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

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ICAO ASBU REGIONAL WORKSHOP/SEMINAR

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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)

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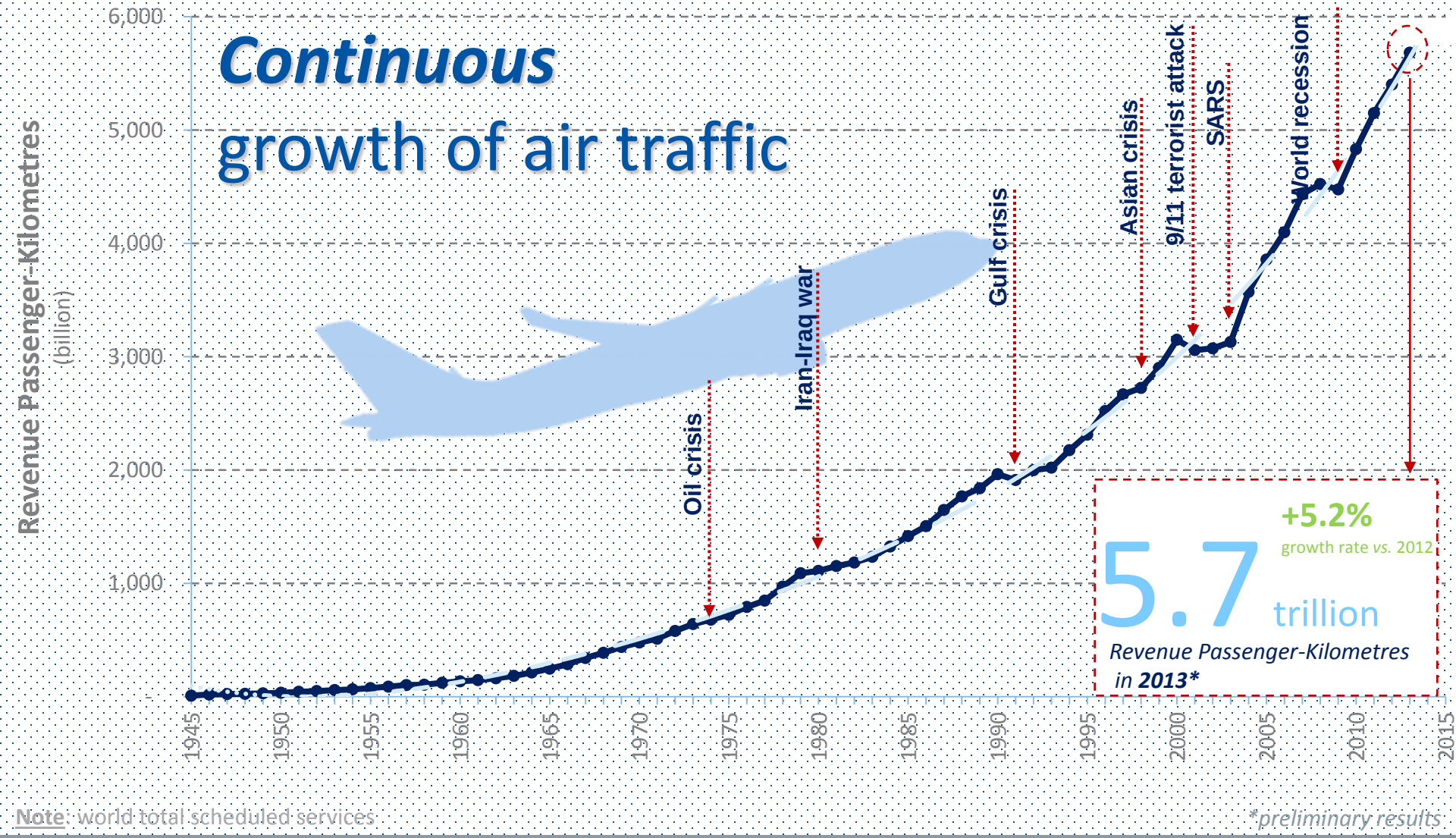
Today's Challenges

- 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

**preliminary results*

Air Transport in 2013*

3.1 billion
+5% ***vs 2012***
Passengers carried

32 million
vs 31 million in 2012
Aircraft departures

5.7 trillion
+5.2% ***vs 2012***
Revenue Passenger-Kilometres

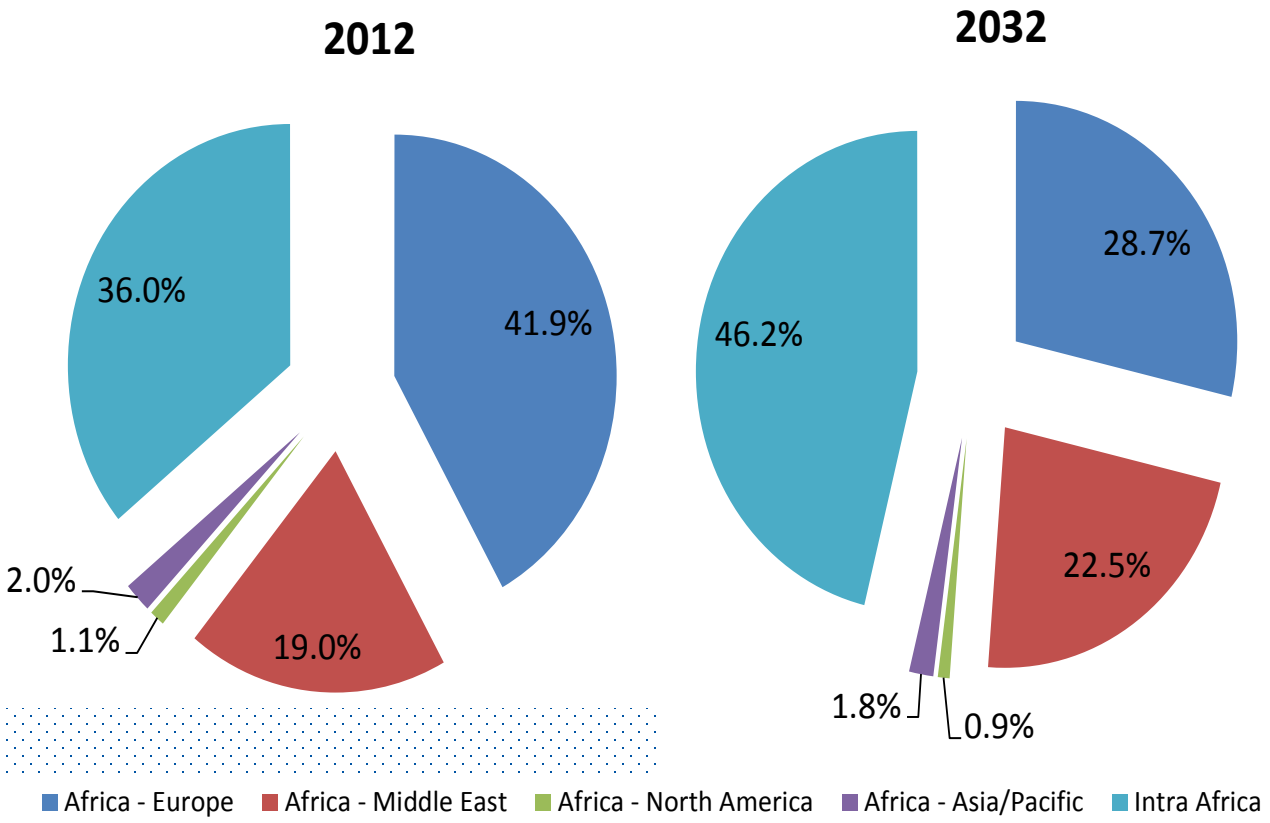
184 billion
+1% ***vs 2012***
Freight Tonne-kilometres

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:

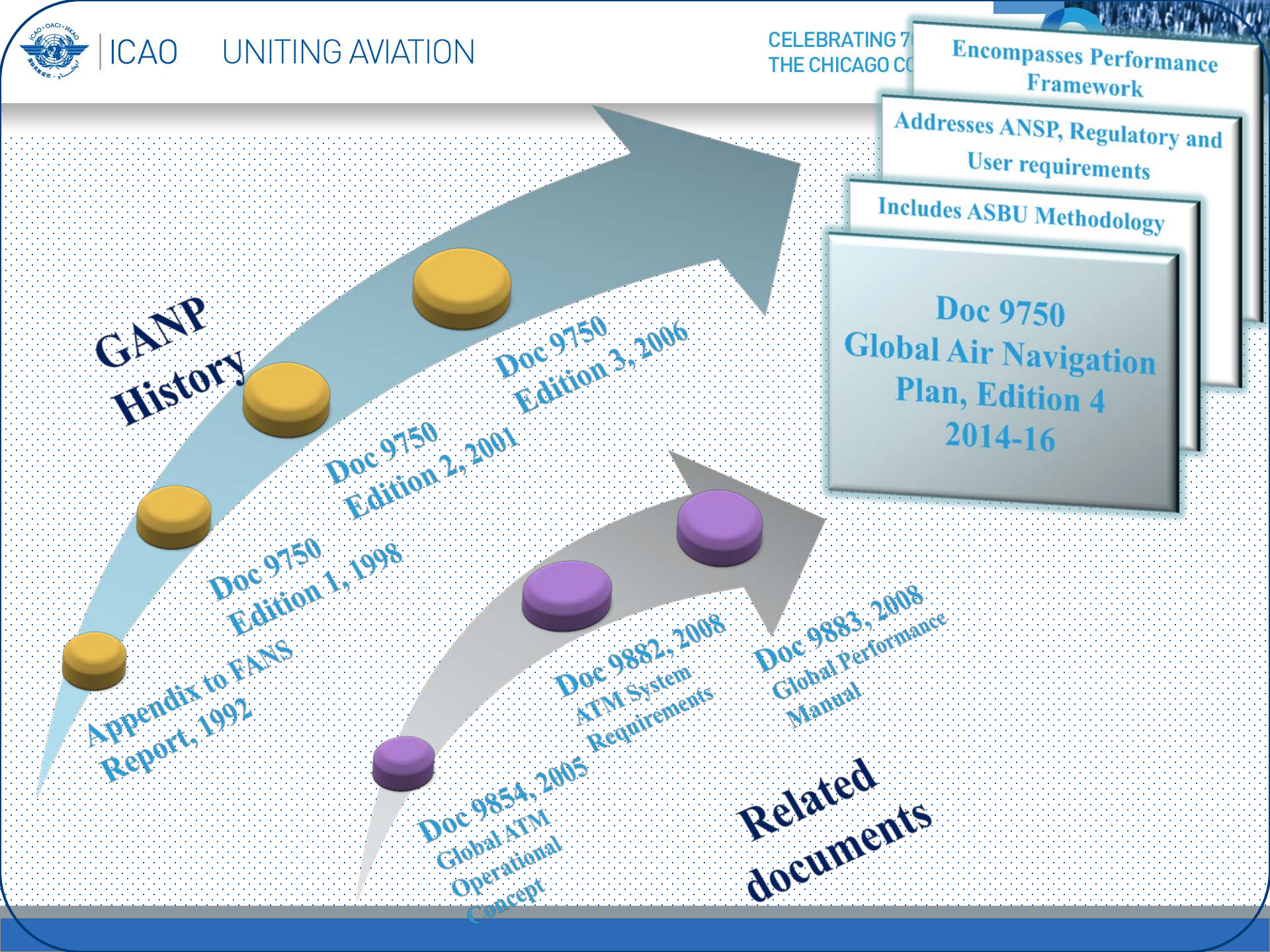
- Safety is maintained and enhanced
- ATM improvement programmes are harmonized
- Barriers to future efficiency and environmental gains are removed, at reasonable cost

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.**


GANP History
Appendix to FANS Report, 1992
Doc 9750 Edition 1, 1998
Doc 9750 Edition 2, 2001
Doc 9750 Edition 3, 2006
Doc 9854, 2005 Global ATM Operational Concept
Doc 9882, 2008 ATM System Requirements
Doc 9883, 2008 Global Performance Manual
Related documents
Encompasses Performance Framework
Addresses ANSP, Regulatory and User requirements
Includes ASBU Methodology
Doc 9750 Global Air Navigation Plan, Edition 4 2014-16

ICAO's Role in ATM Modernization

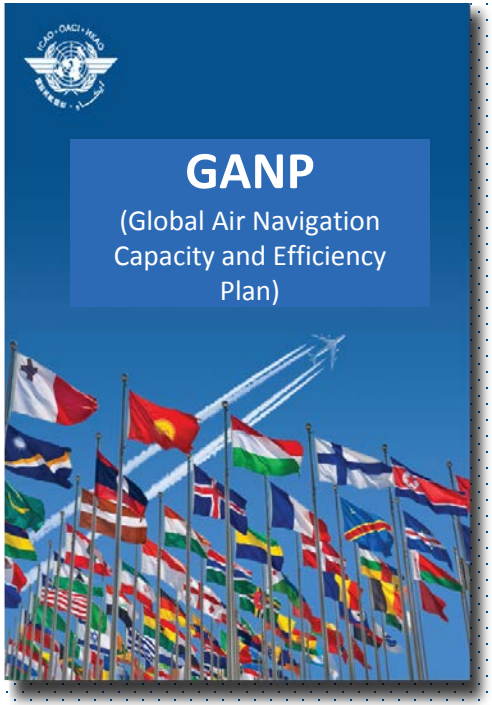
"Increase the capacity and improve the efficiency of the global civil aviation system"

- 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



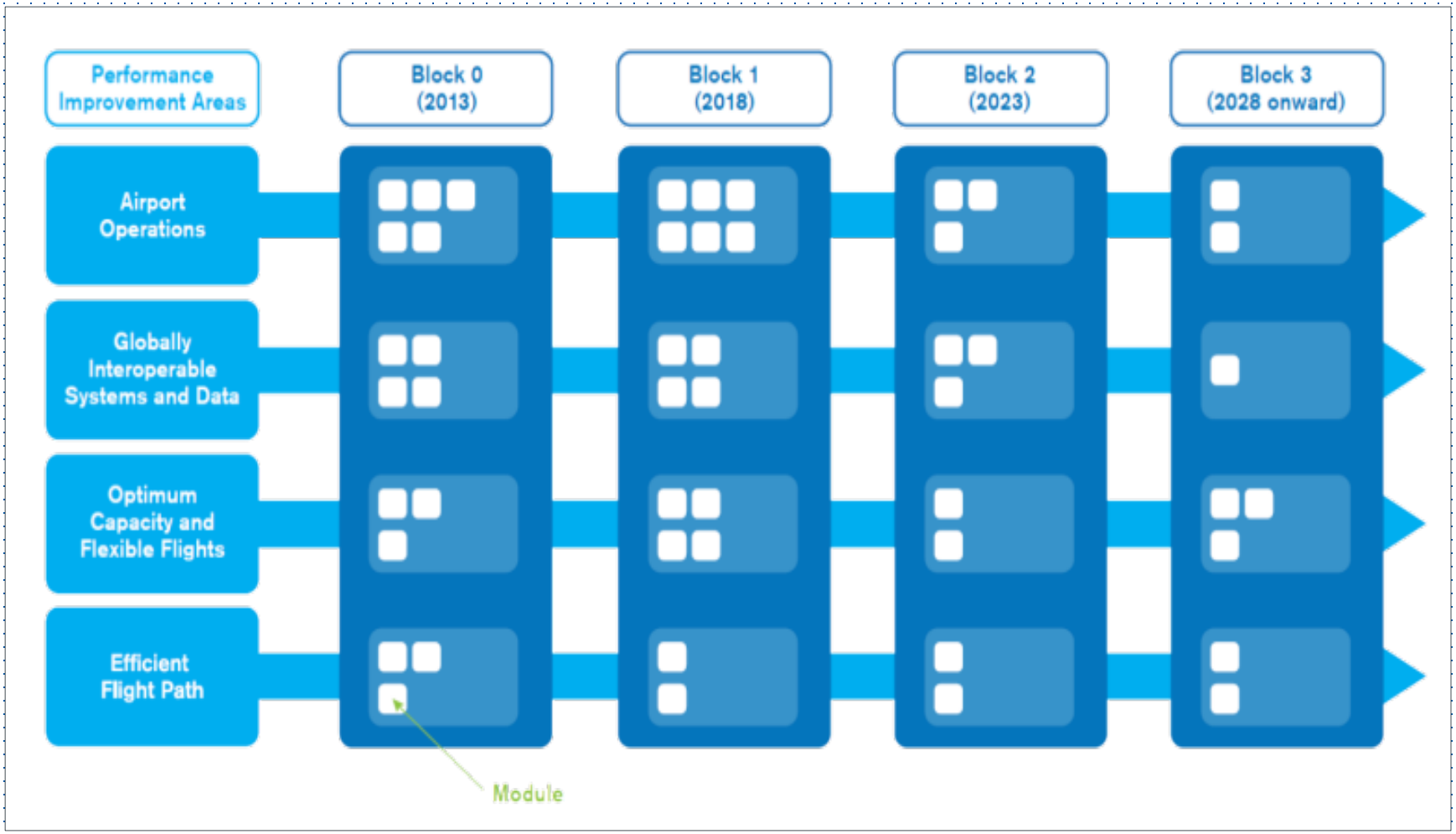
GANP Policy Principles

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
10. Review and Evaluation of Air Navigation Planning

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 Area 3:
Optimum Capacity and Flexible Flights – Through Global Collaborative ATM

Block 0	Block 1	Block 2	Block 3
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, sector) 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

Block 0	Block 1	Block 2	Block 3
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 though 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)** Metoeroligical information supporting both air and ground automated decision support aids for implementing weather mitigation strategies.

Performance Improvement Area 1: Airport Operations

Block 0	Block 1	Block 2	Block 3
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.		
B0-WAKE **Increased 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-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.	
B0-RSEQ **Improved Traffic Flow through Sequencing (AMAN/DMAN)** Time-based metering to sequence departing and arriving flights.	**B1-RSEQ** **Improved Airport Operations through Departure, Surface and Arrival Management** Extended arrival metering, integration of surface management with departure sequencing bring robustness to runway management and increase airport performances and flight efficiency.	**B2-RSEQ** **Linked AMAN/DMAN** Synchronized AMAN/DMAN will promote more agile and efficient en-route and terminal operations.	**B3-RSEQ** **Integrated AMAN/DMAN/SMAN** 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-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.	
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.		
	B1-RATS **Remotely Operated Aerodrome Control** Remotely operated Aerodrome Control Tower contingency and remote provision of ATS to aerodromes through visualization systems and tools.		

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

Block 0	Block 1	Block 2	Block 3
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

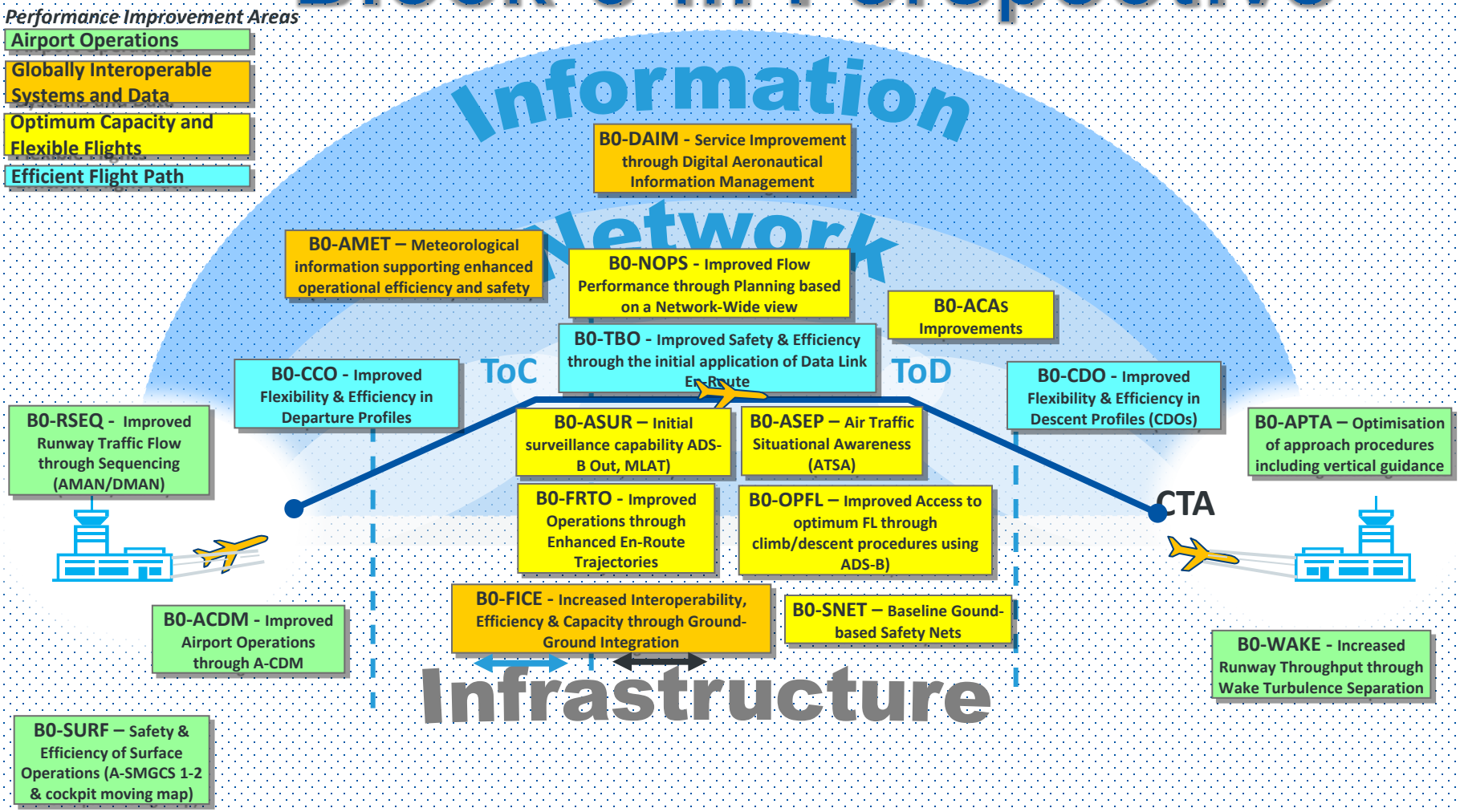
Block 0	Block 1	Block 2	Block 3
B0-CDO **Improved Flexibility and Efficiency in Descent Profiles (CDO)** Deployment of performance-based airspace and arrival procedures that allow the aircraft to fly their optimum aircraft profile taking account of airspace and traffic complexity with continuous descent operations (CDOs).	**B1-CDO** **Improved Flexibility and Efficiency in Descent Profiles (CDOs) using VNAV** 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).	**B2-CDO** **Improved Flexibility and Efficiency in Descent Profiles - Continuous Descent Operations (CDOs) using VNAV, required speed and time of arrival** 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.	
B0-TBO **Improved Safety and Efficiency through the initial application of Data Link En-Route** Implementation of an initial set of data link applications for surveillance and communications in ATC.	**B1-TBO** **Improved Traffic Synchronization and Initial Trajectory-Based Operation** 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).		**B3-TBO** **Full 4D Trajectory-based Operations** Trajectory-based operations deploys an accurate four-dimensional trajectory that is shared among all of the aviation system users at the cores 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.
B0-CCO **Improved Flexibility and Efficiency in Departure Profiles - Continuous Climb Operations (CCO)** 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).			
	B1-RPAS **Initial Integration of Remotely Piloted Aircraft (RPA) Systems into non-segregated airspace** Implementation of basic procedures for operating RPA in non-segregated airspace including detect and avoid.	**B2-RPAS** **RPA Integration in Traffic** Implements refined operational procedures that cover lost link (including a unique squawk code for lost link) as well as enhanced detect and avoid technology.	**B3-RPAS** **RPA Transparent Management** RPA operate on the aerodrome surface and in non-segregated airspace just like any other aircraft.

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 in Perspective



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)

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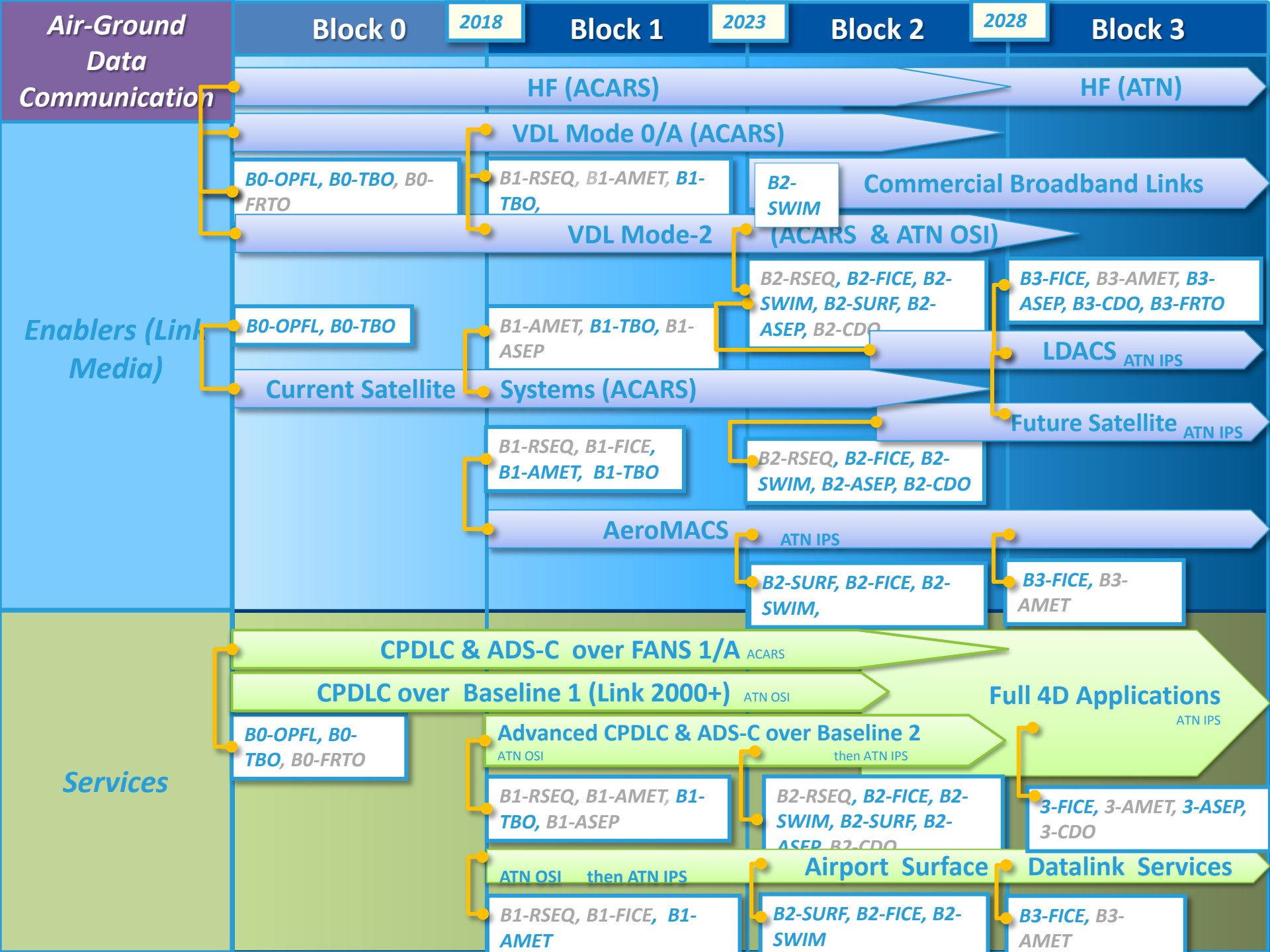
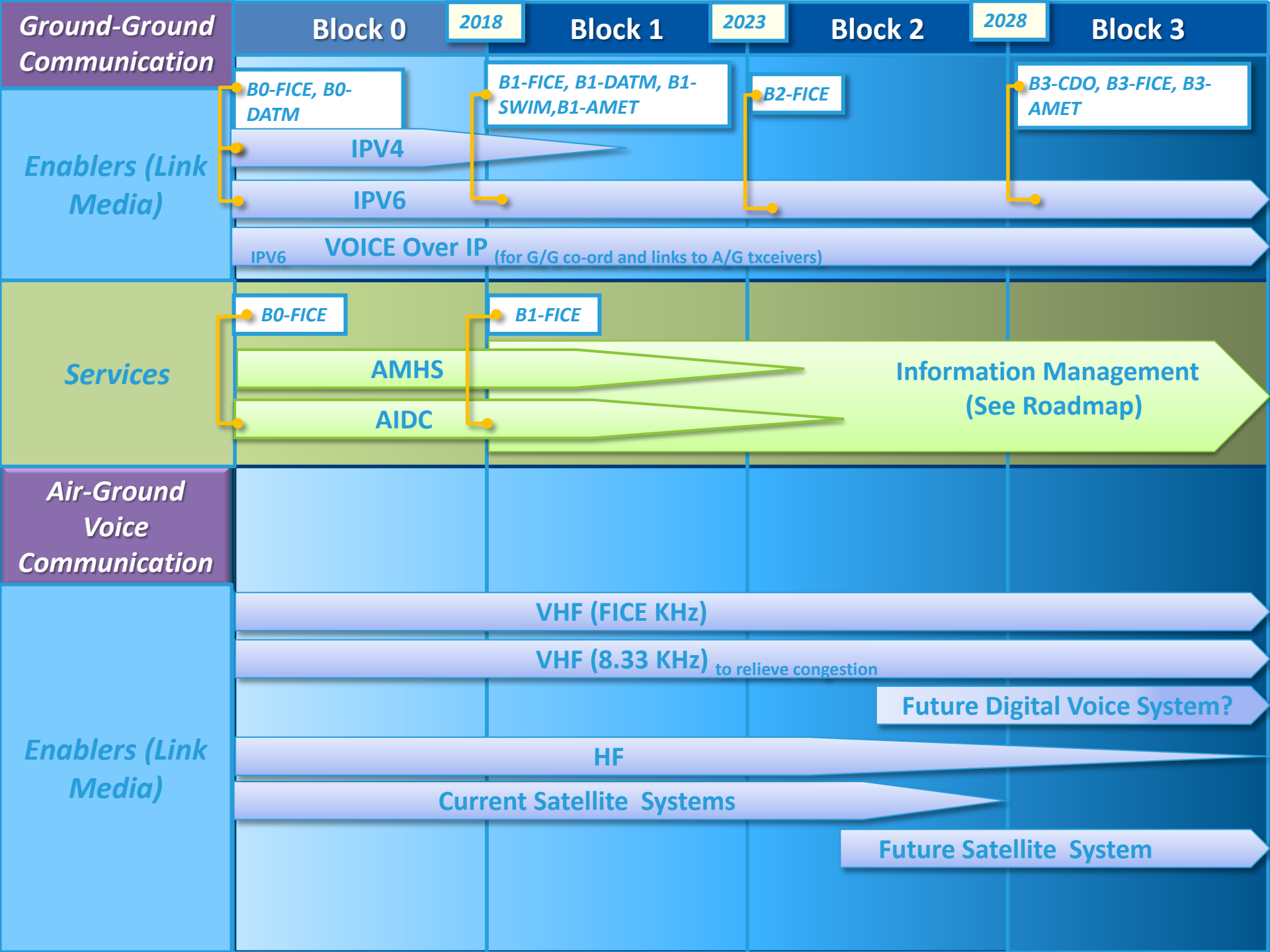
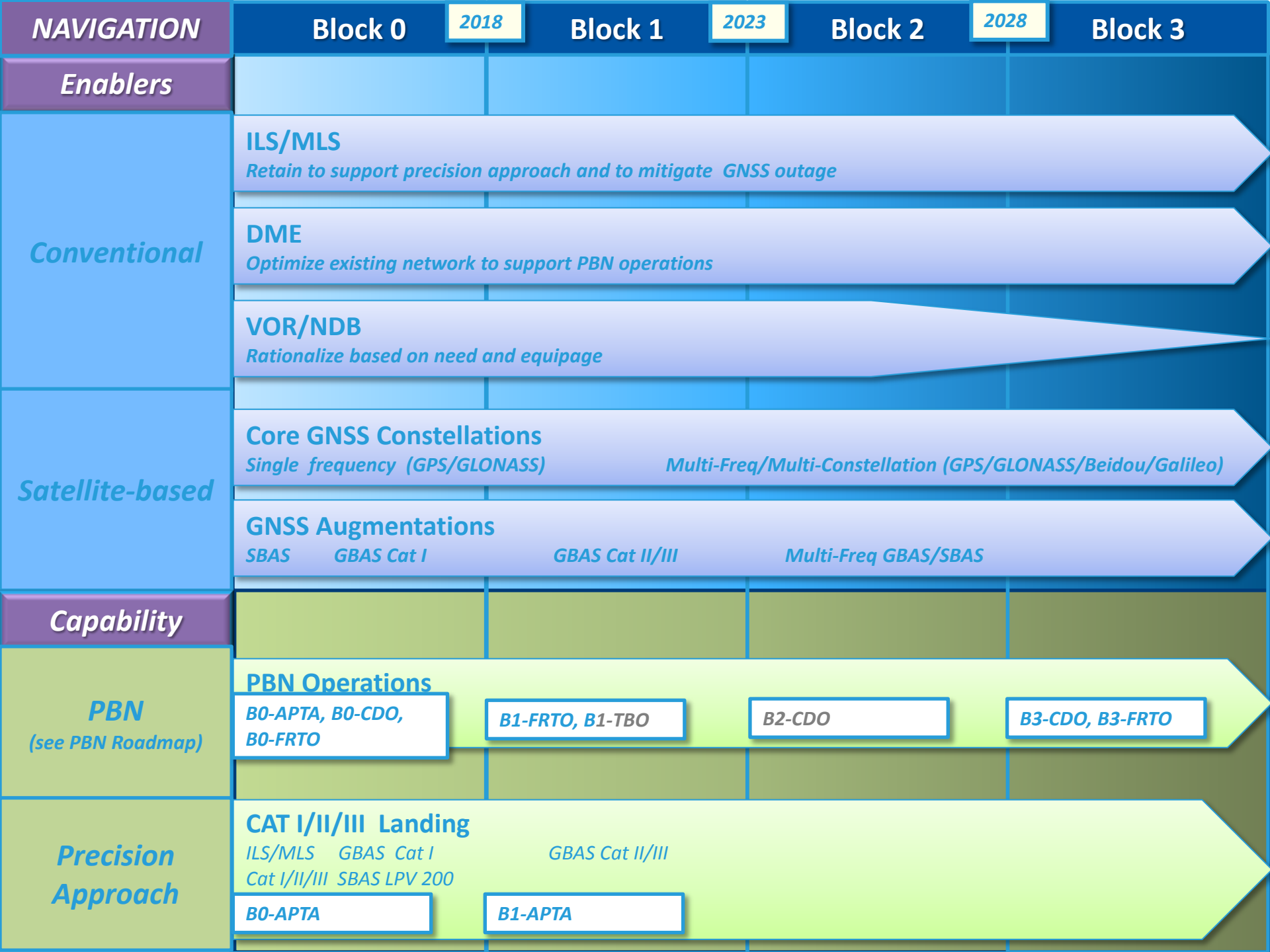
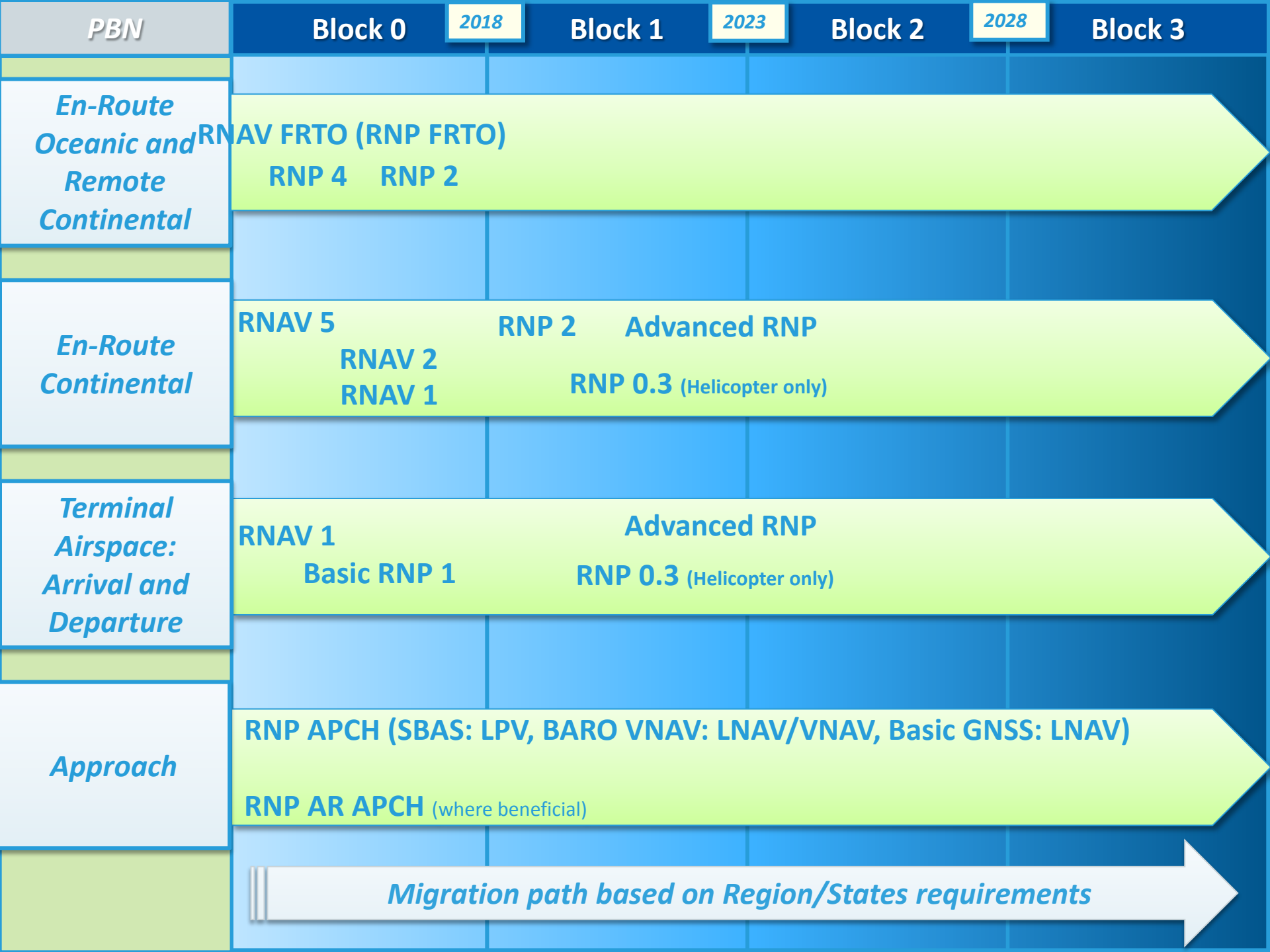
Technology Roadmaps

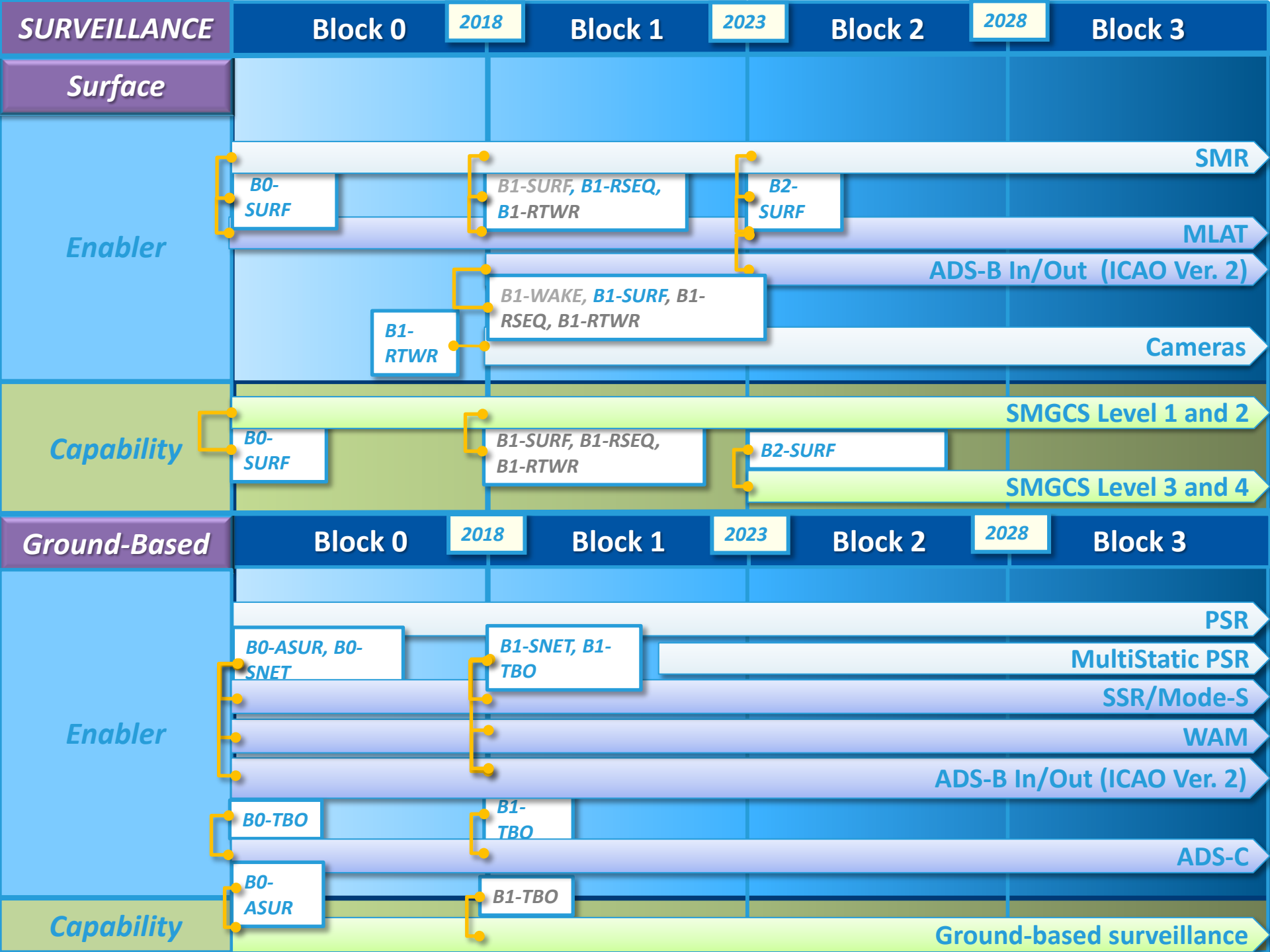
- The ASBUs are supplemented by Communications, Navigation, Surveillance, Avionics and Information Management Roadmaps.
- The ASBUs and associated technology roadmaps are an integral part of the GANP.
- The GANP represents a rolling, fifteen–year strategic methodology which leverages existing technologies 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.

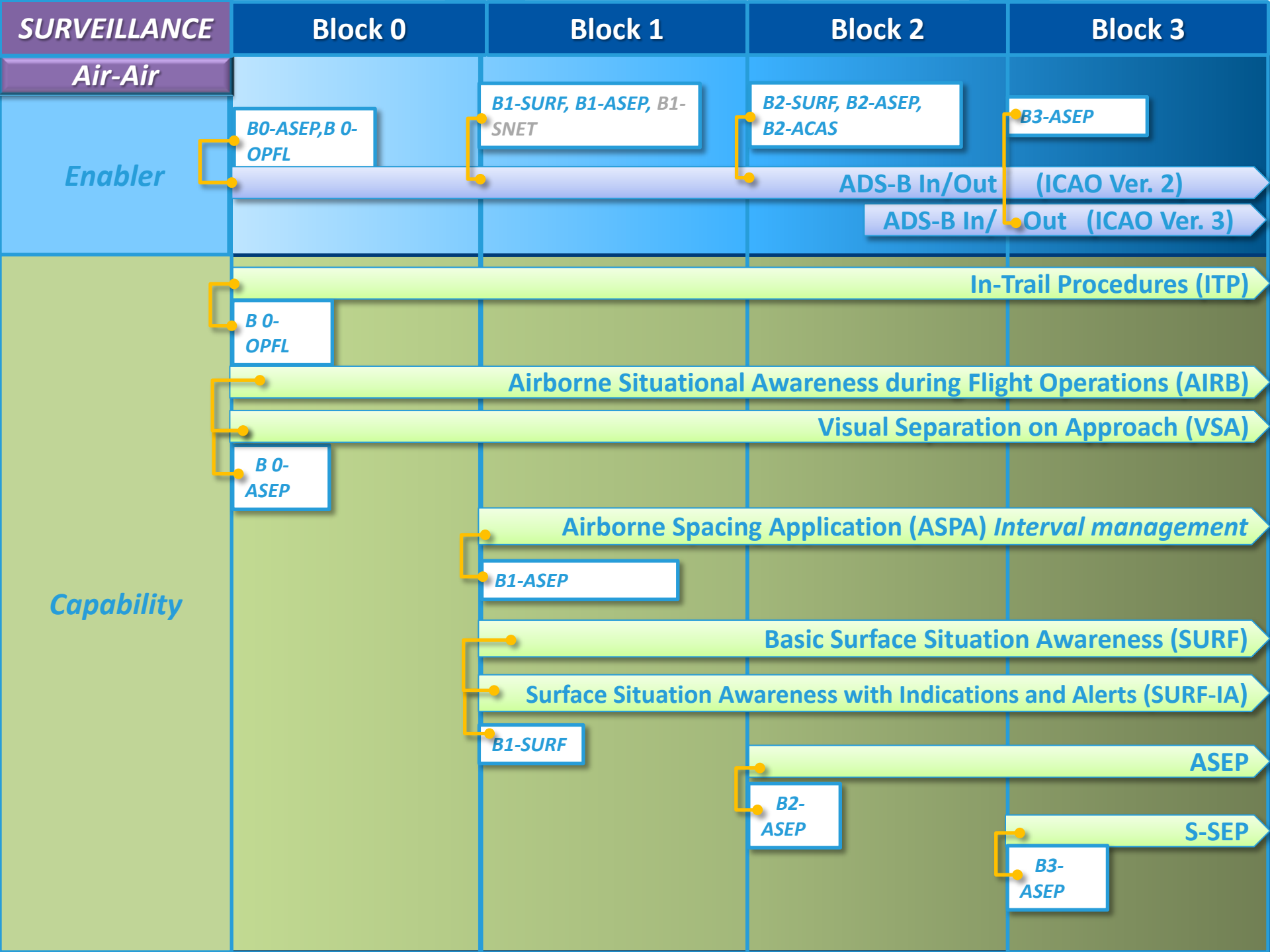

Air-Ground Data Communication
Block 0
2018
Block 1
2023
Block 2
2028
Block 3
HF (ACARS)
HF (ATN)
VDL Mode 0/A (ACARS)
B0-OPFL, B0-TBO, B0-FRTO
B1-RSEQ, B1-AMET, B1-TBO,
B2-SWIM
Commercial Broadband Links
VDL Mode-2 (ACARS & ATN OSI)
B2-RSEQ, B2-FICE, B2-SWIM, B2-SURF, B2-ASEP, B2-CDO
B3-FICE, B3-AMET, B3-ASEP, B3-CDO, B3-FRTO
Enablers (Link Media)
B0-OPFL, B0-TBO
B1-AMET, B1-TBO, B1-ASEP
LDACS ATN IPS
Current Satellite Systems (ACARS)
Future Satellite ATN IPS
B1-RSEQ, B1-FICE, B1-AMET, B1-TBO
B2-RSEQ, B2-FICE, B2-SWIM, B2-ASEP, B2-CDO
AeroMACS
ATN IPS
B2-SURF, B2-FICE, B2-SWIM,
B3-FICE, B3-AMET
CPDLC & ADS-C over FANS 1/A ACARS
CPDLC over Baseline 1 (Link 2000+) ATN OSI
Full 4D Applications
ATN IPS
B0-OPFL, B0-TBO, B0-FRTO
Advanced CPDLC & ADS-C over Baseline 2
ATN OSI
then ATN IPS
Services
B1-RSEQ, B1-AMET, B1-TBO, B1-ASEP
B2-RSEQ, B2-FICE, B2-SWIM, B2-SURF, B2-
3-FICE, 3-AMET, 3-ASEP, 3-CDO
ATN OSI
then ATN IPS
Airport Surface Datalink Services
B1-RSEQ, B1-FICE, B1-AMET
B2-SURF, B2-FICE, B2-SWIM
B3-FICE, B3-AMET

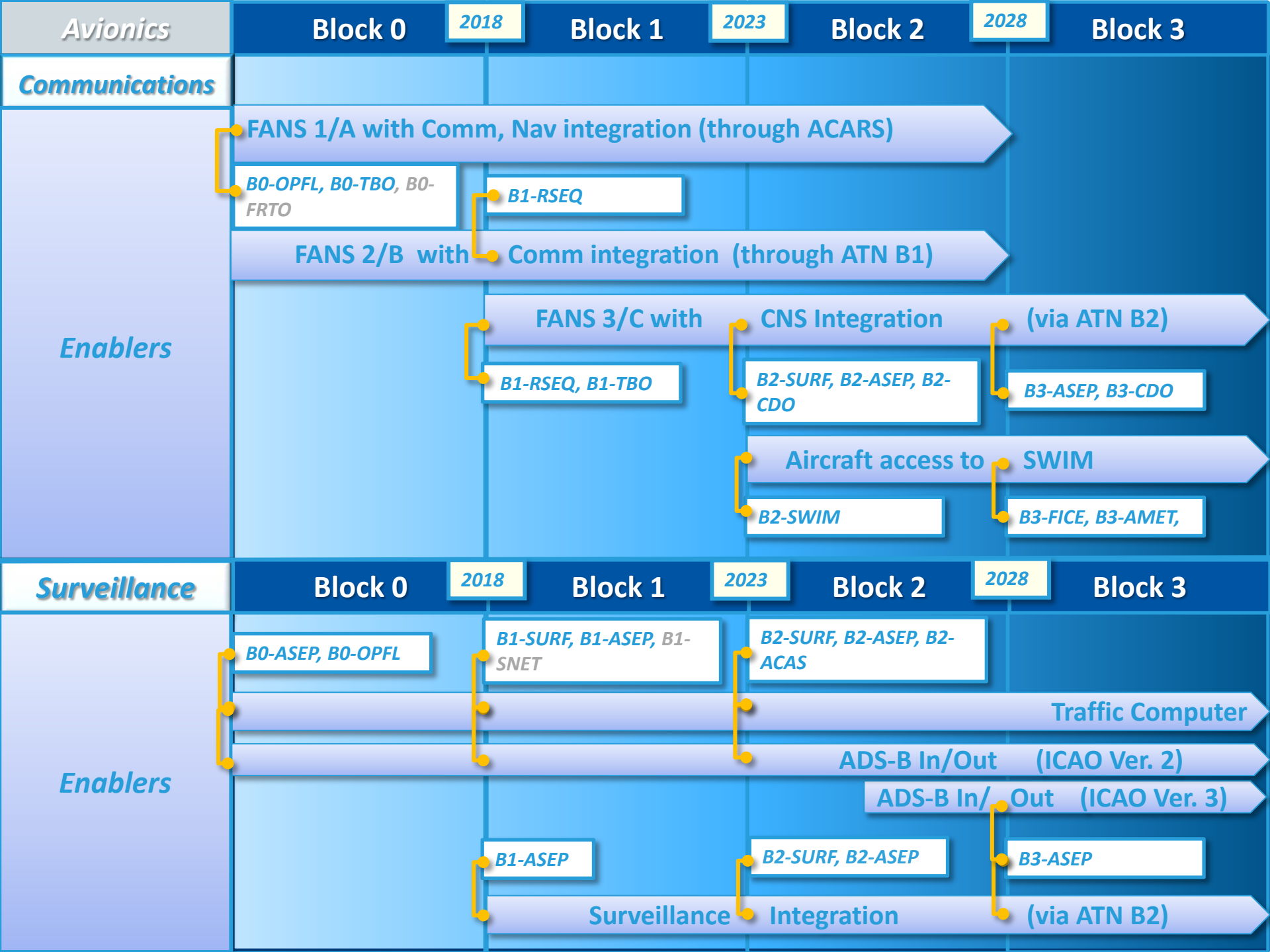

Ground-Ground Communication
Block 0
2018
Block 1
2023
Block 2
2028
Block 3
B0-FICE, B0-DATM
B1-FICE, B1-DATM, B1-SWIM,B1-AMET
B2-FICE
B3-CDO, B3-FICE, B3-AMET
Enablers (Link Media)
IPV4
IPV6
IPV6
VOICE Over IP
(for G/G co-ord and links to A/G txceivers)
Services
B0-FICE
B1-FICE
AMHS
AIDC
Information Management
(See Roadmap)
Air-Ground Voice Communication
VHF (FICE KHz)
VHF (8.33 KHz)
to relieve congestion
Future Digital Voice System?
Enablers (Link Media)
HF
Current Satellite Systems
Future Satellite System

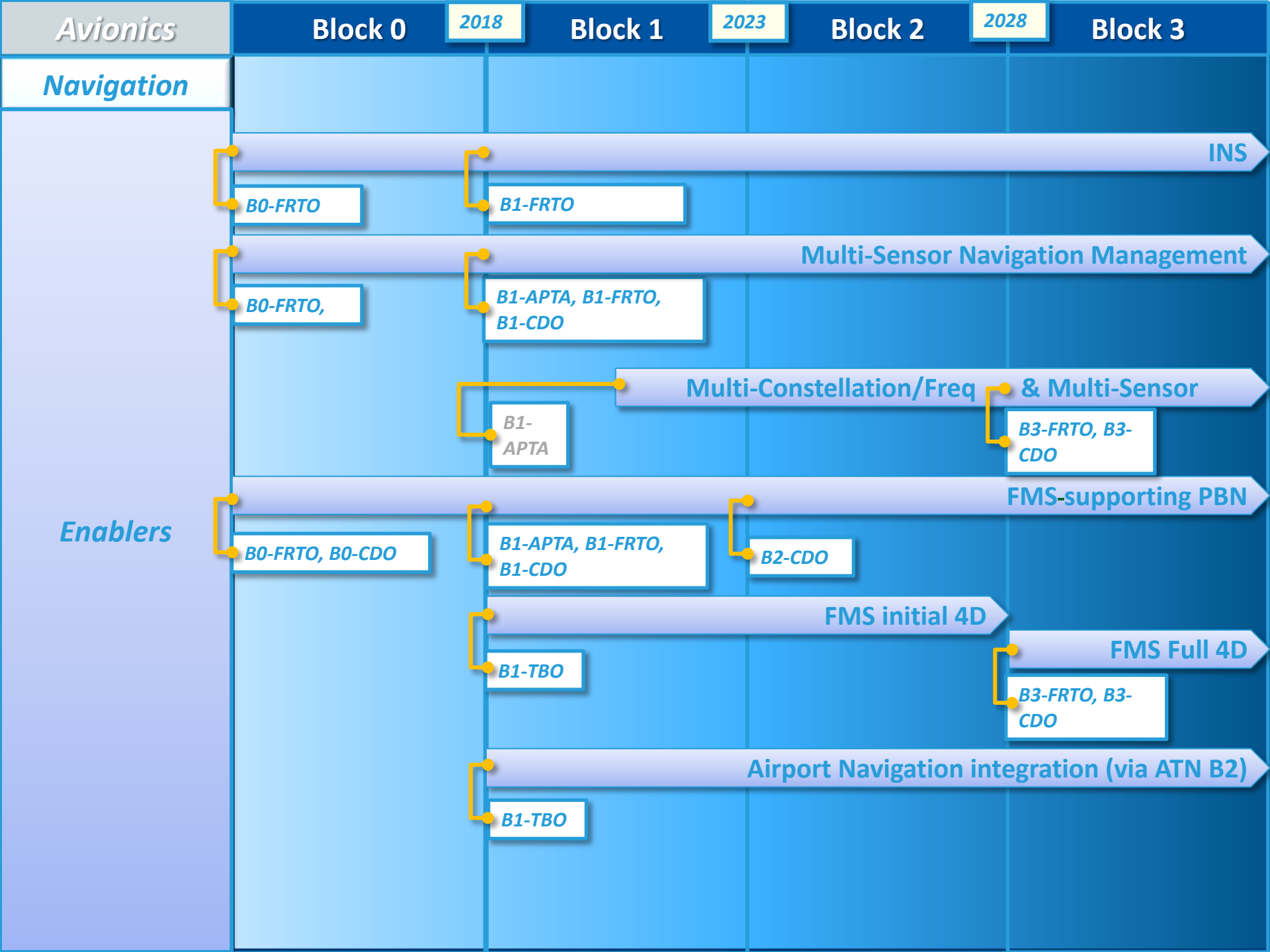

NAVIGATION
Block 0
2018
Block 1
2023
Block 2
2028
Block 3
Enablers
Conventional
ILS/MLS
Retain to support precision approach and to mitigate GNSS outage
DME
Optimize existing network to support PBN operations
VOR/NDB
Rationalize based on need and equipage
Satellite-based
Core GNSS Constellations
Single frequency (GPS/GLONASS)
Multi-Freq/Multi-Constellation (GPS/GLONASS/Beidou/Galileo)
GNSS Augmentations
SBAS
GBAS Cat I
GBAS Cat II/III
Multi-Freq GBAS/SBAS
Capability
PBN
(see PBN Roadmap)
PBN Operations
B0-APTA, B0-CDO, B0-FRTO
B1-FRTO, B1-TBO
B2-CDO
B3-CDO, B3-FRTO
Precision Approach
CAT I/II/III Landing
ILS/MLS
GBAS Cat I
GBAS Cat II/III
Cat I/II/III
SBAS LPV 200
B0-APTA
B1-APTA


PBN
Block 0
2018
Block 1
2023
Block 2
2028
Block 3
En-Route Oceanic and Remote Continental
RNAV FRTO (RNP FRTO)
RNP 4
RNP 2
En-Route Continental
RNAV 5
RNAV 2
RNAV 1
RNP 2
Advanced RNP
RNP 0.3 (Helicopter only)
Terminal Airspace: Arrival and Departure
RNAV 1
Basic RNP 1
Advanced RNP
RNP 0.3 (Helicopter only)
Approach
RNP APCH (SBAS: LPV, BARO VNAV: LNAV/VNAV, Basic GNSS: LNAV)
RNP AR APCH (where beneficial)
Migration path based on Region/States requirements

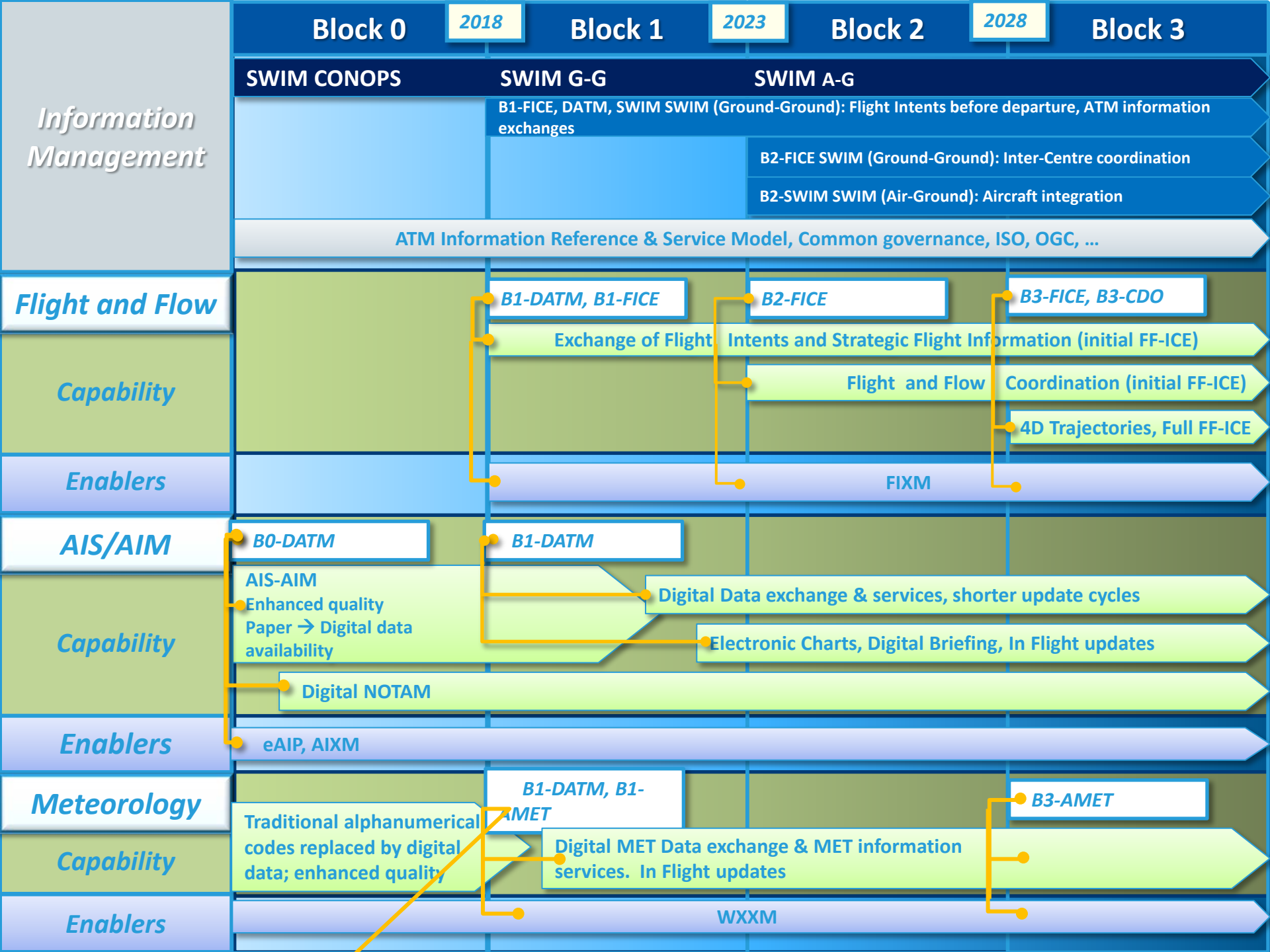

SURVEILLANCE
Block 0
2018
Block 1
2023
Block 2
2028
Block 3
Surface
Enabler
SMR
B0-SURF
B1-SURF, B1-RSEQ, B1-RTWR
B2-SURF
MLAT
ADS-B In/Out (ICAO Ver. 2)
B1-WAKE, B1-SURF, B1-RSEQ, B1-RTWR
B1-RTWR
Cameras
Capability
SMGCS Level 1 and 2
B0-SURF
B1-SURF, B1-RSEQ, B1-RTWR
B2-SURF
SMGCS Level 3 and 4
Ground-Based
Block 0
2018
Block 1
2023
Block 2
2028
Block 3
Enabler
PSR
B0-ASUR, B0-SNET
B1-SNET, B1-TBO
MultiStatic PSR
SSR/Mode-S
WAM
ADS-B In/Out (ICAO Ver. 2)
B0-TBO
B1-TBO
ADS-C
B0-ASUR
B1-TBO
Capability
Ground-based surveillance


SURVEILLANCE
Block 0
Block 1
Block 2
Block 3
Air-Air
Enabler
B0-ASEP,B 0-OPFL
B1-SURF, B1-ASEP, B1-SNET
B2-SURF, B2-ASEP, B2-ACAS
B3-ASEP
ADS-B In/Out (ICAO Ver. 2)
ADS-B In/ Out (ICAO Ver. 3)
Capability
In-Trail Procedures (ITP)
B 0-OPFL
Airborne Situational Awareness during Flight Operations (AIRB)
Visual Separation on Approach (VSA)
B 0-ASEP
Airborne Spacing Application (ASPA) Interval management
B1-ASEP
Basic Surface Situation Awareness (SURF)
Surface Situation Awareness with Indications and Alerts (SURF-IA)
B1-SURF
ASEP
B2-ASEP
S-SEP
B3-ASEP


Avionics
Block 0
2018
Block 1
2023
Block 2
2028
Block 3
Communications
Enablers
FANS 1/A with Comm, Nav integration (through ACARS)
B0-OPFL, B0-TBO, B0-FRTO
B1-RSEQ
FANS 2/B with Comm integration (through ATN B1)
FANS 3/C with CNS Integration (via ATN B2)
B1-RSEQ, B1-TBO
B2-SURF, B2-ASEP, B2-CDO
B3-ASEP, B3-CDO
Aircraft access to SWIM
B2-SWIM
B3-FICE, B3-AMET,
Surveillance
Block 0
2018
Block 1
2023
Block 2
2028
Block 3
Enablers
B0-ASEP, B0-OPFL
B1-SURF, B1-ASEP, B1-SNET
B2-SURF, B2-ASEP, B2-ACAS
Traffic Computer
ADS-B In/Out (ICAO Ver. 2)
ADS-B In/Out (ICAO Ver. 3)
B1-ASEP
B2-SURF, B2-ASEP
B3-ASEP
Surveillance Integration
(via ATN B2)


Avionics
Block 0
2018
Block 1
2023
Block 2
2028
Block 3
Navigation
Enablers
INS
B0-FRTO
B1-FRTO
Multi-Sensor Navigation Management
B0-FRTO,
B1-APTA, B1-FRTO, B1-CDO
Multi-Constellation/Freq
& Multi-Sensor
B1-APTA
B3-FRTO, B3-CDO
FMS-supporting PBN
B0-FRTO, B0-CDO
B1-APTA, B1-FRTO, B1-CDO
B2-CDO
FMS initial 4D
FMS Full 4D
B1-TBO
B3-FRTO, B3-CDO
Airport Navigation integration (via ATN B2)
B1-TBO

Avionics
Block 0
2018
Block 1
2023
Block 2
2028
Block 3
Airborne Safety Nets
Enablers
ACAS 7.1
B0-ACAS
Future ACAS
B2-ACAS
TAWS
Weather Radar
B2-WAKE
On-Board Systems
Block 0
2018
Block 1
2023
Block 2
2028
Block 3
Displays
Airport Moving Map
B0-SURF
B1-SURF, B1-TBO
EVS
B1-SURF
B2-SURF
SVS
CDTI
B0-ASEP, B0-OPFL
B1-SURF, B1-ASEP
B2-SURF, B2-ASEP, B2-CDO
B3-AMET, B3-ASEP
Information
Electronic Flight Bags


Block 0
2018
Block 1
2023
Block 2
2028
Block 3
Information Management
SWIM CONOPS
SWIM G-G
SWIM A-G
B1-FICE, DATM, SWIM SWIM (Ground-Ground): Flight Intents before departure, ATM information exchanges
B2-FICE SWIM (Ground-Ground): Inter-Centre coordination
B2-SWIM SWIM (Air-Ground): Aircraft integration
ATM Information Reference & Service Model, Common governance, ISO, OGC, …
Flight and Flow
Capability
Enablers
B1-DATM, B1-FICE
B2-FICE
B3-FICE, B3-CDO
Exchange of Flight Intents and Strategic Flight Information (initial FF-ICE)
Flight and Flow Coordination (initial FF-ICE)
4D Trajectories, Full FF-ICE
FIXM
AIS/AIM
Capability
Enablers
B0-DATM
B1-DATM
AIS-AIM
Enhanced quality
Paper → Digital data availability
Digital Data exchange & services, shorter update cycles
Electronic Charts, Digital Briefing, In Flight updates
Digital NOTAM
eAIP, AIXM
Meteorology
Capability
Enablers
B1-DATM, B1-AMET
B3-AMET
Traditional alphanumerical codes replaced by digital data; enhanced quality
Digital MET Data exchange & MET information services. In Flight updates
WXXM

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)

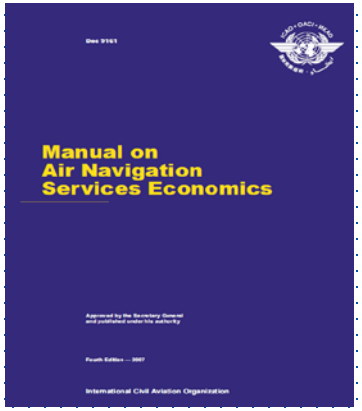
Multidisciplinary Working Group on the Aviation System Block Upgrades

ICAO Strategic Objective:

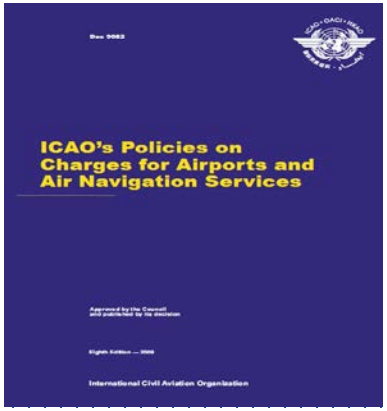
Economic Development of Air Transport

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

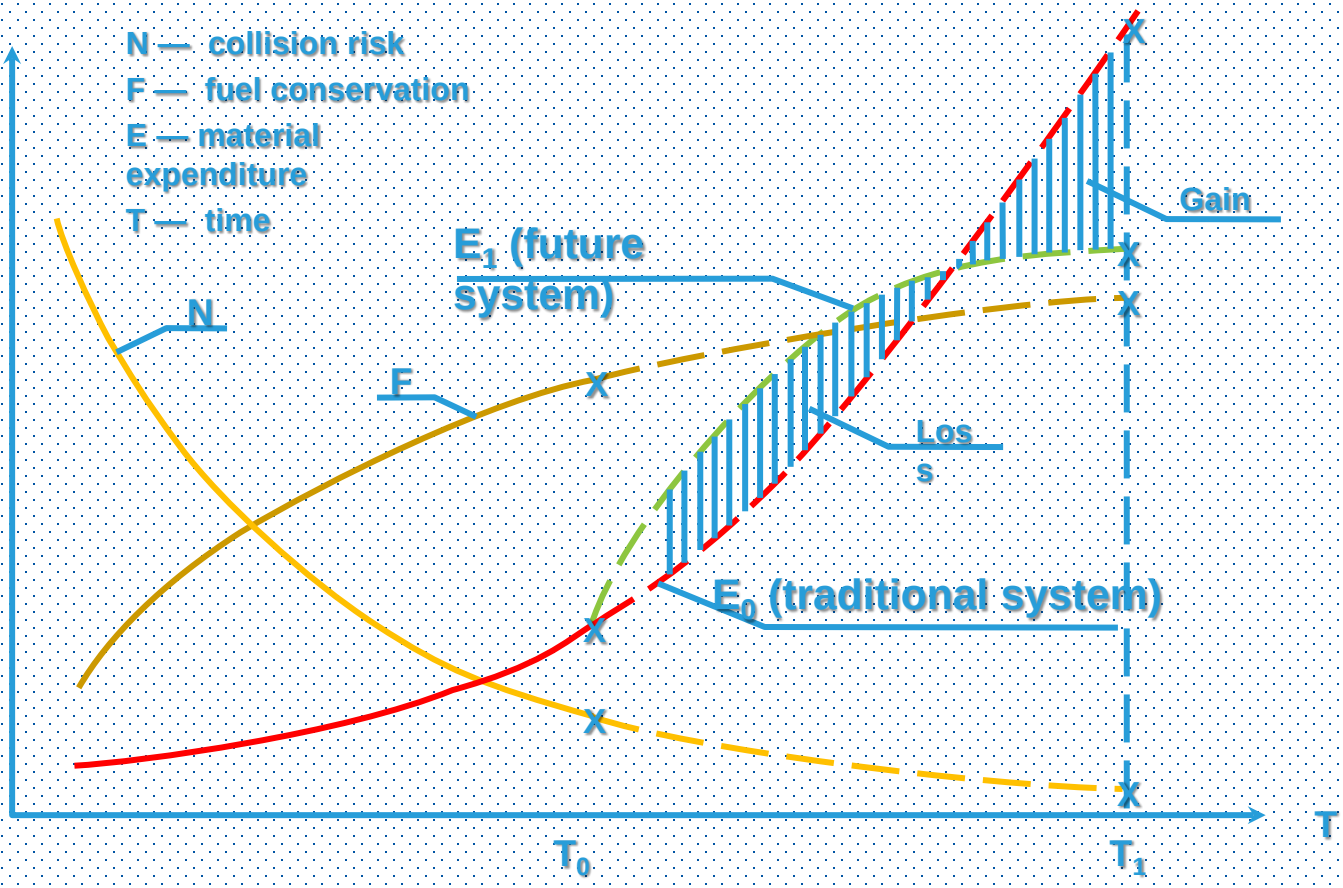
- The cost basis for air navigation services (ANS) charges
- The cost recovery for (ANS) charges
- Pre-funding of projects
- Financing ANS Infrastructure
- GNSS provision and operation

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



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**

ASBUs

- **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-ASBUs).
  - 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.

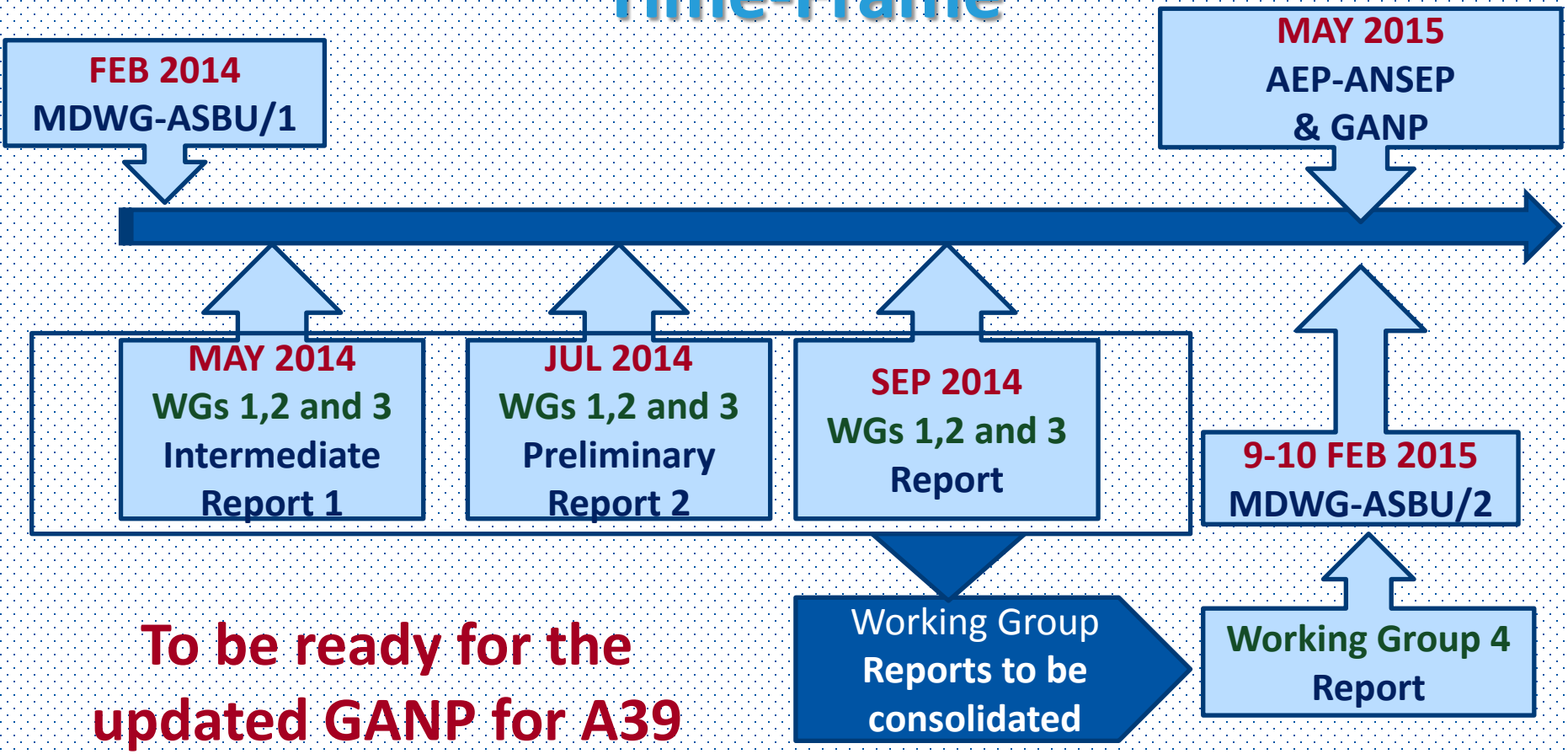
First meeting of MDWG-ASBUs in February 2014

- **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**

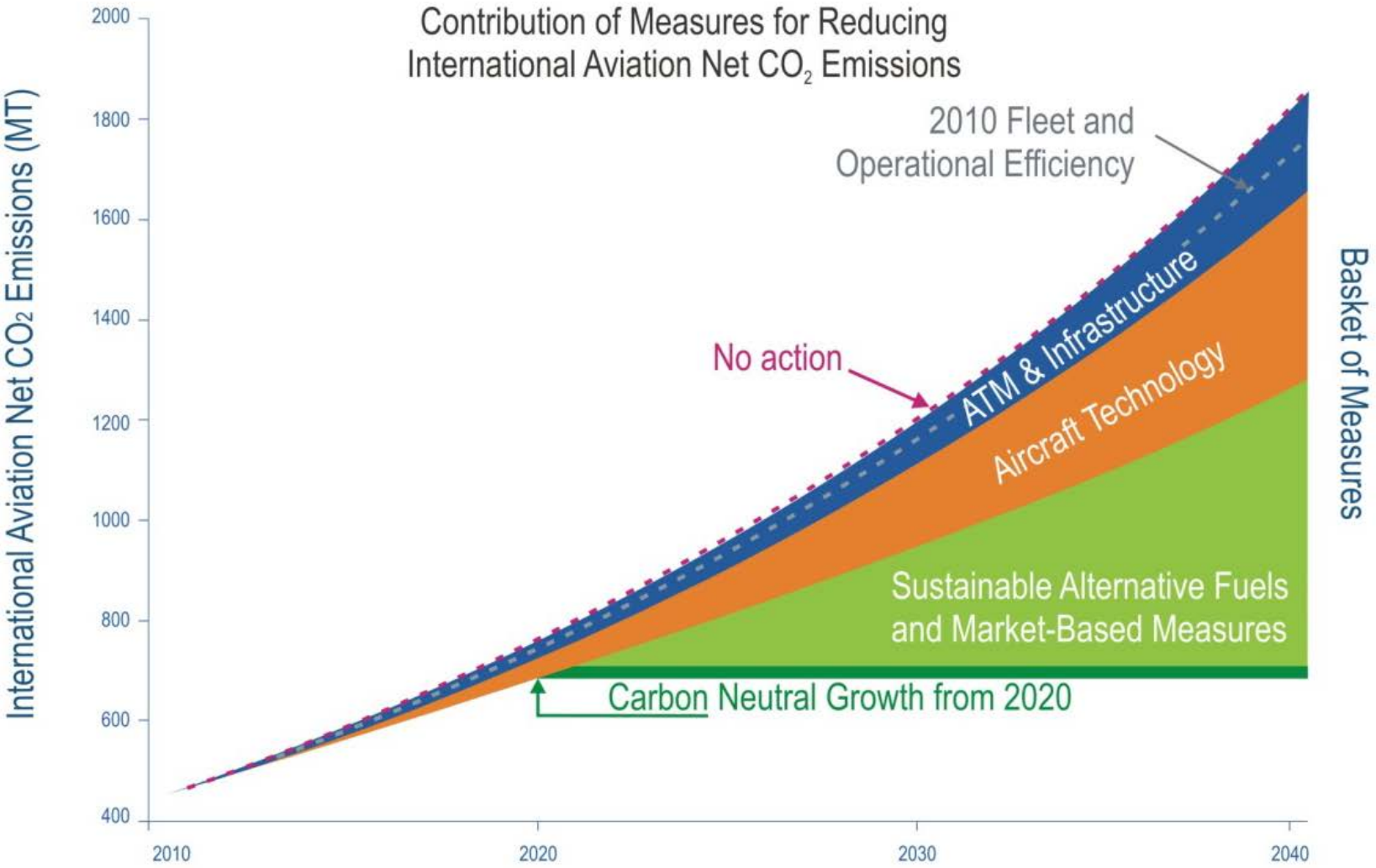
4 sub-working groups

- **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

Time-Frame



To be ready for the updated GANP for A39


Contribution of Measures for Reducing International Aviation Net CO_2 Emissions
International Aviation Net CO_2 Emissions (MT)
2000
1800
1600
1400
1200
1000
800
600
400
2010
2020
2030
2040
2010 Fleet and Operational Efficiency
No action
ATM & Infrastructure
Aircraft Technology
Sustainable Alternative Fuels and Market-Based Measures
Carbon Neutral Growth from 2020
Basket of Measures

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*

Next GANP *2016*

GANP

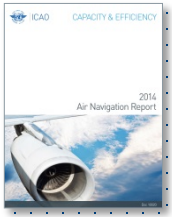
PIRGS

Establish Regional Priorities, ASBU Modules & Targets
Regional workshops and meetings

Revise Regional Air Navigation Implementation Plans

Revise Regional Air Navigation Plans

In progress



Annual Global Air Navigation Report

Regional Performance Indicators

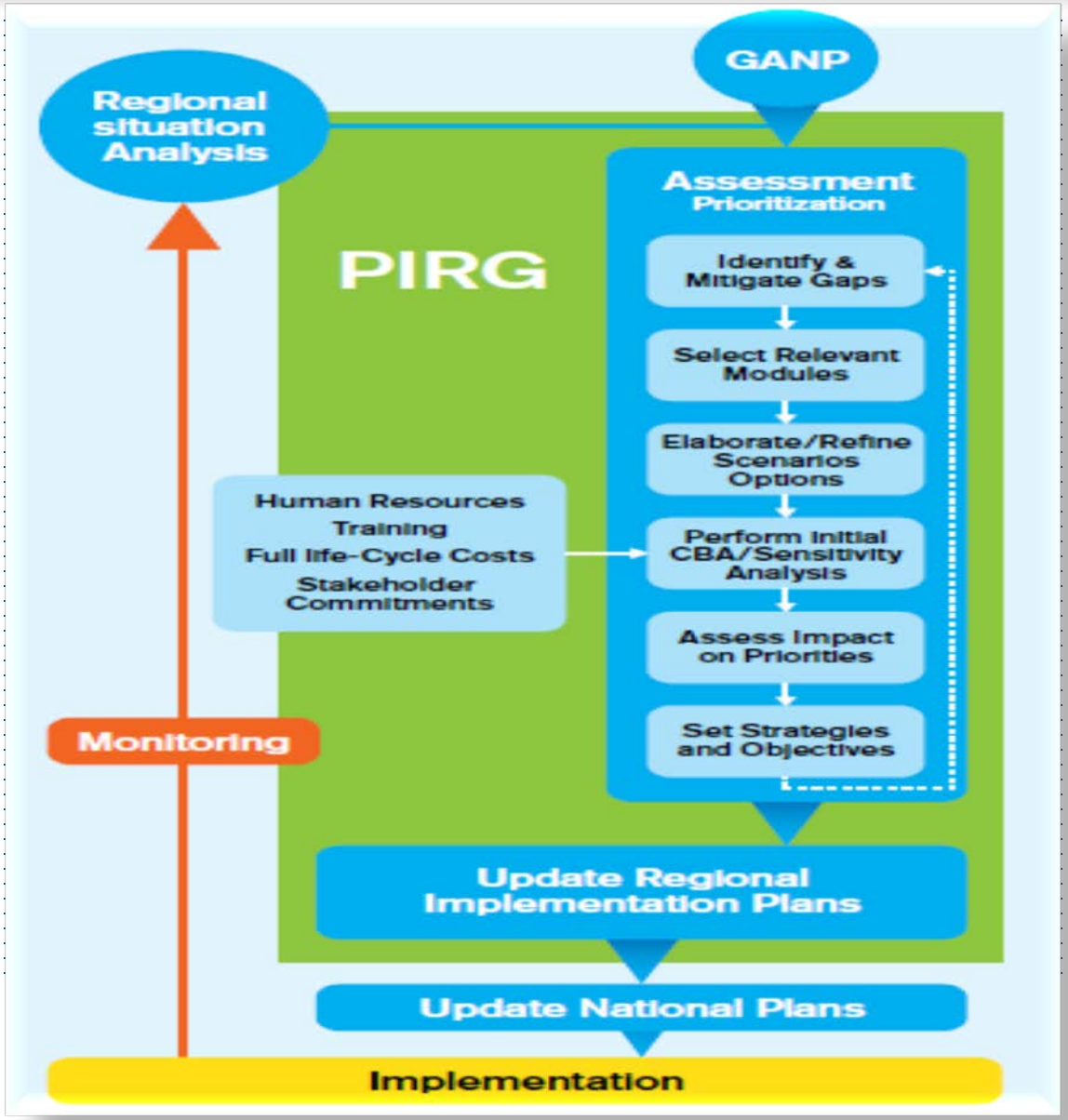
Revised PIRG TORs & Work Programme

PIRG Meeting Reports

Annual ANC/Council Review

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

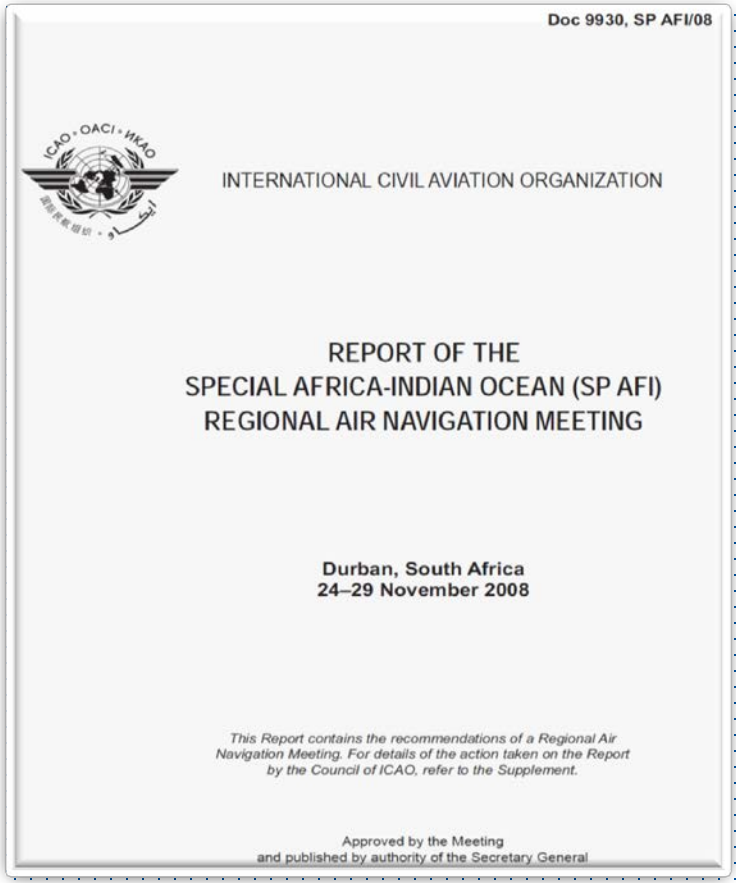

GANP
Regional situation Analysis
PIRG
Assessment
Prioritization
Identify & Mitigate Gaps
Select Relevant Modules
Elaborate/Refine Scenarios Options
Perform Initial CBA/Sensitivity Analysis
Assess Impact on Priorities
Set Strategies and Objectives
Human Resources
Training
Full life-Cycle Costs
Stakeholder Commitments
Monitoring
Update Regional Implementation Plans
Update National Plans
Implementation

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



Doc 9930, SP AFI/08

INTERNATIONAL CIVIL AVIATION ORGANIZATION

REPORT OF THE
SPECIAL AFRICA-INDIAN OCEAN (SP AFI)
REGIONAL AIR NAVIGATION MEETING

Durban, South Africa
24–29 November 2008

This Report contains the recommendations of a Regional Air Navigation Meeting. For details of the action taken on the Report by the Council of ICAO, refer to the Supplement.

Approved by the Meeting
and published by authority of the Secretary General

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.

11/18/2014
61

Regional Targets

AIR NAV. REGION	REGIONAL OFFICE	SAFETY	AIR NAVIGATION
AFI	ESAF	**ADOPTED** ✓ (Abuja Ministerial – July 2012)	**ADOPTED** ✓ (APIRG/19 – October 2013)
	WACAF		
MID	MID	**ADOPTED** ✓ (DGCA-MID/2 May 2013) (Review – 27-29 April 2014)	**MSG Meeting** (November 2014)
ASIA/PAC	APAC	**RASG-APAC/4** (November 2014)	**ADOPTED** ✓ (APANPIRG/25 - September 2014)
NAM	NACC	**US CAST/Canada**	**ADOPTED** (NACC/DCA/5 – April 2014) ✓
CAR		**ADOPTED** (NACC/DCA/5 – April 2014) ✓	
SAM	SAM	**ADOPTED** ✓ (RAAC/13 - December 2013)	**ADOPTED** ✓ (RAAC/13 - December 2013)
EUR	EUR/NAT	**ADOPTED** ✓ (RASG-EUR/03 - February 2014)	**ADOPTED** ✓ (EANPG/55 - November 2013)
NAT		**ADOPTED** ✓ (NAT SPG/49-June 2013)	*TBA*

Regional Targets - Communications

ASBU B0-FICE: Planning Targets and Implementation Progress

Elements	Targets and Implementation Progress (Ground and Air)
1. Complete AMHS implementation at States still not counting with this system	December 2015 – Services provider
2. AMHS interconnection	December 2015 – Services provider
3. Implement AIDC/OLDI at some States automated centres	June 2014 – Services provider
4. Implement operational AIDC/OLDI between adjacent ACCs	June 2015 – Services provider
5. Implement the AFI Integrated Telecommunication Network	June2015– Services provider

Regional Targets – Communications

ASBU B0-ASUR: Planning Targets and Implementation Progress

Elements	Targets and Implementation Progress (Ground and Air)
1. Implementation of ADS-B	June 2018 – Users and service provider
2. Implementation of Multilateration	June 2018 – Users and service provider
3. Automation system (Presentation)	June 2017 – Users and service provider

ASBU B0-TBO: Planning Targets and Implementation Progress

Elements	Targets and Implementation Progress (Ground and Air)
1. ADS-C over oceanic and remote areas	June 2018 – Service provider
2. Continental CPDLC	June 2018 – Service provider

Regional Targets - Surveillance

ASBU B0-SNET: Planning Targets and Implementation Progress

Elements	Targets and Implementation Progress (Ground and Air)
1. Short Term Conflict Alert (STCA)	June 2014 / Service provider 2013-2018
2. Area Proximity Warning (APW)	June 2014 / Service provider 2013-2018
3. Minimum Safe Altitude Warning (MSAW)	June 2014
4. Dangerous Area Infringement Warning (DAIW)	2013-2018

Regional Targets - Navigation

ASBU B0-APTA: Planning Targets and Implementation Progress

Elements	Targets and Implementation Progress (Ground and Air)
1. APV with Baro-VNAV	December 2016 – Service Providers and users
2. APV with SBAS	December 2017 – As per AFI-GNSS Strategy.
3. APV with GBAS	December 2018 – Initial implementation at some States (service providers)

Regional Targets - Surveillance

ASBU B0-SURF: Planning Targets and Implementation Progress

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

Regional Targets - Surveillance

ASBU B0-SNET: Planning Targets and Implementation Progress

Elements	Targets and Implementation Progress (Ground and Air)
1. Short Term Conflict Alert (STCA)	June 2014 / Service provider 2013-2018
2. Area Proximity Warning (APW)	June 2014 / Service provider 2013-2018
3. Minimum Safe Altitude Warning (MSAW)	June 2014
4. Dangerous Area Infringement Warning (DAIW)	2013-2018

Regional Targets – Meteorological Information Management

ASBU B0-AMET: Planning Targets and Implementation Progress

Elements	Targets and Implementation Progress (Ground and Air)
1. WAFS	In process of implementation
2. IAVW	In process of implementation
3. Tropical cyclone watch	In process of implementation
4. Aerodrome warnings	In process of implementation
5. Wind shear warnings and alerts	50% by December 2014
6. SIGMET	80% by December 2014
7. QMS/MET	75% by December 2014
8. Other OPMET Information (METAR, SPECI, TAF)	In process of improvement

Regional Targets – Aeronautical Information Management

ASBU B0-DATM: Planning Targets and Implementation Progress

Elements	Targets and Implementation Progress (Ground and Air)
1. QMS for AIM	December 2014
2. e-TOD implementation	December 2016
3. WGS-84 implementation	Implemented
4. AIXM implementation	December 2016
5. e-AIP implementation	December 2014
6. Digital NOTAM	December 2017

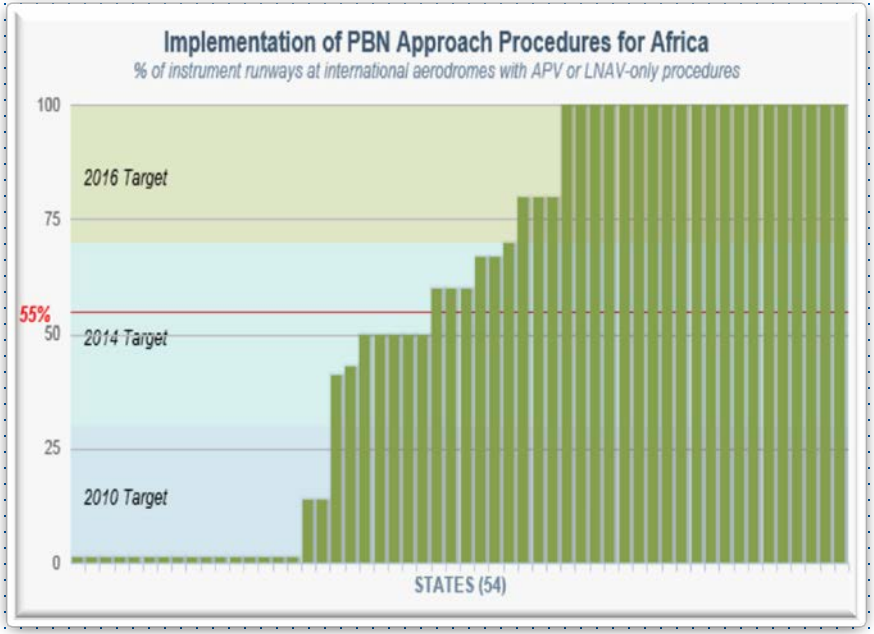
Regional Targets – Avionics

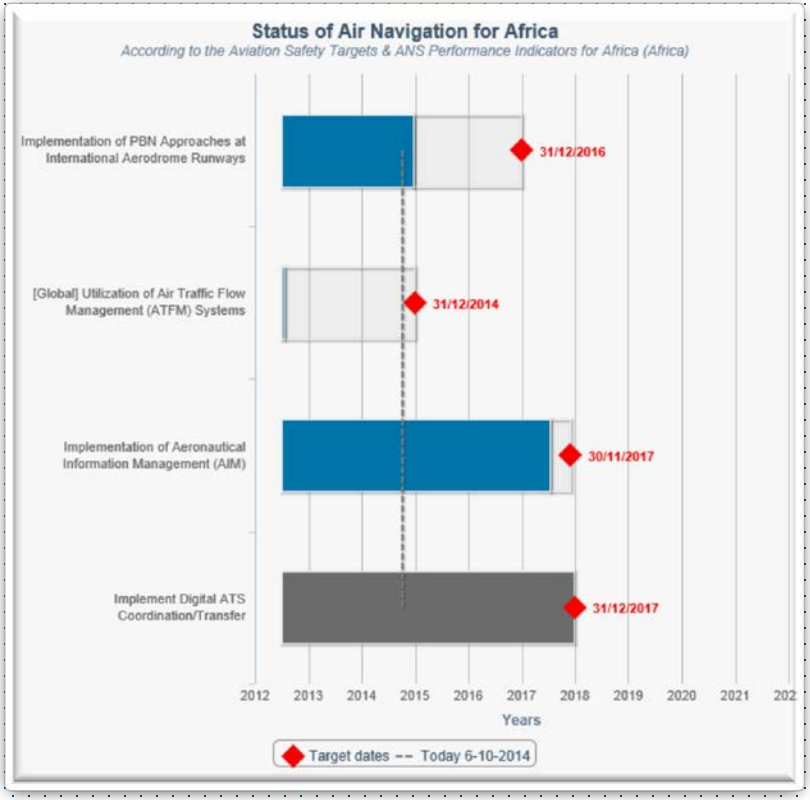
ASBU B0-ACAS: Planning Targets and Implementation Progress

Elements	Targets and Implementation Progress (Ground and Air)
ACAS II (TCAS Version 7.1)	2013-2018

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)					
	Access & Equity	Capacity	Efficiency	Environment	Safety
Applicable	N	N	Y	Y	Y

ASBUB0- CDO: Implementation Targets & Progress	
Elements	Implementation Status (Ground and Air)
1. CDO	
2. PBN STARs	

ASBU B0-CDO: Implementation Challenges				
Elements	Implementation Area			
	Ground Implementation	Air Implementation	Procedures Availability	Operational Approvals
1. CDO				
2. PBN STARs				

ASBU B0-CDO: Performance Monitoring and Measurement (Benefits)	
Key Performance Areas	**Performance Metrics**
Access & Equity	Not applicable
Capacity	Not applicable
Efficiency	Kilograms of fuel saved per flight
Environment	Kilograms of CO_2 emissions reduced per flight (= KGs fuel saved per flight x 3.157)
Safety	Number of controlled flight into terrain (CFIT) incidents/accidents

ASBU B0-CDO: Performance Monitoring and Measurement (Implementation)	
Elements	**Implementation Indicators/Metrics**
1. CDO	Percentage of international aerodromes/TMAs with CDO implemented
2. PBN STARs	Percentage of international aerodromes/TMAs with PBN STARs implemented

APIRG Decision EO/01

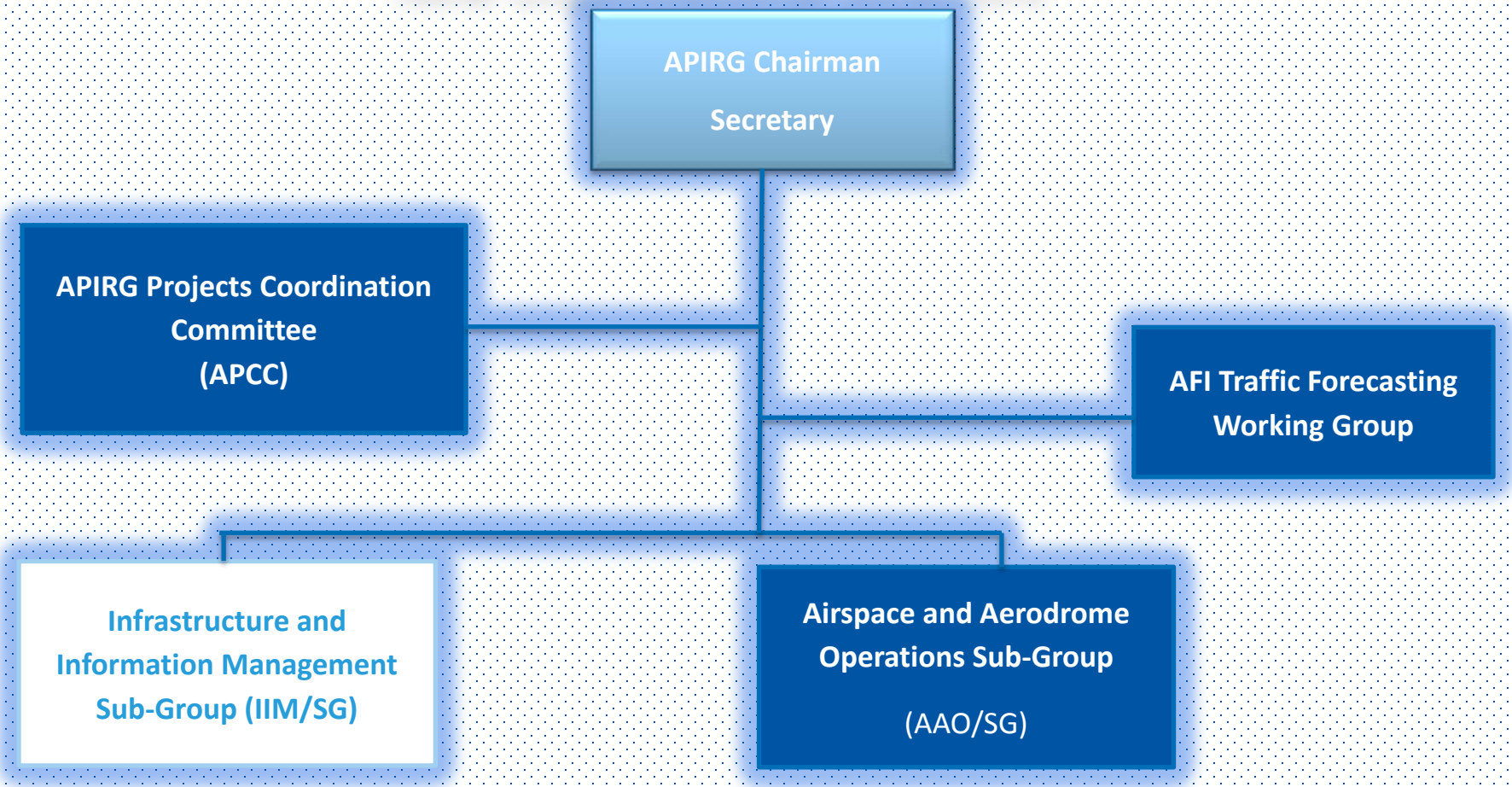
That the new organizational structure of APIRG comprising:

- **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



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THANK YOU