></td>
<td></td>
<td><strong>SWIM G-G</strong></td>
<td></td>
<td><strong>SWIM A-G</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B1-FICE, DATM, SWIM SWIM (Ground-Ground): Flight Intents before departure, ATM information exchanges</td>
<td></td>
<td>B2-FICE SWIM (Ground-Ground): Inter-Centre coordination</td>
<td></td>
<td>B2-SWIM SWIM (Air-Ground): Aircraft integration</td>
<td></td>
<td>ATM Information Reference &amp; Service Model, Common governance, ISO, OGC, ...</td>
</tr>
</tbody>
</table>

### Flight and Flow

#### Capability

- **AIS/AIM**
  - B0-DATM
  - AIS-AIM
    - Enhanced quality
    - Paper → Digital data availability
  - Digital NOTAM

- **Meteorology**
  - B1-DATM
  - B1-MET
    - Traditional alphanumerical codes replaced by digital data; enhanced quality
    - Digital MET Data exchange & MET information services. In Flight updates

- **Enablers**
  - eAIP, AIXM

- **Enablers**
  - FIXM
    - Electronic Charts, Digital Briefing, In Flight updates
    - Digital Data exchange & services, shorter update cycles
  - WXXM
    - 4D Trajectories, Full FF-ICE
    - Flight and Flow Coordination (initial FF-ICE)
Outline

• Overview of Aviation System Block Upgrades (ASBU)
• Technology Roadmaps
✓ Economic Aspects
• Global & Regional Planning Process
• AFI Regional Requirements (Focus on Technology & Information Management)
  – Regional Performance Objectives (SP AFI RAN 2008)
  – Air Navigation System Implementation Plan - Alignment with ASBU Methodology (APIRG/19 & APIRG/EO)
Multidisciplinary Working Group on the Aviation System Block Upgrades

ICAO Strategic Objective:

Economic Development of Air Transport
ICAO policies and guidance

• Policies are not mandatory but States have a moral obligation to adhere to them: Conferences, Council, Assembly
• Chicago Convention – Article 15: basis for key policies (non-discrimination, cost-relatedness and transparency)
• Guidance materials
  • Doc 9082 – ICAO’s Policies on Charges for Airports and Air Navigation Services
  • Doc 9161 – Manual on Air Navigation Services Economics
  • GNSS – ANSEP Report and Council Provisional Policy Guidance
ICAO’s financing policies

- The cost basis for air navigation services (ANS) charges
- The cost recovery for (ANS) charges
- Pre-funding of projects
- Financing ANS Infrastructure
- GNSS provision and operation
Challenges

- Consensus on the ultimate benefits of the future air navigation systems.
- BUT airlines are not making the needed aircraft equipage investments an estimated USD 150,000 to USD 1 million per aircraft.
- Many airline balance sheets remain weakened since 2001, making the cost of discretionary, non-aircraft capital expensive, such as new avionics equipage not a top priority compared to protecting cash flow remains a top priority.
- There are uncertainties in the benefits from the new ATM operating and technology requirements, harmonization, and benefits.
- Investments in the necessary cockpit technology will need to be supported by a strong cost/benefit analysis.

Without aircraft equipage ASBUs cannot produce operational benefits
General trend in the variation of the main factors of the ATM system

- $N$ — collision risk
- $F$ — fuel conservation
- $E$ — material expenditure
- $T$ — time

$E_1$ (future system)

$E_0$ (traditional system)

Gain
Incentives for economic pricing

Incentive:
an instrument that incites a particular course of action

- financial reward (or penalty) or a change in operational efficiency.
- through charging scheme to encourage users to act in ways that will lead to the desired outcome.

Incentive would affect users’ decisions on fleet renewal or on the selection of types of aircraft used

- Non-discrimination, cost-relatedness, transparency, consultation with users
Cost-Benefit Analysis (CBA)

- The benefits from ASBUs need to exceed the costs of implementing them.
- Costs and Benefits to be shared between:
  - States
  - Airlines
  - Air Navigation Service Providers
  - Airports
  - Passengers

Challenges

- Difficulty of qualifying the impact of relevant factors which will affect the actual economic outcome.
- Choice of implementation option.
CBA – Sensitivity Analysis

Assumptions are required, for example, for:

- Traffic forecasts
- Capital cost of equipment
- Avionics prices
- Proportion of the fleet equipped
- Efficiency improvements for aircraft
- Value per hour of passenger time saved
Financing Air Transport

• Existing ICAO policies for Infrastructure (airports and Air Navigation Service Providers)

• No policies for airlines nor aircraft manufacturers

• Implementation of the Aviation System Block Upgrades (ASBUs):
  – economic and operational challenges associated with the air navigation services upgrades in particular, and with financing the air transport system in general.
Background

- **November 2012: Twelfth Air Navigation Conference - AN-Conf/12**
  - Recommendation 6/3 b)

- **March 2013: Sixth Worldwide Air Transport Conference - AT-Conf/6**
  - Recommendation 2.7/1b for the multi-disciplinary working group on ASBUs

- **June 2013: ICAO Council (199th session)**
  - Approved Recommendation 2.7/1b) of AT-Conf/6

- **September 2013: ICAO 38th Assembly**
  - Resolution A38/14 – Appendix E – 7

- **October 2013: State Letter**
ASBUss

- Twelfth Air Navigation Conference (AN-Conf/12), in November 2012,
- Sixth Worldwide Air Transport Conference (ATConf/6), in March 2013.
- The Council, approved recommendations ATConf/6, at the 9th Meeting of its 199th Session,
- Establishment of a multi-disciplinary working group
  - linked to the implementation of the aviation system block upgrades (MDWG-ASBUss).
  - to consider the economic and operational challenges associated with the air navigation services upgrades in particular, and with financing the air transport system in general.
First meeting of MDWG-ASBUs in February 2014

- **2 Co-Secretaries:**
  - 1 from the Air Transport Bureau
  - 1 from the Air Navigation Bureau

- **Members, advisors and observers of:**
  - 13 Member States
  - 12 international and regional organizations

- **51 participants**
4 sub-working groups

- **WG1**: Identification of best practices for incentives (including operational and financial incentives) supporting the implementation of ASBUs

- **WG2**: Business cases and Cost-Benefit Analysis (CBA) for ASBUs implementation

- **WG3**: Schemes to finance the ASBUs implementation

- **WG4**: ICAO Policies: consider how the findings of MDWG-ASBUs are impacting ICAO policies
To be ready for the updated GANP for A39
Contribution of Measures for Reducing International Aviation Net CO₂ Emissions

- 2010 Fleet and Operational Efficiency
- Aircraft Technology
- Sustainable Alternative Fuels and Market-Based Measures

Basket of Measures

International Aviation Net CO₂ Emissions (MT)

Carbon Neutral Growth from 2020
Outline

• Overview of Aviation System Block Upgrades (ASBU)
• Technology Roadmaps
• Economic Aspects
✓ Global & Regional Planning Process
• AFI Regional Requirements (Focus on Technology & Information Management)
  – Regional Performance Objectives (SP AFI RAN 2008)
  – Air Navigation System Implementation Plan - Alignment with ASBU Methodology (APIRG/19 & APIRG/EO)
Regional Implementation – Air Navigation

- Establish Regional Priorities, ASBU Modules & Targets
- Regional workshops and meetings
- Revised PIRG TORs & Work Programme
- PIRG Meeting Reports
- Annual ANC/Council Review

Next GANP 2016

In progress
Regional Implementation Support Mechanisms

• **APIRG**
  - Set regional *air navigation priorities and targets*
  - Support *regional implementation* of the GANP
  - Review air navigation *plans and deficiencies*
  - Involve *all aviation stakeholders* in the region
    - States, ICAO, and international organizations

• **Regional Offices**
  - *Technical evaluation, follow-up and assistance missions to States*
  - *Training* courses, seminars and workshops
  - *Regional* technical cooperation and assistance projects - FPPs
  - *Regional mechanisms* – RASGs and PIRGs
Outline

- Overview of Aviation System Block Upgrades (ASBU)
- Technology Roadmaps
- Economic Aspects
- Global & Regional Planning Process

✓ AFI Regional Requirements *(Focus on Technology & Information Management)*

- Regional Performance Objectives (SP AFI RAN 2008)
- Air Navigation System Implementation Plan - Alignment with ASBU Methodology (APIRG/19 & APIRG/EO)
AFI Regional Performance Objectives

- ASBU Workshop.AFI ATM PFFs.docx
- ASBU Workshop.AFI AIM PFFs.docx
- ASBU Workshop.AFI SAR PFFs.docx
- ASBU Workshop.AFI MET PFFs.docx
- ASBU Workshop.AFI AOP PFFs.docx
- ASBU Workshop.AFI CNS PFFs.docx
Outcome of APIRG/19 –
Implementation of AN-Conf/12 Rec 6/1

APIRG Conclusion 19/06: Adoption of AFI Regional Air Navigation System Implementation Plan aligned with the ICAO Aviation System Block Upgrades

That:

a) AFI States adopt the Regional Air Navigation System Implementation Plan aligned with the 18 Block 0 Modules of the ICAO Aviation System Block Upgrades (ASBU) Methodology, as provided at Appendix 3.0A to this report;

b) That AFI States implement the adopted modules based on their operational needs, the categorization and the prioritization defined in the Action Plan;

c) The Secretariat finalize the implementation targets set for the adopted ASBU Block 0 Modules, and ensure that these targets are aligned with existing regional programmes aimed at enhancing air navigation capacity and efficiency and aviation safety;
APIRG Conclusion 19/06: Adoption of AFI Regional Air Navigation System Implementation Plan aligned with the ICAO Aviation System Block Upgrades

d) The APIRG and the ICAO Regional Offices coordinate the implementation of the ASBU Block 0 Modules related to Safety Key Performance Area with regional aviation safety mechanisms (RASG-AFI, AFI Plan) and other relevant safety initiatives for the AFI Region;

e) ICAO continually provide capacity building through workshops and seminars to AFI States and regional stakeholders as the needs arise in the different levels of ASBUs; and

f) The African Civil Aviation Commission (AFCAC), Regional Economic Communities and Financial institutions to provide their support and assist States the implementation of the AFI Regional Air Navigation System Implementation Action Plan.
## Regional Targets

<table>
<thead>
<tr>
<th>AIR NAV. REGION</th>
<th>REGIONAL OFFICE</th>
<th>SAFETY</th>
<th>AIR NAVIGATION</th>
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<tr>
<td>AFI</td>
<td>ESAF</td>
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<td><strong>ADOPTED</strong></td>
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<tr>
<td>MID</td>
<td>MID</td>
<td><strong>ADOPTED</strong></td>
<td>MSG Meeting</td>
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<tr>
<td></td>
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<td>(DGCA-MID/2 May 2013)</td>
<td>(November 2014)</td>
</tr>
<tr>
<td>ASIA/PAC</td>
<td>APAC</td>
<td>RASG-APAC/4</td>
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<td></td>
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<td>(November 2014)</td>
<td>(APANPIRG/25 - September 2014)</td>
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<td>NAM</td>
<td>NACC</td>
<td>US CAST/Canada</td>
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<td>(NACC/DCA/5 – April 2014)</td>
<td>(NACC/DCA/5 – April 2014)</td>
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<td>CAR</td>
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<td></td>
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<td>(NACC/DCA/5 – April 2014)</td>
<td>(RAAC/13 - December 2013)</td>
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<td>SAM</td>
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<td>EUR/NAT</td>
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<td>EUR/NAT</td>
<td>(RASG-EUR/03 - February 2014)</td>
<td>(EANPG/55 - November 2013)</td>
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<td>EUR/NAT</td>
<td>(NAT SPG/49-June 2013)</td>
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</table>

**Regional Targets**

- ****: Adopted
- **✓**: Meeting
# Regional Targets - Communications

ASBU B0-FICE: Planning Targets and Implementation Progress

<table>
<thead>
<tr>
<th>Elements</th>
<th>Targets and Implementation Progress (Ground and Air)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Complete AMHS implementation at States still not counting with this system</td>
<td>December 2015 – Services provider</td>
</tr>
<tr>
<td>2. AMHS interconnection</td>
<td>December 2015 – Services provider</td>
</tr>
<tr>
<td>3. Implement AIDC/OLDI at some States automated centres</td>
<td>June 2014 – Services provider</td>
</tr>
<tr>
<td>4. Implement operational AIDC/OLDI between adjacent ACCs</td>
<td>June 2015 – Services provider</td>
</tr>
<tr>
<td>5. Implement the AFI Integrated Telecommunication Network</td>
<td>June 2015 – Services provider</td>
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</table>
# Regional Targets – Communications

## ASBU B0-ASUR: Planning Targets and Implementation Progress

<table>
<thead>
<tr>
<th>Elements</th>
<th>Targets and Implementation Progress (Ground and Air)</th>
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</thead>
<tbody>
<tr>
<td>1. Implementation of ADS-B</td>
<td>June 2018 – Users and service provider</td>
</tr>
<tr>
<td>2. Implementation of Multilateration</td>
<td>June 2018 – Users and service provider</td>
</tr>
<tr>
<td>3. Automation system (Presentation)</td>
<td>June 2017 – Users and service provider</td>
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## ASBU B0-TBO: Planning Targets and Implementation Progress

<table>
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<th>Elements</th>
<th>Targets and Implementation Progress (Ground and Air)</th>
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<tbody>
<tr>
<td>1. ADS-C over oceanic and remote areas</td>
<td>June 2018 – Service provider</td>
</tr>
<tr>
<td>2. Continental CPDLC</td>
<td>June 2018 – Service provider</td>
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</table>
### Regional Targets - Surveillance

ASBU B0-SNET: Planning Targets and Implementation Progress

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<thead>
<tr>
<th>Elements</th>
<th>Targets and Implementation Progress (Ground and Air)</th>
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</thead>
<tbody>
<tr>
<td>1. Short Term Conflict Alert (STCA)</td>
<td>June 2014 / Service provider 2013-2018</td>
</tr>
<tr>
<td>3. Minimum Safe Altitude Warning (MSAW)</td>
<td>June 2014</td>
</tr>
<tr>
<td>4. Dangerous Area Infringement Warning (DAIW)</td>
<td>2013-2018</td>
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</tbody>
</table>
### Regional Targets - Navigation

ASBU B0-APTA: Planning Targets and Implementation Progress

<table>
<thead>
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<th>Elements</th>
<th>Targets and Implementation Progress</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(Ground and Air)</td>
</tr>
<tr>
<td>1. APV with Baro-VNAV</td>
<td>December 2016 – Service Providers and users</td>
</tr>
<tr>
<td>2. APV with SBAS</td>
<td>December 2017 – As per AFI-GNSS Strategy.</td>
</tr>
<tr>
<td>3. APV with GBAS</td>
<td>December 2018 – Initial implementation at some States (service providers)</td>
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## Regional Targets - Surveillance

**ASBU B0-SURF: Planning Targets and Implementation Progress**

<table>
<thead>
<tr>
<th>Elements</th>
<th>Targets and Implementation Progress (Ground and Air)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Surveillance system for ground surface movement (PSR, SSR, ADS-B or Multilateration)</td>
<td>December 2017 Service provider</td>
</tr>
<tr>
<td>2. Surveillance system on board (SSR transponder, ADS-B capacity)</td>
<td>December 2017 Service provider</td>
</tr>
<tr>
<td>3. Surveillance system for vehicle</td>
<td>December 2017 Service provider</td>
</tr>
<tr>
<td>4. Visual aids for navigation</td>
<td>December 2015 Service provider</td>
</tr>
<tr>
<td>5. Wildlife strike hazard reduction</td>
<td>December 2015 Aerodrome operator / Wildlife Committee</td>
</tr>
<tr>
<td>6. Display and processing information</td>
<td>December 2017 Service Provider</td>
</tr>
</tbody>
</table>
## Regional Targets - Surveillance

### ASBU B0-SNET: Planning Targets and Implementation Progress

<table>
<thead>
<tr>
<th>Elements</th>
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</thead>
<tbody>
<tr>
<td>1. Short Term Conflict Alert (STCA)</td>
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<td>3. Minimum Safe Altitude Warning (MSAW)</td>
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</tr>
<tr>
<td>4. Dangerous Area Infringement Warning (DAIW)</td>
<td>2013-2018</td>
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</table>
## Regional Targets – Meteorological Information Management

ASBU B0-AMET: Planning Targets and Implementation Progress

<table>
<thead>
<tr>
<th>Elements</th>
<th>Targets and Implementation Progress (Ground and Air)</th>
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</thead>
<tbody>
<tr>
<td>1. WAFS</td>
<td>In process of implementation</td>
</tr>
<tr>
<td>2. IAVW</td>
<td>In process of implementation</td>
</tr>
<tr>
<td>3. Tropical cyclone watch</td>
<td>In process of implementation</td>
</tr>
<tr>
<td>4. Aerodrome warnings</td>
<td>In process of implementation</td>
</tr>
<tr>
<td>5. Wind shear warnings and alerts</td>
<td>50% by December 2014</td>
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<tr>
<td>6. SIGMET</td>
<td>80% by December 2014</td>
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<tr>
<td>7. QMS/MET</td>
<td>75% by December 2014</td>
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<tr>
<td>8. Other OPMET Information (METAR, SPECI, TAF)</td>
<td>In process of improvement</td>
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## Regional Targets – Aeronautical Information Management

ASBU B0-DATM: Planning Targets and Implementation Progress

<table>
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<th>Elements</th>
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<tbody>
<tr>
<td></td>
<td>(Ground and Air)</td>
</tr>
<tr>
<td>1. QMS for AIM</td>
<td>December 2014</td>
</tr>
<tr>
<td>2. e-TOD implementation</td>
<td>December 2016</td>
</tr>
<tr>
<td>3. WGS-84 implementation</td>
<td>Implemented</td>
</tr>
<tr>
<td>4. AIXM implementation</td>
<td>December 2016</td>
</tr>
<tr>
<td>5. e-AIP implementation</td>
<td>December 2014</td>
</tr>
<tr>
<td>6. Digital NOTAM</td>
<td>December 2017</td>
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### Regional Targets – Avionics

ASBU B0-ACAS: Planning Targets and Implementation Progress

<table>
<thead>
<tr>
<th>Elements</th>
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</thead>
<tbody>
<tr>
<td>ACAS II (TCAS Version 7.1)</td>
<td>2013-2018</td>
</tr>
</tbody>
</table>
Air Navigation Dashboard (Africa)
(PBN, ATFM, AIM, Digital ATS Coordination/Transfer)
**REGIONAL/NATIONAL PERFORMANCE OBJECTIVE –**

**B0-CDO: Improved Flexibility and Efficiency in Descent Profiles (CDO)**

**Performance Improvement Area 4:**

**Efficient Flight Path – Through Trajectory-based Operations**

**ASBU B0-CDO: Impact on Main Key Performance Areas (KPA)**

<table>
<thead>
<tr>
<th>Access &amp; Equity</th>
<th>Capacity</th>
<th>Efficiency</th>
<th>Environment</th>
<th>Safety</th>
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<tbody>
<tr>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
</tbody>
</table>

**ASBU B0-CDO: Implementation Targets & Progress**

<table>
<thead>
<tr>
<th>Elements</th>
<th>Implementation Status (Ground and Air)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. CDO</td>
<td></td>
</tr>
<tr>
<td>2. PBN STARs</td>
<td></td>
</tr>
</tbody>
</table>

**ASBU B0-CDO: Implementation Challenges**

<table>
<thead>
<tr>
<th>Elements</th>
<th>Implementation Area</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ground Implementation</td>
</tr>
<tr>
<td>1. CDO</td>
<td></td>
</tr>
<tr>
<td>2. PBN STARs</td>
<td></td>
</tr>
</tbody>
</table>
### ASBU B0-CDO: Performance Monitoring and Measurement (Benefits)

<table>
<thead>
<tr>
<th>Key Performance Areas</th>
<th>Performance Metrics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access &amp; Equity</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Capacity</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Efficiency</td>
<td>Kilograms of fuel saved per flight</td>
</tr>
<tr>
<td>Environment</td>
<td>Kilograms of CO₂ emissions reduced per flight ((=) KGs fuel saved per flight x 3.157)</td>
</tr>
<tr>
<td>Safety</td>
<td>Number of controlled flight into terrain (CFIT) incidents/accidents</td>
</tr>
</tbody>
</table>

### ASBU B0-CDO: Performance Monitoring and Measurement (Implementation)

<table>
<thead>
<tr>
<th>Elements</th>
<th>Implementation Indicators/Metrics</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. CDO</td>
<td>Percentage of international aerodromes/TMA with CDO implemented</td>
</tr>
<tr>
<td>2. PBN STARs</td>
<td>Percentage of international aerodromes/TMA with PBN STARs implemented</td>
</tr>
</tbody>
</table>
APIRG Decision EO/01

That the new organizational structure of APIRG comprising:

- one Projects Coordination Committee (APCC)
- one Airspace and Aerodrome Operations Sub-Group (AAO/SG),
- one Infrastructure and Information Management Sub-Group (IIM/SG), and
- one Traffic Forecasting Group...is adopted and will become effective following the next APIRG meeting;

the preliminary terms of reference of the APCC provided at Appendix D to this report are to be reviewed and finalized at the next APIRG meeting; and

projects be identified from ASBU modules and regional performance objectives adopted by APIRG, to be carried out by teams of experts provided by States and concerned international organizations.
AFI Planning and Implementation Regional Group (APIRG)
New Organizational Structure

APIRG Chairman
Secretary

APIRG Projects Coordination Committee
(APCC)

AFI Traffic Forecasting Working Group

Infrastructure and Information Management Sub-Group (IIM/SG)

Airspace and Aerodrome Operations Sub-Group (AAO/SG)
THANK YOU