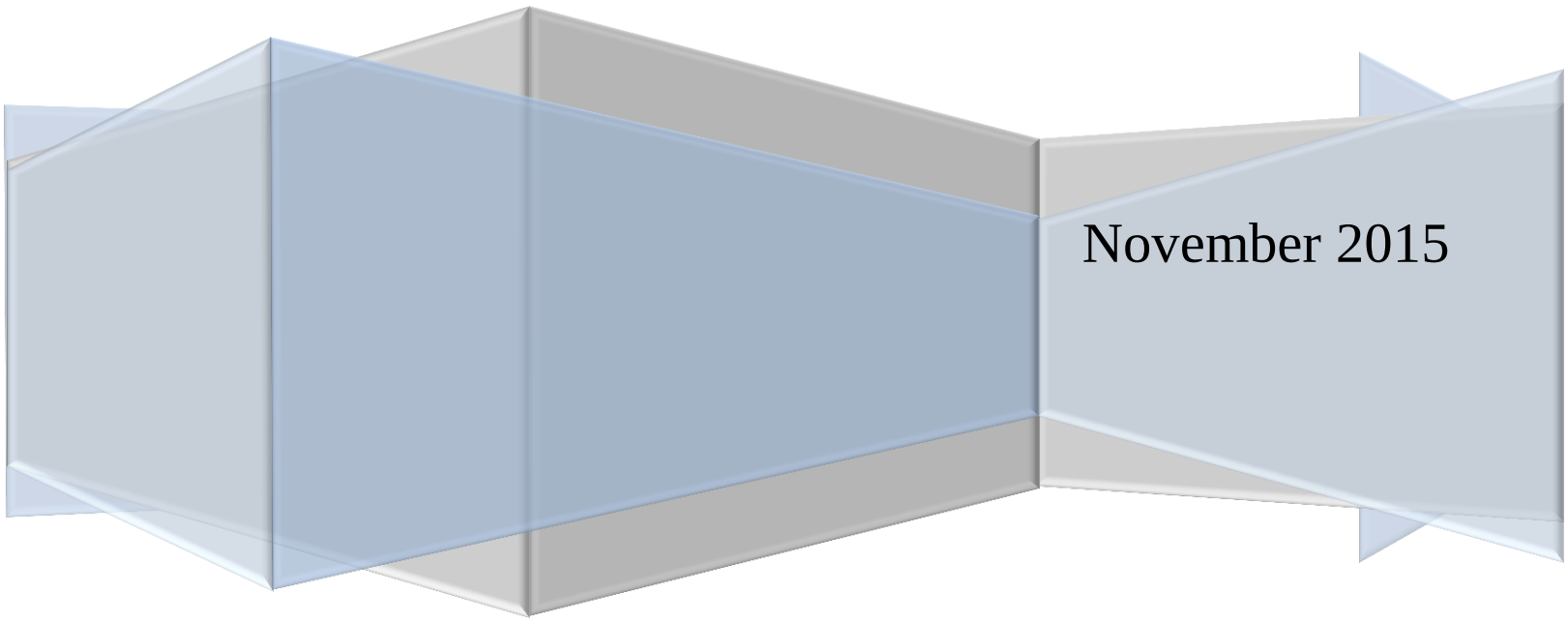
NAM ASBU Handbook

Supporting analysis and implementation reporting of the ICAO ASBU Modules



November 2015

Foreword

The *NAM ASBU Handbook* was created to assist in the application of the Aviation System Block Upgrade (ASBU) approach as detailed in the Fourth Edition of the *Global Air Navigation Plan* (GANP, Doc 9750).

The ASBU approach was globally endorsed during the 38th Assembly of the International Civil Aviation Organization (ICAO) which took place at ICAO Headquarters in Montréal, Canada, from 28 September to 4 October 2013, via the adoption of the 4th Edition of the GANP, which was presented to the Technical Commission of the 38th Assembly by the Council of ICAO in Appendix A to A38-WP/39 - . A Comprehensive Strategy for Air Navigation: Endorsement of the Global Air Navigation Plan.

As noted in A38-WP/39, the Fourth Edition of the GANP was meant to "provide clear guidance on the guiding operational targets and supporting technologies, avionics, procedures, standards and regulatory approvals needed to realize them" and to establish "a framework for incremental implementations based on the specific operational profiles and traffic densities of each State" (A38-WP/39 paragraph 2.1 refers).

The detailed material which formed the basis of the Fourth Edition of the GANP was presented at the 12th Air Navigation Conference (12th ANC) which took place at ICAO Headquarters from 19 to 30 November, 2012. This base material was subsequently updated to incorporate the recommendations of the 12th ANC and is made available by ICAO as *The Aviation System Block Upgrades - ASBUs (Edition March 2013)* (ASBU Working Document); this document is only accessible on the website for the 12th ANC, via the following link:

http://www.icao.int/Meetings/anconf12/Pages/Aviation-System-Block-Upgrades.aspx

The *NAM ASBU Handbook* references both the GANP and the ASBU Working Document.

Please provide any comments, corrections or suggestions regarding the *NAM ASBU Handbook* to:

Midori Tanino Midori.Tanino@faa.gov

and

Carole Stewart-Green Carole.Stewart@navcanada.ca

Explanation of the Handbook

When analyzing the ASBU Modules for applicability in a Region or a State, it can be difficult to determine what specific technological or procedural implementations are associated with each Module. The descriptions provided in the GANP are at a very high level of detail. Specific information for each Module was found in the ASBU Working Document, including, for most Modules, "Elements" which represented specific technical or procedural implementations. In some cases, the Elements could be directly copied from the ASBU Working Document, but in many cases, the specific technical or procedural implementation needed to be derived through careful review of the Module text.

The *NAM ASBU Handbook* provides an outline of the ASBU Modules to the Element level. The Elements are categorized as follows:

Defined - Word for word, the text for the Element as provided in the ASBU Working Document

Derived - An Element from the ASBU Working Document edited for clarity or specificity or developed on the basis of the Module description in the ASBU Working Document.

Identified - An Element developed by a Region or State which uses a similar technology or method to achieve the same results as other Elements Defined or Derived for that Module.

The sources of the detailed Module descriptions in this Handbook are indicated in the following diagram:

<table>
<tr><td rowspan="2">Module Designation
B# - Acronym - GANP
Begins page # - ASBU Working Document</td><td>Thread - Module Name
Thread name GANP, page 45, Module name, GANP</td></tr>
<tr><td>Performance Improvement Area (PIA)
GANP</td></tr>
<tr><td colspan="2">Summary Description
GANP, pages 46-87</td></tr>
<tr><td colspan="2">Operating Environment/Phases of Flight
ASBU Working Document</td></tr>
<tr><td colspan="2">Applicability Considerations
GANP, pages 46-87</td></tr>
<tr><td colspan="2">Elements
ASBU Working Document
"Derived from" indicates the paragraph number where the source concept was described
"Defined" indicates the Element number as per the ASBU Working Document
"Identified" indicates the Region or State which developed the Element</td></tr>
</table>

The Handbook provides the ASBU Modules in alphabetical order. This is different from the order in which they appear in the GANP on pages 46-87, the order on pages 40-44, the order in which the Threads are presented on page 45 and the order corresponding to the Table of Contents of the ASBU Working Document. None of these orders matches another.

Table of Contents

Foreword i
Explanation of the Handbook ii
Table of Contents iii
Index of ASBU Modules by PIA vi
Index of ASBU Modules by Thread, Block and Page vii
ASBU Modules by Block 1
Block 0 - For implementation in the 2013 - 2018 timeframe 1
PIA 1: Airport Operations 1
B0-ACDM 1
B0-APTA 2
B0-RSEQ 3
B0-SURF 4
B0-WAKE 5
PIA 2: Globally Interoperable Systems and Data - Through Globally Interoperable System Wide Information Management 6
B0-AMET 6
B0-DATM 7
B0-FICE 8
PIA 3: Optimum Capacity and Flexible Flights – Through Global Collaborative ATM 8
B0-ACAS 8
B0-ASEP 9
B0-ASUR 9
B0-FRTO 10
B0-NOPS 10
B0-OPFL 11
B0-SNET 11
PIA 4: Efficient Flight Path – Through Trajectory-based Operations 12
B0-CCO 12
B0-CDO 13
B0-TBO 14

Block 1 - For implementation in the 2018 - 2023 timeframe 15
PIA 1: Airport Operations 15
B1-ACDM 15
B1-APTA 16
B1-RATS 17
B1-RSEQ 18
B1-SURF 19
B1-WAKE 20
PIA 2: Globally Interoperable Systems and Data - Through Globally Interoperable System Wide Information Management 21
B1-AMET 21
B1-DATM 22
B1-FICE 22
B1-SWIM 23
PIA 3: Optimum Capacity and Flexible Flights - Through Global Collaborative ATM 23
B1-ASEP 23
B1-FRTO 24
B1-NOPS 25
B1-SNET 26
PIA 4: Efficient Flight Paths - Through Trajectory-based Operations 26
B1-CDO 26
B1-RPAS 27
B1-TBO 28

Block 2 - For implementation in the 2023 - 2028 timeframe 29
PIA 1: Airport Operations 29
B2-RSEQ 29
B2-SURF 29
B2-WAKE 30
PIA 2: Globally Interoperable Systems and Data 30
B2-FICE 30
B2-SWIM 31
PIA 3: Optimum Capacity and Flexible Flights 31
B2-ACAS 31
B2-ASEP 32
B2-NOPS 32
PIA 4: Efficient Flight Paths 33
B2-CDO 33
B2-RPAS 33

Block 3 - For implementation in the 2028 - onwards timeframe 34
PIA 1: Airport Operations 34
B3-RSEQ 34
PIA 2: Globally Interoperable Systems and Data 35
B3-AMET 35
B3-FICE 35
PIA 3: Optimum Capacity and Flexible Flights 36
B3-NOPS 36
PIA 4: Efficient Flight Paths 36
B3-RPAS 36
B3-TBO 37

Index of ASBU Modules by PIA

PIA 1: Airport Operations

	Page
B0-ACDM	1
B1-ACDM	15
B0-APTA	2
B1-APTA	16
B1-RATS	17
B0-RSEQ	3
B1-RSEQ	18
B2-RSEQ	29
B3-RSEQ	34
B0-SURF	4
B1-SURF	19
B2-SURF	29
B0-WAKE	5
B1-WAKE	20
B2-WAKE	30

PIA 2: Globally Interoperable Systems and Data - Through Globally Interoperable System Wide Information Management

	Page
B0-AMET	6
B1-AMET	21
B3-AMET	35
B0-DATM	7
B1-DATM	22
B0-FICE	8
B1-FICE	22
B2-FICE	30
B3-FICE	35
B1-SWIM	23
B2-SWIM	31

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

	Page
B0-ACAS	8
B2-ACAS	31
B0-ASEP	9
B1-ASEP	23
B2-ASEP	32
B0-ASUR	9
B0-FRTO	10
B1-FRTO	24
B0-NOPS	10
B1-NOPS	25
B2-NOPS	32
B3-NOPS	36
B0-OPFL	11
B0-SNET	11
B1-SNET	26

PIA 4: Efficient Flight Path – Through Trajectory-based Operations

	Page
B0-CCO	12
B0-CDO	13
B1-CDO	26
B2-CDO	33
B1-RPAS	27
B2-RPAS	33
B3-RPAS	36
B0-TBO	14
B1-TBO	28
B3-TBO	37

Index of ASBU Modules by Thread, Block and Page

Module Code	Thread	B0	B1	B2	B3
ACAS	Airborne Collision Avoidance Systems	8		31	
ACDM	Airport Collaborative Decision Making	1	15		
AMET	Advanced Meteorological Information	6	21		35
APTA	Airport Accessibility	2	16		
ASEP	Airborne Separation	9	23	32	
ASUR	Alternative Surveillance	9			
CCO	Continuous Climb Operations	12			
CDO	Continuous Descent Operations	13	26	33	
DATM	Digital Air Traffic Management	7	22		
FICE	Flight and Flow Information for a Collaborative Environment (FF-ICE)	8	22	30	35
FRTO	Free-Route Operations	10	24		
NOPS	Network Operations	10	25	32	36
OPFL	Optimum Flight Levels	11			
RATS	Remote Aerodrome Control Towers		17		
RPAS	Remotely Piloted Aircraft Systems (RPAS)		27	33	36
RSEQ	Runway Sequencing	3	18	29	34
SNET	Safety Nets	11	26		
SURF	Surface Operations	4	19	29	
SWIM	System-Wide Information Management		23	31	
TBO	Trajectory-Based Operations	14	28		37
WAKE	Wake Turbulence Separation	5	20	30	

ASBU Modules by Block

Block 0 - For implementation in the 2013 - 2018 timeframe

PIA 1: Airport Operations

Module Designation **B0-ACDM** Begins page 99	*Thread - Module Name* Airport Collaborative Decision Making - Improved Airport Operations through Airport-CDM
	Performance Improvement Area 1: Airport Operations
Summary Description Implements collaborative applications that will allow the sharing of surface operations data among the different stakeholders on the airport. This will improve surface traffic management reducing delays on movement and manoeuvring areas and enhance safety, efficiency and situational awareness.	
Operating Environment/Phases of Flight Aerodrome, terminal.	
Applicability Considerations Local for equipped/capable fleets and already established airport surface infrastructure.	
Elements 1. (Derived from 1.1.2 and 1.2.2) Airport CDM procedures 2. (Derived from 1.1.2 and 1.2.2) Airport CDM tools 3. (Derived from 3.1 & 7.2.1) Collaborative departure queue management	

Module Designation **B0-APTA** Begins on page 13	*Thread - Module Name* Airport Accessibility - Optimization of Approach Procedures including vertical guidance
	Performance Improvement Area 1: Airport Operations
Summary Description The use of Performance-based Navigation (PBN) and ground-based augmentation system (GBAS) landing system (GLS) procedures to enhance the reliability and predictability of approaches to runways, thus increasing safety, accessibility and efficiency. This is possible through the application of basic global navigation satellite system (GNSS), Baro-vertical navigation (VNAV), satellite-based augmentation system (SBAS) and GLS. The flexibility inherent in PBN approach design can be exploited to increase runway capacity.	
Operating Environment/Phases of Flight Approach.	
Applicability Considerations This Module is applicable to all instrument, and precision instrument runway ends, and to a limited extent, non-instrument runway ends.	
Elements 1. (Derived from 4.1.1) PBN Approach Procedures with vertical guidance (LPV, LNAV/VNAV minima, using SBAS and Baro VNAV) 2. (Derived from 4.1.1) PBN Approach Procedures without vertical guidance (LP, LNAV minima; using SBAS) 3. (Derived from 1.3.2) GBAS Landing System (GLS) Approach procedures	

Module Designation **B0-RSEQ** Begins page 49	*Thread - Module Name* Runway Sequencing - Improved Traffic Flow through Sequencing (AMAN/DMAN)
	Performance Improvement Area 1: Airport Operations
Summary Description Manage arrivals and departures (including time-based metering) to and from a multi-runway aerodrome or locations with multiple dependent runways at closely proximate aerodromes, to efficiently utilize the inherent runway capacity.	
Operating Environment/Phases of Flight Aerodrome and terminal.	
Applicability Considerations Runways and terminal manoeuvring area in major hubs and metropolitan areas will be most in need of these improvements. The improvement is least complex – runway sequencing procedures are widely used in aerodromes globally. However, some locations might have to confront environmental and operational challenges that will increase the complexity of development and implementation of technology and procedures to realize this Module.	
Elements 1. (Derived from Element 1) AMAN via controlled time of arrival to a reference fix 2. (Derived from Element 1) AMAN via controlled time of arrival at the aerodrome 3. (Defined: Element 2) Departure management 4. (Derived from Element 2) Departure flow management 5. (Defined: Element 3) Point merge	

Module Designation **B0-SURF** Begins page 77	*Thread - Module Name* Surface Operations - Safety and Efficiency of Surface Operations (A-SMGCS Level 1-2)
	Performance Improvement Area 1: Airport Operations
Summary Description Basic advanced-surface movement guidance and control systems (A-SMGCS) provides surveillance and alerting of movements of both aircraft and vehicles at the aerodrome, thus improving runway/aerodrome safety. Automatic dependent surveillance-broadcast (ADS-B) information is used when available (ADS-B APT).	
Operating Environment/Phases of Flight Aerodrome surface movements (aircraft + vehicles), taxi, push-back, parking.	
Applicability Considerations A-SMGCS is applicable to any aerodrome and all classes of aircraft/vehicles. Implementation is to be based on requirements stemming from individual aerodrome operational and cost-benefit assessments. ADS-B APT, when applied is an element of A-SMGCS, is designed to be applied at aerodromes with medium traffic complexity, having up to two active runways at a time and the runway width of minimum 45 m.	
Elements 1. (Derived from Element 1) A-SMGCS with at least one cooperative surface surveillance system 2. (Derived from Element 1) Including ADS-B APT as an element of A-SMGCS 3. (Derived from Element 2) A-SMGCS alerting with flight identification information 4. (Derive from 1.4.1) Airport vehicles equipped with transponders	

Module Designation **B0-WAKE** Begins page 27	*Thread - Module Name* Wake Turbulence Separation - Increased Runway Throughput through Optimized Wake Turbulence Separation
	Performance Improvement Area 1: Airport Operations
Summary Description Improves throughput on departure and arrival runways through optimized wake turbulence separation minima, revised aircraft wake turbulence categories and procedures.	
Operating Environment/Phases of Flight Arrival and departure.	
Applicability Considerations Least complex – Implementation of revised wake turbulence categories is mainly procedural. No changes to automation systems are needed.	
Elements 1. (Defined: Element 1) New PANS-ATM wake turbulence categories and separation minima 2. (Derived from Element 2) Dependent diagonal paired approach procedures for parallel runways with centrelines spaced less than 760 meters (2,500 feet) apart 3. (Derived from Element 3) Wake independent departure and arrival procedures for parallel runways with centrelines spaced less than 760 meters (2,500 feet) apart 4. (Derived from Element 3) Wake turbulence mitigation for departures procedures for parallel runways with centrelines spaced less than 760 meters (2,500 feet) apart 5. (Identified by the United States) 6 wake turbulence categories and separation minima	

PIA 2: Globally Interoperable Systems and Data - Through Globally Interoperable System Wide Information Management

<table>
<tr><td rowspan="2">Module Designation
B0-AMET
Begins page 171</td><td>Thread - Module Name
Advanced Meteorological Information - Meteorological information supporting enhanced operational efficiency and safety</td></tr>
<tr><td>Performance Improvement Area
2: Globally Interoperable Systems and Data - Through Globally Interoperable System Wide Information Management</td></tr>
<tr><td colspan="2">Summary Description
Global, regional and local meteorological information:
a) Forecasts provided by world area forecast centres (WAFCs), volcanic ash advisory centres (VAACs) and tropical cyclone advisory centres (TCAC).
b) Aerodrome warnings to give concise information of meteorological conditions that could adversely affect all aircraft at an aerodrome, including wind shear.
c) SIGMETs to provide information on occurrence or expected occurrence of specific en-route weather phenomena which may affect the safety of aircraft operations and other operational meteorological (OPMET) information, including METAR/SPECI and TAF, to provide routine and special observations and forecasts of meteorological conditions occurring or expected to occur at the aerodrome.
This information supports flexible airspace management, improved situational awareness and collaborative decision-making, and dynamically-optimized flight trajectory planning. This Module includes elements which should be viewed as a subset of all available meteorological information that can be used to support enhanced operational efficiency and safety.</td></tr>
<tr><td colspan="2">Operating Environment/Phases of Flight
All phases of flight.</td></tr>
<tr><td colspan="2">Applicability Considerations
Applicable to traffic flow planning, and to all aircraft operations in all domains and flight phases, regardless of level of aircraft equipage.</td></tr>
<tr><td colspan="2">Elements
1. (Defined: Element 1) WAFS
2. (Defined: Element 2) IAVW
3. (Defined: Element 3) TCAC forecasts
4. (Defined: Element 4) Aerodrome warnings
5. (Defined: Element 5) Wind shear warnings and alerts
6. (Derived from Element 6) SIGMET
7. (Derived from Element 6) Other OPMET information (METAR, SPECI and/or TAF)
8. (Identified by NAT) QMS for MET</td></tr>
</table>

Module Designation **B0-DATM** Begins page 147	*Thread - Module Name* Digital Air Traffic Management - Service Improvement through Digital Aeronautical Information Management
	Performance Improvement Area 2: Globally Interoperable Systems and Data - Through Globally Interoperable System Wide Information Management
Summary Description The initial introduction of digital processing and management of information through, aeronautical information service (AIS)/aeronautical information management (AIM) implementation, use of aeronautical exchange model (AIXM), migration to electronic aeronautical information publication (AIP) and better quality and availability of data.	
Operating Environment/Phases of Flight All phases of flight.	
Applicability Considerations Applicable at State level with increased benefits as more States participate.	
Elements 1. (Derived from 1.1.1) Aeronautical Information Exchange Model (AIXM) 2. (Derived from 3.1.3) eAIP 3. (Derived from 7.1) Digital NOTAM 4. (Identified by NACC) eTOD 5. (Identified by NACC) WGS-84 6. (Identified by NACC) QMS for AIM	

Module Designation **B0-FICE** Begins page 123	*Thread - Module Name* Flight and Flow Information for a Collaborative Environment (FF-ICE) - Increased Interoperability, Efficiency and Capacity through Ground-Ground Integration
	Performance Improvement Area 2: Globally Interoperable Systems and Data - Through Globally Interoperable System Wide Information Management
Summary Description Improves coordination between air traffic service units (ATSUs) by using ATS interfacility data communication (AIDC) defined by the ICAO Manual of Air Traffic Services Data Link Applications (Doc 9694). The transfer of communication in a data link environment improves the efficiency of this process, particularly for oceanic ATSUs.	
Operating Environment/Phases of Flight All flight phases and all type of ATS units.	
Applicability Considerations Applicable to at least two area control centres (ACCs) dealing with en-route and/or terminal control area (TMA) airspace. A greater number of consecutive participating ACCs will increase the benefits.	
Elements 1. (Derived from 1.1.4) AIDC to provide initial flight data to adjacent ATSUs 2. (Derived from 1.1.5) AIDC to update previously coordinated flight data 3. (Derived from 1.1.5) AIDC for control transfer 4. (Derived from 1.1.6) AIDC to transfer CPDLC logon information to the Next Data Authority	

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

Module Designation **B0-ACAS** Begins page 279	*Thread - Module Name* Airborne Collision Avoidance Systems - ACAS Improvements
	Performance Improvement Area 3: Optimum Capacity and Flexible Flights – Through Global Collaborative ATM
Summary Description Provides short-term improvements to existing airborne collision avoidance systems (ACAS) to reduce nuisance alerts while maintaining existing levels of safety. This will reduce trajectory deviations and increase safety in cases where there is a breakdown of separation.	
Operating Environment/Phases of Flight En-route flight phases and approach flight phases.	
Applicability F Safety and operational benefits increase with the proportion of equipped aircraft.	
Elements 1. (Derived from 1.3.2) ACAS II (TCAS version 7.1) 2. (Derived from 1.3.7 a) Auto Pilot/Flight Director (AP/FD) TCAS 3. (Derived from 1.3.7 b) TCAS Alert Prevention (TCAP)	

Module Designation **B0-ASEP** Begins page 253	*Thread - Module Name* Airborne Separation - Air Traffic Situational Awareness (ATSA)
	Performance Improvement Area 3: Optimum Capacity and Flexible Flights – Through Global Collaborative ATM
Summary Description Two air traffic situational awareness (ATSA) applications which will enhance safety and efficiency by providing pilots with the means to enhance traffic situational awareness and achieve quicker visual acquisition of targets: a) AIRB (basic airborne situational awareness during flight operations). b) VSA (visual separation on approach).	
Operating Environment/Phases of Flight En-route, terminal, approach.	
Applicability Considerations These are cockpit-based applications which do not require any support from the ground hence they can be used by any suitably equipped aircraft. This is dependent upon aircraft being equipped with ADS-B OUT. Avionics availability at low enough costs for General Aviation (GA) is not yet available.	
Elements 1. (Defined: Element 1) ATSA-AIRB 2. (Defined: Element 2) ATSA-VSA	

Module Designation **B0-ASUR** Begins page 245	*Thread - Module Name* Alternative Surveillance - Initial Capability for Ground Surveillance
	Performance Improvement Area 3: Optimum Capacity and Flexible Flights – Through Global Collaborative ATM
Summary Description Provides initial capability for lower cost ground surveillance supported by new technologies such as ADS-B OUT and wide area multilateration (MLAT) systems. This capability will be expressed in various ATM services, e.g. traffic information, search and rescue and separation provision.	
Operating Environment/Phases of Flight All airborne flight phases in continental or subsets of oceanic airspace and on aerodrome surfaces.	
Applicability Considerations This capability is characterized by being dependent/cooperative (ADS-B OUT) and independent/cooperative (MLAT). The overall performance of ADS-B is affected by avionics performance and compliant equipage rate.	
Elements 1. (Defined: Element 1) ADS-B 2. (Defined: Element 2) Multilateration (MLAT)	

Module Designation **B0-FRTO** Begins page 199	*Thread - Module Name* Free-Route Operations - Improved Operations through Enhanced En-Route Trajectories
	Performance Improvement Area 3: Optimum Capacity and Flexible Flights – Through Global Collaborative ATM
Summary Description Allow the use of airspace which would otherwise be segregated (i.e. Special Use 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 lengths and fuel burn.	
Operating Environment/Phases of Flight En-route, TMA.	
Applicability Considerations Applicable to en-route airspace. Benefits can start locally. The larger the size of the concerned airspace the greater the benefits, in particular for flex track aspects. Benefits accrue to individual flights and flows. Application will naturally span over a long period as traffic develops. Its features can be introduced starting with the simplest ones.	
Elements 1. (Derived from Element 1) CDM incorporated into airspace planning 2. (Defined: Element 2) Flexible Use of Airspace (FUA) 3. (Defined: Element 3) Flexible route systems 4. (Derived from Element 3) CPDLC used to request and receive re-route clearances	

Module Designation **B0-NOPS** Begins page 227	*Thread - Module Name* Network Operations - Improved Flow Performance through Planning based on a Network-Wide view
	Performance Improvement Area 3: Optimum Capacity and Flexible Flights – Through Global Collaborative ATM
Summary Description Air traffic flow management (ATFM) is used to manage the flow of traffic in a way that minimizes delays and maximizes the use of the entire airspace. ATFM can regulate traffic flows involving departure slots, smooth flows and manage rates of entry into airspace along traffic axes, manage arrival time at waypoints or flight information region (FIR)/sector boundaries and re-route traffic to avoid saturated areas. ATFM may also be used to address system disruptions including a crisis caused by human or natural phenomena.	
Operating Environment/Phases of Flight Pre-flight phases, some action during actual flight.	
Applicability Considerations Region or sub-region..	
Elements 1. (Derived from 1.1.1) ATFM	

Module Designation **B0-OPFL** Begins page 273	*Thread - Module Name* Optimum Flight Levels - Improved access to Optimum Flight Levels through Climb/Descent Procedures using ADS-B
	Performance Improvement Area 3: Optimum Capacity and Flexible Flights – Through Global Collaborative ATM
Summary Description Enables aircraft to reach a more satisfactory flight level for flight efficiency or to avoid turbulence for safety. The main benefit of ITP is significant fuel savings and the uplift of greater payloads.	
Operating Environment/Phases of Flight En-route.	
Applicability Considerations This can be applied to routes in procedural airspaces.	
Elements 1. (Derived from 1.3.1) ITP using ADS-B	

Module Designation **B0-SNET** Begins page 293	*Thread - Module Name* Safety Nets - Increased Effectiveness of Ground-based Safety Nets
	Performance Improvement Area 3: Optimum Capacity and Flexible Flights – Through Global Collaborative ATM
Summary Description Monitors the operational environment during airborne phases of flight to provide timely alerts on the ground of an increased risk to flight safety. In this case, short-term conflict alert, area proximity warnings and minimum safe altitude warnings are proposed. Ground-based safety nets make an essential contribution to safety and remain required as long as the operational concept remains human centred.	
Operating Environment/Phases of Flight All airborne flight phases.	
Applicability Considerations Benefits increase as traffic density and complexity increase. Not all ground-based safety nets are relevant for each environment. Deployment of this Module should be accelerated.	
Elements 1. (Defined: Element 1) Short Term Conflict Alert (STCA) 2. (Defined: Element 2) Area Proximity Warning (APW) 3. (Defined: Element 3) Minimum Safe Altitude Warning (MSAW) 4. (Identified by NACC) Medium Term Conflict Alert (MTCA)	

PIA 4: Efficient Flight Path – Through Trajectory-based Operations

<table>
<tr><td rowspan="2">Module Designation
B0-CCO
Begins page 347</td><td>Thread - Module Name
Continuous Climb Operations - Improved Flexibility and Efficiency in Departure Profiles - Continuous Climb Operations (CCO)</td></tr>
<tr><td>Performance Improvement Area
4: Efficient Flight Path – Through Trajectory-based Operations</td></tr>
<tr><td colspan="2">Summary Description
Implements continuous climb operations (CCO) in conjunction with Performance-based Navigation (PBN) to provide opportunities to optimize throughput, improve flexibility, enable fuel-efficient climb profiles, and increase capacity at congested terminal areas.</td></tr>
<tr><td colspan="2">Operating Environment/Phases of Flight
Departure and en-route.</td></tr>
<tr><td colspan="2">Applicability Considerations
Regions, States or individual locations most in need of these improvements. For simplicity and implementation success, complexity can be divided into three tiers:
a) Least complex – regional/States/locations with some foundational PBN operational experience that could capitalize on near-term enhancements, which include integrating procedures and optimizing performance.
b) More complex – regional/State/locations that may or may not possess PBN experience, but would benefit from introducing new or enhanced procedures. However, many of these locations may have environmental and operational challenges that will add to the complexities of procedure development and implementation.
c) Most complex – regional/State/locations in this tier will be the most challenging and complex to introduce integrated and optimized PBN operations. Traffic volume and airspace constraints are added complexities that must be confronted. Operational changes to these areas can have a profound effect on the entire State, region or location.</td></tr>
<tr><td colspan="2">Elements
1. (Derived from Element 1) Procedure changes to facilitate CCO
2. (Derived from Element 1) Route changes to facilitate CCO
3. (Derived from Element 2) PBN SIDs</td></tr>
</table>

Module Designation **B0-CDO** Begins page 303	*Thread - Module Name* Continuous Descent Operations - Improved Flexibility and Efficiency in Descent Profiles (CDO)
	Performance Improvement Area 4: Efficient Flight Path – Through Trajectory-based Operations

Summary Description

Performance-based airspace and arrival procedures allowing aircraft to fly their optimum profile using continuous descent operations (CDOs). This will optimize throughput, allow fuel efficient descent profiles, and increase capacity in terminal areas.

Operating Environment/Phases of Flight

Approach/arrivals and en-route.

Applicability Considerations

Regions, States or individual locations most in need of these improvements. For simplicity and implementation success, complexity can be divided into three tiers:

a) Least complex – regional/States/locations with some foundational PBN operational experience that could capitalize on near-term enhancements, which include integrating procedures and optimizing performance.

b) More complex – regional/State/locations that may or may not possess PBN experience, but would benefit from introducing new or enhanced procedures. However, many of these locations may have environmental and operational challenges that will add to the complexities of procedure development and implementation.

c) Most complex – regional/State/locations in this tier will be the most challenging and complex to introduce integrated and optimized PBN operations. Traffic volume and airspace constraints are added complexities that must be confronted. Operational changes to these areas can have a profound effect on the entire State, region or location.

Elements

1. (Derived from Element 1) Procedure changes to facilitate CDO
2. (Derived from Element 1) Route changes to facilitate CDO
3. (Derived from Element 2) PBN STARs

Module Designation **B0-TBO** Begins page 323	*Thread - Module Name* Trajectory-Based Operations - Improved Safety and Efficiency through the initial application of Data Link En-Route
	Performance Improvement Area 4: Efficient Flight Path – Through Trajectory-based Operations
Summary Description Implements an initial set of data link applications for surveillance and communications in air traffic control (ATC), supporting flexible routing, reduced separation and improved safety.	
Operating Environment/Phases of Flight En-route flight phases, including areas where radar systems cannot be installed such as remote or oceanic airspace.	
Applicability Considerations Requires good synchronization of airborne and ground deployment to generate significant benefits, in particular to those equipped. Benefits increase with the proportion of equipped aircraft.	
Elements 1. (Defined: Element 1) ADS-C over oceanic and remote areas 2. (Defined: Element 2) Continental CPDLC	

Block 1 - For implementation in the 2018 - 2023 timeframe

PIA 1: Airport Operations

Module Designation **B1-ACDM** Begin page 105	*Thread - Module Name* Airport Collaborative Decision Making - Optimized Airport Operations through Airport-CDM
	Performance Improvement Area 1: Airport Operations
Summary Description Enhances the planning and management of Airport Operations and allows their full integration for air traffic management using performance targets compliant with those of the surrounding airspace. This entails implementing collaborative airport operations planning (AOP) and where needed, an airport operations centre (APOC).	
Operating Environment/Phases of Flight Surface in, turn around, surface out.	
Applicability Considerations AOP: for use at all the airports (sophistication will depend on the complexity of the operations and their impact on the network). APOC: will be implemented at major/complex airports (sophistication will depend on the complexity of the operations and their impact on the network). Not applicable to aircraft.	
Elements 1. (Derived from 1.3.1 a) Airport Operations Plan (AOP) which encompasses local airport information and information that is shared with the ATM system/ATM network manager 2. (Derived from 1.3.1 b) Airport performance framework integrated into AOP 3. (Derived from 1.3.1 b) Airport performance framework aligned with regional/national performance framework(s) 4. (Derived from 1.3.1 c) Decision making support to facilitate communication and coordination between airport stakeholders for joint planning 5. (Derived from 1.3.1 d) Accessible information on airport resource availability and planned aircraft operations for use by airport operators and ATM system/network managers 6. (Derived from 1.3.1 e) Real time monitoring and alerting to activate collaborative airside/landside airport operations to respond to specific conditions, such as specified meteorological conditions/events	

Module Designation **B1-APTA** Begins on page 19	*Thread - Module Name* Airport Accessibility - Optimized Airport Accessibility
	Performance Improvement Area 1: Airport Operations
Summary Description Progresses further with the universal implementation of Performance-based Navigation (PBN) approaches. PBN and GLS (CAT II/III) procedures to enhance the reliability and predictability of approaches to runways, increasing safety, accessibility and efficiency.	
Operating Environment/Phases of Flight Approach and landing.	
Applicability Considerations This module is applicable to all runway ends.	
Elements 1. (Derived from 1.3.1) CAT II PBN approach procedures 2. (Derived from 1.3.1) CAT III PBN approach procedures 3. (Derived from 1.3.1) CAT II GLS approach procedures 4. (Derived from 1.3.1) CAT III GLS approach procedures 5. (Derived from 1.3.1) PBN STARs directly integrated to approaches with vertical guidance	

Module Designation **B1-RATS** Begins on page 111	*Thread - Module Name* Remote Aerodrome Control Towers - Remotely Operated Aerodrome Control
	Performance Improvement Area 1: Airport Operations

Summary Description

Provides a safe and cost-effective air traffic services (ATS) from a remote facility to one or more aerodromes where dedicated, local ATS are no longer sustainable or cost-effective, but there is a local economic and social benefit from aviation. This can also be applied to contingency situations and depends on enhanced situational awareness of the aerodrome under remote control.

Operating Environment/Phases of Flight

TMA, descent, airport surface, climb out.

Applicability Considerations

The main target for the single and multiple remote tower services are small rural airports, which today are struggling with low business margins. Both ATC and AFIS aerodromes are expected to benefit.

The main targets for the contingency tower solution are medium to large airports – those that are large enough to require a contingency solution, but require an alternative to A-SMGCS-based "heads down" solutions or where maintaining a visual view is required.

Although some cost benefits are possible with remote provision of ATS to a single aerodrome, maximum benefit is expected with the remote of ATS to multiple aerodromes.

Elements

1. (Derived from Element 1) Provision of tower control (TWR) or aerodrome flight information service (AFIS) for single aerodrome(s) by remotely located air traffic controllers (ATCO) or aerodrome flight information service officers (AFISO).
2. (Derived from Element 2) Provision of TWR or AFIS for multiple aerodromes by a single ATCO or AFISO.
3. (Defined: Element 3) Remote provision of ATS for contingency situations

Module Designation **B1-RSEQ** Begins on page 55	*Thread - Module Name* Runway Sequencing - Improved Airport operations through Departure, Surface and Arrival Management
	Performance Improvement Area 1: Airport Operations
Summary Description Extension of arrival metering and integration of surface management with departure sequencing will improve runway management and increase airport performance and flight efficiency.	
Operating Environment/Phases of Flight Aerodrome and terminal.	
Applicability Considerations Runways and terminal manoeuvring areas in major hubs and metropolitan areas will be most in need of these improvements. Complexity in implementation of this Module depends on several factors. Some locations might have to confront environmental and operational challenges that will increase the complexity of development and implementation of technology and procedures to realize this Module. Performance-based Navigation (PBN) routes need to be in place.	
Elements 1. (Derived from Element 1 and 4.1.1) Surface management of runway demand and sequencing aircraft on the ground to support departure operations based on precise surface movement tracking 2. (Derived from Element 2) Integration of departure sequencing and surface management 3. (Derived from Element 3) Arrival metering extended across FIR boundaries 4. (Derived from Element 4) Assignment of RNAV/RNP routes linked to controlled time of arrival at metering fixes	

Module Designation **B1-SURF** Begins on page 83	*Thread - Module Name* Surface Operations - Enhanced Safety and Efficiency of Surface Operations-SURF, SURF IA and Enhanced Vision Systems (EVS)
	Performance Improvement Area 1: Airport Operations
Summary Description Provides enhancements for surface situational awareness, including both cockpit and ground elements, in the interest of runway and taxiway safety, and surface movement efficiency. Cockpit improvements including the use of surface moving maps with traffic information (SURF), runway safety alerting logic (SURF-IA), and enhanced vision systems (EVS) for low visibility taxi operations.	
Operating Environment/Phases of Flight Aerodrome operations.	
Applicability For SURF and SURF-IA, applicable to large aerodromes (ICAO codes 3 and 4) and all classes of aircraft; cockpit capabilities work independently of ground infrastructure, but other aircraft equipage and/or ground surveillance broadcast will improve.	
Elements 1. (Derived from 1.4.1) Basic surface situation awareness (SURF) through display of other aerodrome traffic to aircraft via ADS-B or TIS-B 2. (Derived from 1.4.2) SURF with Indications and Alerts (SURF-IA) for aircraft 3. (Derived from 1.4.3 & 1.4.4) SURF for airport vehicles 4. (Derived from 1.4.4) SURF-IA for airport vehicles 5. (Defined: Element 2) Enhanced vision systems for taxi operations	

Module Designation **B1-WAKE** Begins on page 35	*Thread - Module Name* Wake Turbulence Separation - Increased Runway Throughput through Dynamic Wake Turbulence Separation
	Performance Improvement Area 1: Airport Operations
Summary Description Improved throughput on departure and arrival runways through the dynamic management of wake turbulence separation minima based on the real-time identification of wake turbulence hazards.	
Operating Environment/Phases of Flight Aerodrome.	
Applicability Considerations Least complex – implementation of re-categorized wake turbulence is mainly procedural. No changes to automation systems are needed.	
Elements 1. (Derived from Element 1 and 3.1.1) PANS-ATM aircraft leader/follower pair-wise wake turbulence separation minima. 2. (Derived from Element 2 and 3.2.1) Wake Turbulence Mitigation for Arrivals (WTMA) on parallel runways with runway centre lines spaced less than 760 m (2 500 feet) apart or on a single runway through variable application of wake turbulence separation dependant on the crosswinds present along the approach corridor. 3. (Derived from Element 3) Wake Turbulence Mitigation for Departures (WTMD) on parallel runways with runway centre lines spaced less than 760 m (2 500 feet) through reduction of separation between departures when runway crosswinds are of sufficient strength and persistence.	

PIA 2: Globally Interoperable Systems and Data - Through Globally Interoperable System Wide Information Management

Module Designation **B1-AMET** Begins on page 181	*Thread - Module Name* Advanced Meteorological Information - Enhanced Operational Decisions through Integrated Meteorological Information (Planning and Near-term Service)
	Performance Improvement Area 2: Globally Interoperable Systems and Data - Through Globally Interoperable System Wide Information Management

Summary

Enables the reliable identification of solutions when forecast or observed meteorological conditions impact aerodromes or airspace. Full ATM-Meteorology integration is needed to ensure that: meteorological information is included in the logic of a decision process and the impact of the meteorological conditions (the constraints) are automatically calculated and taken into account. The decision time-horizons range from minutes, to several hours or days ahead of the ATM operation (this includes optimum flight profile planning and tactical in-flight avoidance of hazardous meteorological conditions) to typically enable near-term and planning (>20 minutes) type of decision making. This Module also promotes the establishment of Standards for global exchange of the information.

Appreciating that the number of flights operating on cross-polar and trans-polar routes continues to steadily grow and recognizing that space weather affecting the earth's surface or atmosphere (such as solar radiation storms) pose a hazard to communications and navigation systems and may also pose a radiation risk to flight crew members and passengers, this module acknowledges the need for space weather information services in support of safe and efficient international air navigation. Unlike traditional meteorological disturbances which tend to be local or sub-regional in scale, the effects of space weather disturbances can be global in nature (although tend to be more prevalent in the polar regions), with much more rapid onset.

This Module builds, in particular, upon Module B0-AMET, which detailed a subset of all available meteorological information that can be used to support enhanced operational efficiency and safety.

Operating Environment/Phases of Flight

All flight phases.

Applicability Considerations

Applicable to traffic flow planning, and to all aircraft operations in all domains and flight phases, regardless of level of aircraft equipage.

Elements

1. (Derived from Element 1 and 1.3.2) Producing meteorological information elements that can be ingested by automated decision support tools.
2. (Derived from Element 2) Automated processing of meteorological information to derive predicted effects on airspace capacity.
3. (Derived from Element 2) Automated processing of meteorological information to derive predicted effects on aerodrome capacity.
4. (Derived from Element 3) Comparison of predicted meteorological airspace capacity constraints to projected demand.
5. (Derived from Element 3) Comparison of predicted meteorological aerodrome capacity constraints to projected demand.
6. (Derived from Element 4) Meteorological information integrated decision support that creates ranked mitigation strategies.

Module Designation **B1-DATM** Begins on page 153	*Thread - Module Name* Digital Air Traffic Management - Service Improvement through Integration of all Digital ATM Information
	Performance Improvement Area 2: Globally Interoperable Systems and Data - Through Globally Interoperable System Wide Information Management
Summary Description Implements the ATM information reference model, integrating all ATM information, using common formats (UML/XML and WXXM) for meteorological information, FIXM for flight and flow information and Internet protocols.	
Operating Environment/Phases of Flight All phases of flight.	
Applicability Considerations Applicable at State level, with increased benefits as more States participate.	
Elements 1. (Derived from 1.1.1) Implementation of digital information management using WXXM for meteorological information 2. (Derived from 1.1.1) Implementation of digital information management using FIXM for flight and flow information 3. (Derived from 1.1.1) Implementation of digital information management for aircraft performance-related data	

Module Designation **B1-FICE** Begins on page 129	*Thread - Module Name* Flight and Flow Information for a Collaborative Environment (FF-ICE) - Increased Interoperability, Efficiency and Capacity though FF-ICE, Step 1 application before Departure
	Performance Improvement Area 2: Globally Interoperable Systems and Data - Through Globally Interoperable System Wide Information Management
Summary Description Introduces FF-ICE, Step 1 providing ground-ground exchanges using a common flight information reference model (FIXM) and extensible markup language (XML) standard formats before departure.	
Operating Environment/Phases of Flight Planning phase for FF-ICE, Step 1.	
Applicability Considerations Applicable between ATS units to facilitate exchange between ATM service provider (ASP), airspace user operations and Airport Operations.	
Elements 1. (Derived from 1.3.5 a) Ability for ATS to receive early flight intention information 2. (Derived from 1.3.5 b) Ability for AOC and ATS to exchange 4D trajectory information 3. (Derived from 1.3.5 c) Implementation of a flight and flow information format using internet protocol and XML 4. (Derived from 1.3.5 d) Allocation and use of globally unique flight identifiers (GUFI) 5. (Derived from 1.3.5 e) Ability for ATS to receive FF-ICE information elements	

Module Designation **B1-SWIM** Begins on page 159	*Thread - Module Name* System-Wide Information Management - Performance Improvement through the application of System-Wide Information Management (SWIM)
	Performance Improvement Area 2: Globally Interoperable Systems and Data - Through Globally Interoperable System Wide Information Management
Summary Description Implementation of system-wide information management (SWIM) services (applications and infrastructure) creating the aviation Intranet based on standard data models and Internet-based protocols to maximize interoperability.	
Operating Environment/Phases of Flight All phases of flight.	
Applicability Considerations Applicable at State level, with increased benefits as more States participate.	
Elements 1. (Derived from 1.1.5 a) Implement structure/protocols for sharing information within communities of interest 2. (Derived from 8.1) PANS-AIM	

PIA 3: Optimum Capacity and Flexible Flights - Through Global Collaborative ATM

Module Designation **B1-ASEP** Begins on page 259	*Thread - Module Name* Airborne Separation - Increased Capacity and Efficiency through Interval Management
	Performance Improvement Area 3: Optimum Capacity and Flexible Flights - Through Global Collaborative ATM
Summary Description Interval management (IM) improves the organization of traffic flows and aircraft spacing. This creates operational benefits through precise management of intervals between aircraft with common or merging trajectories, thus maximizing airspace throughput while reducing ATC workload along with more efficient aircraft fuel burn reducing environmental impact.	
Operating Environment/Phases of Flight En-route, arrival, approach, departure.	
Applicability Considerations En-route and terminal areas.	
Elements 1. (Derived from 1.1.1, 1.1.2 and 1.3.1) Implementation of procedures for aircraft to be cleared to maintain a specified distance from a preceding aircraft from top of descent to the initial or final approach fix 2. (Derived from 1.1.1, 1.1.2 and 1.3.1) Implementation of procedures for aircraft to be cleared to maintain a specified time interval between it and a preceding aircraft from top of descent to the initial or final approach fix	

Module Designation **B1-FRTO** Begins on page 213	*Thread - Module Name* Free-Route Operations - Improved Operations through Optimized ATS Routing
	Performance Improvement Area 3: Optimum Capacity and Flexible Flights - Through Global Collaborative ATM
Summary Description Provides, through Performance-based Navigation (PBN), closer and consistent route spacing, curved approaches, parallel offsets and the reduction of holding area size. This will allow the sectorization of airspace to be adjusted more dynamically. This will reduce potential congestion on trunk routes and busy crossing points and reduce controller workload. The main goal is to allow flight plans to be filed with a significant part of the intended route specified by the user-preferred profile. Maximum freedom will be granted within the limits posed by the other traffic flows. The overall benefits are reduced fuel burn and emissions.	
Operating Environment/Phases of Flight En-route, including oceanic and remote areas and TMA.	
Applicability Considerations Region or sub-region: the geographical extent of the airspace of application should be large enough; significant benefits arise when the dynamic routes can apply across flight information region (FIR) boundaries rather than imposing traffic to cross boundaries at fixed predefined points.	
Elements 1. (Derived from Element 1) Free routing, including within defined airspace and/or at defined times and/or within defined flows 2. (Derived from Element 2 (1.4.3 b)) Maintaining same PBN route spacing between straight and turning segments 3. (Derived from Element 2 (1.4.3 c)) Publishing PBN holding procedures 4. (Defined: Element 3) Dynamic sectorization	

Module Designation **B1-NOPS** Begins on page 233	*Thread - Module Name* Network Operations - Enhanced Flow Performance through Network Operational Planning
	Performance Improvement Area 3: Optimum Capacity and Flexible Flights - Through Global Collaborative ATM
Summary Description Introduces enhanced processes to manage flows or groups of flights in order to improve overall flow. The resulting increased collaboration among stakeholders in real-time, regarding user preferences and system capabilities will result in better use of airspace with positive effects on the overall cost of ATM.	
Operating Environment/Phases of Flight Mainly applicable to pre-flight phases, with some application in flight.	
Applicability Considerations Region or sub-region for most applications; specific airports in case of initial user-driven prioritization process (UDPP). This Module is more particularly needed in areas with the highest traffic density. However, the techniques it contains would also be of benefit to areas with less traffic, subject to the business case.	
Elements 1. (Derived from Element 1) Improving ATFM algorithms and techniques 2. (Derived from Element 1) Integrating ATFM and Airspace Organization and Management (AOM) in the design of alternative route options for ATFM 3. (Derived from Element 2) Using trajectory projections as soon as possible after departure to update ATFM requirements and perform additional ATFM smoothing for single flows 4. (Derived from Element 2) Using trajectory projections as soon as possible after departure to update ATFM requirements and perform additional ATFM smoothing for converging flows 5. (Derived from Element 3) Initial User Driven Prioritization Process (UDPP) whereby operators affected by ATFM measures can collaborate with each other and ATFM to devise alternative measures that serve ATFM requirements while at the same time taking account of operators' priorities	

Module Designation **B1-SNET** Begins on page 297	*Thread - Module Name* Safety Nets - Ground-based Safety Nets on Approach
	Performance Improvement Area 3: Optimum Capacity and Flexible Flights - Through Global Collaborative ATM
Summary Description Enhances safety by reducing the risk of controlled flight into terrain accidents on final approach through the use of an approach path monitor (APM). APM warns the controller of increased risk of controlled flight into terrain during final approaches. The major benefit is a significant reduction of the number of major incidents.	
Operating Environment/Phases of Flight Approach.	
Applicability Considerations This Module will increase safety benefits during final approach particularly where terrain or obstacles represent safety hazards. Benefits increase as traffic density and complexity increase.	
Elements 1. (Derived from 1.3.1) Implementation of Approach Path Monitor (APM), which generates timely alerts to ATCOs if aircraft are in unsafe proximity to obstacles or terrain during final approach 2. (Derived from 1.3.2) Implementation of accurate approach path model in APM which minimizes nuisance alerts	

PIA 4: Efficient Flight Paths - Through Trajectory-based Operations

Module Designation **B1-CDO** Begins on page 311	*Thread - Module Name* Continuous Descent Operations - Improved Flexibility and Efficiency in Descent Profiles (CDOs) using VNAV
	Performance Improvement Area 4: Efficient Flight Paths - Through Trajectory-based Operations
Summary Description Enhances vertical flight path precision during descent, arrival, and enables aircraft to fly an arrival procedure not reliant on ground-based equipment for vertical guidance. The main benefit is higher utilization of airports, improved fuel efficiency, increased safety through improved flight predictability and reduced radio transmission, and better utilization of airspace.	
Operating Environment/Phases of Flight Descent, arrival, flight in terminal area.	
Applicability Considerations Terminal arrival and departure procedures.	
Elements 1. (Derived from 1.2.1 and 1.3.1) CDO procedures defined as vertical paths to be followed within specified tolerances	

Module Designation **B1-RPAS** Begins on page 357	*Thread - Module Name* Remotely Piloted Aircraft Systems (RPAS) - Initial Integration of Remotely Piloted Aircraft (RPA) Systems into non-segregated airspace
	Performance Improvement Area 4: Efficient Flight Paths - Through Trajectory-based Operations
Summary Description Implementation of basic procedures for operating remotely piloted aircraft (RPA) in non-segregated airspace, including detect and avoid.	
Operating Environment/Phases of Flight En-route, oceanic, terminal (arrival and departure), aerodrome (taxi, takeoff and landing).	
Applicability Considerations Applies to all RPA operating in non-segregated airspace and at aerodromes. Requires good synchronization of airborne and ground deployment to generate significant benefits, in particular to those able to meet minimum certification and equipment requirements.	
Elements 1. (Derived from 1.3.1 a) Streamlined process for RPA access to non-segregated airspace 2. (Derived from 1.3.1 b) Defined airworthiness certification for RPA 3. (Derived from 1.3.1 c) Defined operator certification for RPA operators 4. (Derived from 1.3.1 d) Defined communication performance requirements for Command and Control (C2) links and for ATC communications 5. (Derived from 1.3.1 e) Defined remote pilot licencing requirements 6. (Derived from 1.3.1 f) Defined detect and avoid technology performance requirements	

Module Designation **B1-TBO** Begins on page 331	*Thread - Module Name* Trajectory-Based Operations - Improved Traffic Synchronization and Initial Trajectory-Based Operation
	Performance Improvement Area 4: Efficient Flight Paths - Through Trajectory-based Operations
Summary Improves 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.	
Operating Environment/Phases of Flight All flight phases.	
Applicability Considerations Requires good synchronization of airborne and ground deployment to generate significant benefits, in particular to those equipped. Benefit increases with size of equipped aircraft population in the area where the services are provided.	
Elements 1. (Derived from 1.3.1) Ability to download trajectory information via air/ground data link 2. (Derived from 1.3.1) Ability to exchange complex route clearances via ground/ground data link from one ANSP to another 3. (Derived from 1.3.1) Ability to exchange complex route clearances via ground/ground data link across multiple airspace boundaries 4. (Derived from Element 1) Initial 4D operations by specifying Required Time of Arrival (RTA) 5. (Defined: Element 2) Data Link Operational Terminal Information Service (D-OTIS) 6. (Derived from Element 3) Departure clearances via data link (DCL) 7. (Defined: Element 4) Data Link Taxi (D-TAXI)	

Block 2 - For implementation in the 2023 - 2028 timeframe

PIA 1: Airport Operations

Module Designation **B2-RSEQ** Begins page 65	*Thread - Module Name* Runway Sequencing - Linked Arrival Management and Departure Management (AMAN/DMAN)
	Performance Improvement Area 1: Airport Operations
Summary Description Integrated AMAN/DMAN to enable dynamic scheduling and runway configuration to better accommodate arrival/departure patterns and integrate arrival and departure management. This Module also summarizes the benefits of such integration and the elements that facilitate it.	
Operating Environment/Phases of Flight Aerodrome and terminal.	
Applicability Considerations Runways and terminal manoeuvring area in major hubs and metropolitan areas will be most in need of these improvements. The implementation of this Module is least complex. Some locations might have to confront environmental and operational challenges that will increase the complexity of development and implementation technology and procedures to realize this Block. Infrastructure for RNAP/RNP routes need to be in place.	
Elements 1. TBD	

Module Designation **B2-SURF** Begins page 89	*Thread - Module Name* Surface Operations - Optimized Surface Routing and Safety Benefits (A-SMGCS Level 3-4 and SVS)
	Performance Improvement Area 1: Airport Operations
Summary Description To improve efficiency and reduce the environmental impact of surface operations, even during periods of low visibility. Queuing for departure runways is reduced to the minimum necessary to optimize runway use and taxi times are also reduced. Operations will be improved so that low visibility conditions have only a minor effect on surface movement.	
Operating Environment/Phases of Flight Aerodrome.	
Applicability Considerations Most applicable to large aerodromes with high demand, as the Upgrades address issues surrounding queuing and management and complex aerodrome operations.	
Elements 1. TBD	

Module Designation **B2-WAKE** Begins page 43	*Thread - Module Name* Wake Turbulence Separation - Advanced Wake Turbulence Separation (Time-based)
	Performance Improvement Area 1: Airport Operations
Summary Description The application of time-based aircraft-to-aircraft wake separation minima and changes to the procedures the ANSP uses to apply wake separation minima.	
Operating Environment/Phases of Flight Aerodrome.	
Applicability Considerations Most complex – establishment of time-based separation criteria between pairs of aircraft extends the existing variable distance re-categorization of existing wake turbulence into a conditions-specific time-based interval. This will optimize the interoperation wait time to the minimum required for wake disassociation and runway occupancy. Runway throughput is increased as a result.	
Elements 1. TBD	

PIA 2: Globally Interoperable Systems and Data

Module Designation **B2-FICE** Begins page 135	*Thread - Module Name* Flight and Flow Information for a Collaborative Environment (FF-ICE) - Improved Coordination through Multi-centre Ground-Ground Integration (FF ICE, Step 1 and Flight Object, SWIM)
	Performance Improvement Area 2: Globally Interoperable Systems and Data
Summary Description FF-ICE supporting trajectory-based operations through exchange and distribution of information for multi-centre operations using flight object implementation and interoperability (IOP) standards. Extension of use of FF-ICE after departure, supporting trajectory-based operations. New system interoperability SARPs to support the sharing of ATM services involving more than two air traffic service units (ATSUs).	
Operating Environment/Phases of Flight All flight phases and all types of ground stakeholders.	
Applicability Considerations Applicable to all ground stakeholders (ATS, airports, airspace users) in homogeneous areas, potentially global.	
Elements 1. TBD	

Module Designation **B2-SWIM** Begins page 165	*Thread - Module Name* System-Wide Information Management - Enabling Airborne Participation in Collaborative ATM through SWIM
	Performance Improvement Area 2: Globally Interoperable Systems and Data
Summary Description This allows the aircraft to be fully connected as an information node in SWIM, enabling full participation in collaborative ATM processes with exchange of data including meteorology. This will start with non-safety critical exchanges supported by commercial data links.	
Operating Environment/Phases of Flight All phases of flight.	
Applicability V Long-term evolution potentially applicable to all environments.	
Elements 1. TBD	

PIA 3: Optimum Capacity and Flexible Flights

Module Designation **B2-ACAS** Begins page 285	*Thread - Module Name* Airborne Collision Avoidance Systems - New Collision Avoidance System
	Performance Improvement Area 3: Optimum Capacity and Flexible Flights
Summary Description Implementation of the airborne collision avoidance system (ACAS) adapted to trajectory-based operations with improved surveillance function supported by ADS-B and adaptive collision avoidance logic aiming at reducing nuisance alerts and minimizing deviations. The implementation of a new airborne collision warning system will enable more efficient operations and future airspace procedures while complying with safety regulations. The new system will accurately discriminate between necessary alerts and "nuisance alerts". This improved differentiation will lead to a reduction in controller workload as personnel will spend less time to respond to "nuisance alerts". This will result in a reduction in the probability of a near mid-air collision.	
Operating Environment/Phases of Flight Aerodrome.	
Applicability Considerations Safety and operational benefits increase with the proportion of equipped aircraft. The safety case needs to be carefully done.	
Elements 1. TBD	

Module Designation **B2-ASEP** Begins page 265	*Thread - Module Name* Airborne Separation - Airborne Separation (ASEP)
	Performance Improvement Area 3: Optimum Capacity and Flexible Flights
Summary Description 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. The flight crew ensures separation from suitably equipped designated aircraft as communicated in new clearances, which relieve the controller of the responsibility for separation between these aircraft. However, the controller retains responsibility for separation from aircraft that are not part of these clearances.	
Operating Environment/Phases of Flight En-route phase, oceanic, and approach, departure and arrival.	
Applicability Considerations The safety case needs to be carefully done and the impact on capacity is still to be assessed in case of delegation of separation for a particular situation implying new regulation on airborne equipment and equipage roles and responsibilities (new procedure and training). First applications of ASEP are envisaged in Oceanic airspace and in approach for closely-spaced parallel runways.	
Elements 1. TBD	

Module Designation **B2-NOPS** Begins page 239	*Thread - Module Name* Network Operations - Increased User Involvement in the Dynamic Utilization of the Network
	Performance Improvement Area 3: Optimum Capacity and Flexible Flights
Summary Description 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 enough capacity to meet user demands. This further develops the CDM applications by which ATM will be able to offer/delegate to the users the optimization of solutions to flow problems. Benefits include an improvement in the use of available capacity and optimized airline operations in degraded situations.	
Operating Environment/Phases of Flight Pre-flight phases.	
Applicability Considerations Region or sub-region.	
Elements 1. TBD	

PIA 4: Efficient Flight Paths

Module Designation **B2-CDO** Begins page 315	*Thread - Module Name* Continuous Descent Operations - Improved Flexibility and Efficiency in Continuous Descent Profiles (CDOs) Using VNAV, Required Speed and Time at Arrival
	Performance Improvement Area 4: Efficient Flight Paths
Summary Description A key emphasis is on the use of arrival procedures that allow the aircraft to apply little or no throttle in areas where traffic levels would otherwise prohibit this operation. This Block will consider airspace complexity, air traffic workload, and procedure design to enable optimized arrivals in dense airspace.	
Operating Environment/Phases of Flight En-route, terminal area, descent.	
Applicability Considerations Global, high-density airspace (based on the United States FAA procedures).	
Elements 1. TBD	

Module Designation **B2-RPAS** Begins page 365	*Thread - Module Name* Remotely Piloted Aircraft Systems - Remotely Piloted Aircraft (RPA) Integration in Traffic
	Performance Improvement Area 4: Efficient Flight Paths
Summary Description Continuing to improve the remotely piloted aircraft (RPA) access to non-segregated airspace; continuing to improve the remotely piloted aircraft system (RPAS) approval/certification process; continuing to define and refine the RPAS operational procedures; continuing to refine communication performance requirements; standardizing the command and control (C2) link failure procedures and agreeing on a unique squawk code for C2 link failure; and working on detect and avoid technologies, to include automatic dependent surveillance – broadcast (ADS-B) and algorithm development to integrate RPA into the airspace.	
Operating Environment/Phases of Flight All phases of flight including taxi.	
Applicability Considerations Applies to all RPA operating in non-segregated airspace and at aerodromes. Requires good synchronization of airborne and ground deployment to generate significant benefits, in particular to those able to meet minimum certification and equipment requirements.	
Elements 1. TBD	

Block 3 - For implementation in the 2028 - onwards timeframe

PIA 1: Airport Operations

Module Designation **B3-RSEQ** Begins page 71	*Thread - Module Name* Runway Sequencing - Integration AMAN/DMAN/SMAN
	Performance Improvement Area 1: Airport Operations
Summary Description This Module includes a brief description of integrated arrival, en-route, surface, and departure management.	
Operating Environment/Phases of Flight All phases of flight.	
Applicability Considerations Runways and terminal manoeuvring areas in major hubs and metropolitan areas will be most in need of these improvements. Complexity in implementation of this Block depends on several factors. Some locations might have to confront environmental and operational challenges that will increase the complexity of development and implementation of technology and procedures to realize this Block. Infrastructure for RNAV/RNP routes need to be in place.	
Elements 1. TBD	

PIA 2: Globally Interoperable Systems and Data

Module Designation **B3-AMET** Begins page 191	*Thread - Module Name* Advanced Meteorological Information - Enhanced Operational Decisions through Integrated Meteorological Information (Near-term and Immediate Service)
	Performance Improvement Area 2: Globally Interoperable Systems and Data *In the GANP, this Module is listed under Performance Improvement Area 3*
Summary The aim of this Module is to enhance global ATM decision-making in the face of hazardous meteorological conditions in the context of decisions that should have an immediate effect. This Module builds upon the initial information integration concept and capabilities developed under B1-AMET. Key points are a) tactical avoidance of hazardous meteorological conditions in especially the 0-20 minute time frame; b) greater use of aircraft based capabilities to detect meteorological parameters (e.g. turbulence, winds, and humidity); and c) display of meteorological information to enhance situational awareness. This Module also promotes further the establishment of Standards for the global exchange of the information.	
Operating Environment/Phases of Flight All.	
Applicability Considerations Applicable to air traffic flow planning, en-route operations, terminal operations (arrival/departure) and surface. Aircraft equipage is assumed in the areas of ADS-B IN/CDTI, aircraft-based meteorological observations, and meteorological information display capabilities, such as EFBs.	
Elements 1. TBD	

Module Designation **B3-FICE** Begins page 139	*Thread - Module Name* Flight and Flow Information for a Collaborative Environment (FF-ICE) - Improved Operational Performance through the Introduction of Full FF-ICE
	Performance Improvement Area 2: Globally Interoperable Systems and Data
Summary Description Data for all relevant flights systematically shared between the air and ground systems using SWIM in support of collaborative ATM and trajectory-based operations.	
Operating Environment/Phases of Flight All phases of flight from initial planning to post-flight.	
Applicability Considerations Air and ground.	
Elements 1. TBD	

PIA 3: Optimum Capacity and Flexible Flights

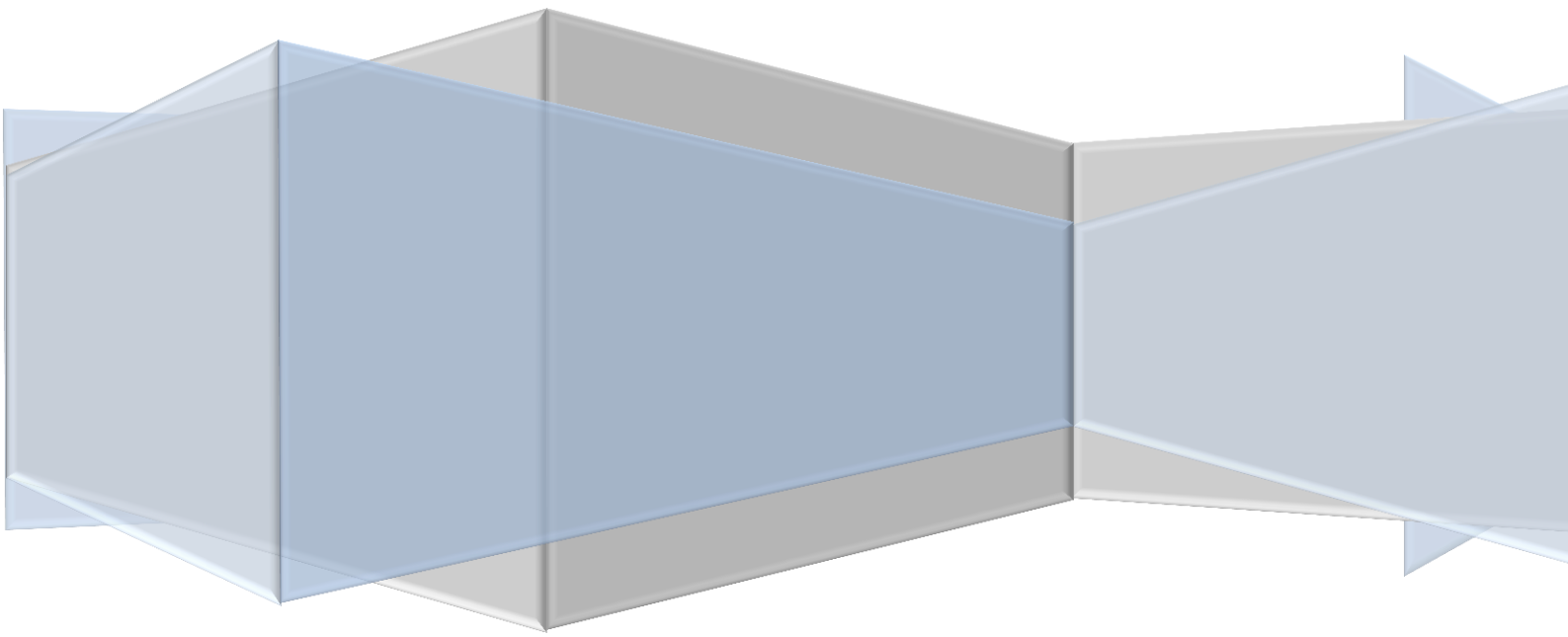
Module Designation **B3-NOPS** Begins page 221 *In ASBU Working Document, this is B3-FRTO*	*Thread - Module Name* Network Operations - Traffic Complexity Management
	Performance Improvement Area 3: Optimum Capacity and Flexible Flights
Summary Description Introduction of complexity management to address 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 SWIM-based ATM. Benefits will include optimized usage and efficiency of system capacity.	
Operating environment/Phases of flight Pre-flight and in-flight.	
Applicability Considerations Regional or sub-regional. Benefits are only significant over a certain geographical size and assume that it is possible to know and control/optimize relevant parameters. Benefits mainly useful in the higher density airspace.	
Elements 1. TBD	

PIA 4: Efficient Flight Paths

Module Designation **B3-RPAS** Begins page 373	*Thread - Module Name* Remotely Piloted Aircraft Systems (RPAS) - Remotely Piloted Aircraft (RPA) Transparent Management
	Performance Improvement Area 4: Efficient Flight Paths
Summary Description Continuing to improve the certification process for remotely piloted aircraft (RPA) in all classes of airspace, working on developing a reliable command and control (C2) link, developing and certifying airborne detect and avoid (ABDAA) algorithms for collision avoidance, and integration of RPA into aerodrome procedures.	
Operating Environment/Phases of Flight En-route, oceanic, terminal (arrival and departure), aerodrome (taxi, take-off and landing).	
Applicability Considerations Applies to all RPA operating in non-segregated airspace and at aerodromes. Requires good synchronization of airborne and ground deployment to generate significant benefits, in particular to those able to meet minimum certification and equipment requirements.	
Elements 1. TBD	

Module Designation **B3-TBO** Begins page 339	*Thread - Module Name* Trajectory Based Operations - Full 4D Trajectory-based Operations
	Performance Improvement Area 4: Efficient Flight Paths
Summary Description The development of advanced concepts and technologies, supporting four dimensional trajectories (latitude, longitude, altitude, time) and velocity to enhance global ATM decision-making. A key emphasis is on integrating all flight information to obtain the most accurate trajectory model for ground automation.	
Operating Environment/Phases of Flight En-route/cruise, terminal area, traffic flow management, descent.	
Applicability Considerations Applicable to air traffic flow planning, en-route operations, terminal operations (approach/departure), and arrival operations. Benefits accrue to both flows and individual aircraft. Aircraft equipage is assumed in the areas of: ADS-B IN/CDTI; data communication and advanced navigation capabilities. Requires good synchronization of airborne and ground deployment to generate significant benefits, in particular to those equipped. Benefit increases with size of equipped aircraft population in the areas where the services are provided.	
Elements 1. TBD	

-- END --



Summary Table for [STATE] Implementation Status of ASBU Block 0 Elements

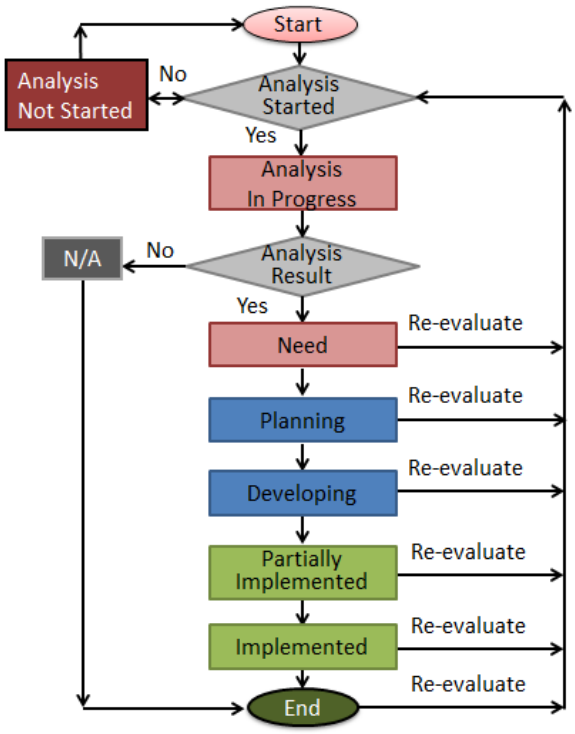
Module	Elements	Need Analysis				Implementation Status (if Element is needed)			
		Not Started	In Progress	Need	N/A	Planning	Developing	Partially Implemented	Implemented
Performance Improvement Area 1: Airport Operations									
ACDM	1. Airport CDM procedures								
	2. Airport CDM tools								
	3. Collaborative departure queue management								
APTA	1. PBN Approach Procedures with vertical guidance (LPV, LNAV/VNAV minima, using SBAS and Baro VNAV)								
	2. PBN Approach Procedures without vertical guidance (LP, LNAV minima; using SBAS)								
	3. GBAS Landing System (GLS) Approach procedures								
RSEQ	1. AMAN via controlled time of arrival to a reference fix								
	2. AMAN via controlled time of arrival at the aerodrome								
	3. Departure management								
	4. Departure flow management								
	5. Point merge								
SURF	1. A-SMGCS with at least one cooperative surface surveillance system								
	2. Including ADS-B APT as an element of A-SMGCS								
	3. A-SMGCS alerting with flight identification information								
	4. Airport vehicles equipped with transponders								
WAKE	1. New PANS-ATM wake turbulence categories and separation minima								
	2. Dependent diagonal paired approach procedures for parallel runways with centrelines spaced less than 760 meters (2,500 feet) apart								
	3. Wake independent departure and arrival procedures for parallel runways with centrelines spaced less than 760 meters (2,500 feet) apart								
	4. Wake turbulence mitigation for departures procedures for parallel runways with centrelines spaced less than 760 meters (2,500 feet) apart								
	5. 6 wake turbulence categories and separation minima								
Performance Improvement Area 2: Globally Interoperable Systems and Data									
AMET	1. WAFS								
	2. IAVW								
	3. TCAC forecasts								
	4. Aerodrome warnings								
	5. Wind shear warnings and alerts								
	6. SIGMET								
	7. Other OPMET information (METAR, SPECI and/or TAF)								
	8. QMS for MET								
DATM	1. Aeronautical Information Exchange Model (AIXM)								
	2. eAIP								
	3. Digital NOTAM								
	4. eTOD								
	5. WGS-84								
	6. QMS for AIM								
FICE	1. AIDC to provide initial flight data to adjacent ATSUs								
	2. AIDC to update previously coordinated flight data								
	3. AIDC for control transfer								

Module	Elements	Need Analysis				Implementation Status (if Element is needed)			
		Not Started	In Progress	Need	N/A	Planning	Developing	Partially Implemented	Implemented
	4. AIDC to transfer CPDLC logon information to the Next Data Authority								
Performance Improvement Area 3: Optimum Capacity and Flexible Flights									
ACAS	1. ACAS II (TCAS version 7.1)								
	2. Auto Pilot/Flight Director (AP.FD) TCAS								
	3. TCAS Alert Prevention (TCAP)								
ASEP	1. ATSA-AIRB								
	2. ATSA-VSA								
ASUR	1. ADS-B								
	2. Multilateration (MLAT)								
FRTO	1. CDM incorporated into airspace planning								
	2. Flexible Use of Airspace (FUA)								
	3. Flexible route system								
	4: CPDLC used to request and receive re-route clearances								
NOPS	1. ATFM								
OPFL	1. ITP using ADS-B								
SNET	1. Short Term Conflict Alert implementation (STCA)								
	2. Area Proximity Warning (APW)								
	3. Minimum Safe Altitude Warning (MSAW)								
	4. Medium Term Conflict Alert (MTCA)								
Performance Improvement Area 4: Efficient Flight Paths									
CCO	1. Procedure changes to facilitate CCO								
	2. Route changes to facilitate CCO								
	3. PBN SIDs								
CDO	1. Procedure changes to facilitate CDO								
	2. Route changes to facilitate CDO								
	3. PBN STARs								
TBO	1. ADS-C over oceanic and remote areas								
	2. Continental CPDLC								
	All Elements: 63								

Analysis and Implementation Workflow: the significance of each step in the workflow

- **Analysis Not Started** – The requirement to implement this ASBU Element has not yet been assessed
- **Analysis In Progress** – A Need Analysis as to whether or not this ASBU Element is required is in progress
- **N/A** – The ASBU Element is not required
- **Need** - The Need Analysis concluded that the ASBU Element is required, but planning for the implementation has not yet begun
- **Planning** – Implementation of this ASBU Element is planned, but not started
- **Developing** – Implementation of this ASBU Element is in the development phase, but not yet operational
- **Partially Implemented** – Implementation of this ASBU Element is partially completed and/or operational but all planned implementations are not yet complete
- **Implemented** - Implementation of this ASBU Element has been completed and/or is fully operational everywhere the need was identified

FIGURE GEN III-1 – Analysis and Implementation Workflow



ANRF Explanation and Instruction

PIA The Performance Improvement Area (1, 2, 3 or 4) for the ASBU Module.

Block - Module The Module Designation for the ASBU Module.

Date The date when the form was completed or updated.

Module Description The Summary Description for the ASBU Module.

Element The descriptive text for each Element. It is not necessary to include the Defined, Derived from or Identified By information. Insert additional rows, if necessary, to accommodate all of the Elements listed for the ASBU Module.

Date Planned or Implemented The month and year when the Element was fully implemented or the year when it is planned for the Element to be fully implemented by all applicable States or at all applicable aerodromes. This field should be left blank if the Status for the Element is "Analysis Not Started" or "Not Applicable" for all States or aerodromes in the Region.

Status The Need Analysis or Implementation status for the Element, in accordance with Table [STATE] ASBU III-1, III-2, III-3 or III-4. Indicate the status as follows:

Not Started: if the Need Analysis has not been started for any of the States or aerodromes

In Progress: if at least one Need Analysis has been started but none have yet been completed

Need: if at least on Need Analysis has determined a requirement for the Element, but no implementation planning has yet been initiated

Not Applicable: 1) if all of the Need Analyses completed to date have concluded the Element is not required, or 2) if the Element is not an aerodrome-related improvement and the Region has not adopted the improvement for region-wide implementation.

Planning: if at least one implementation is in the Planning phase and no implementations have yet been completed.

Developing: if at least one implementation is in the Developing phase but no implementations have yet been completed.

Partially Implemented: if at least one, but not all, implementations have been completed.

Implemented: if all of Needed implementations have been completed.

Status Details Further information to support or explain the reported status. The reason(s) an Element was found to be "Not Applicable" for all the aerodromes (or States) in the Region. The reason(s) why the Need Analysis has not been completed for all or some of the aerodromes (or States) in the Region. Information on where implementation has or has not been completed (as appropriate) if the reported status is "Partially Implemented".

Achieved Benefits Describe the achieved benefits for the entire Module or particular Elements. The benefits can be quantitative or qualitative. The benefits should be described for the

following 5 of the 11 Key Performance Areas (KPAs) defined the *Manual on Global Performance of the Air Navigation System* (Doc 9883):

Access & Equity: Improving the operating environment so as to ensure all airspace users have the right of access to ATM resources needed to meet their specific operational requirements; and ensuring that the shared use of the airspace for different airspace users can be achieved safely. Providing equity for all airspace users that have access to a given airspace or service. Generally, the first aircraft ready to use the ATM resources will receive priority, except where significant overall safety or system operational efficiency would accrue or national defence considerations or interests dictate by providing priority on a different basis.

Capacity: Improving the ability to meet airspace user demand at peak times and locations while minimizing restrictions on traffic flow. Responding to future growth by increasing capacity, efficiency, flexibility, and predictability while ensuring that there are no adverse impacts to safety and giving due consideration to the environment. Increasing resiliency to service disruption and minimising resulting temporary loss of capacity.

Efficiency: Improving the operational and economic cost effectiveness of gate-to-gate flight operations from the airspace users' perspective. Increasing the ability for airspace users to depart and arrive at the times they select and fly the trajectory they determine to be optimum in all phases of flight.

Environment: Contributing to the protection of the environment by minimizing or reducing noise, gaseous emissions, and other negative environmental effects in the implementation and operation of the air navigation system.

Safety: Reducing the likelihood or severity of operational safety risks associated with the provision or use of air navigation services.

Implementation Challenges A description of any circumstances that have been encountered or are foreseen that might prevent or delay implementation. Challenges should be categorized and described under the applicable subject area.

Notes Any further information as deemed appropriate.

STATE ASBU Air Navigation Reporting Form (ANRF)					
PIA	4	**Block - Module**	B0 - CDO	**Date**	August 18, 2015

Module Description

To use Performance-based airspace and arrival procedures allowing aircraft to fly their optimum profile using continuous descent operations (CDOs). This will optimize throughput, allow fuel efficient descent profiles, and increase capacity in terminal areas.

Element Implementation Status

1	**Element Description** Procedure changes to facilitate CDO	**Date Planned/Implemented** Dec 15, 2013	**Status** Implemented
	Status Details Optimized Profile Descent (OPD) is US equivalent to CDO. Most PBN STARs are either being developed or amended as OPD procedures. There are 215 PBN STARs with OPD. These procedures serve 102 airports (as of June 2015)		
2	**Element Description** Route changes to facilitate CDO	**Date Planned/Implemented** Dec 15, 2013	**Status** Implemented
	Status Details Route and associated airspace changes are routinely made as part of PBN procedure design and implementation processes.		
3	**Element Description** PBN STARs	**Date Planned/Implemented** Dec 15, 2013	**Status** Implemented
	Status Details There are 367 total PBN STARs in the NAS with some of the procedures serving multiple airports (as of June 2015). PBN STARs are implemented at 256 airports (as of June 2015).		

Achieved Benefits

Access and Equity

Element 1: Only at locations where PBN STARs can be published to deconflict traffic flows with additional/different routing options. For example, RNAV STARs with OPDs implemented at Dulles and Regan National airports are now laterally separated.

Element 3: Only at locations where PBN STARs can be published to deconflict traffic flows with additional/different routing options.

Capacity

N/A

Efficiency

Element 1: Cost savings through reduced fuel burn due to improved vertical profiles.

Reduction in the number of required radio transmissions, and therefore controller and pilot workloads; however, we do not have empirical data to evaluate this particular benefit.

Operational benefits:

- Arrivals exhibited more efficient vertical profiles
- Average time and distance within 250 nm of the airport did not change

		Vertical Profile Performance Outcomes					Additional Efficiency Performance Outcomes	
Weather	Proportion of Flights (%)	Number of Level Segments	Time in Level Flight (min)	Distance in Level Flight (nm)	Time-Weighted Altitude (feet)	Flights Without Level Segments (%)	Time (min)	Distance (nm)
VMC	86	2.0 (-16%)	5.4 (-13%)	31.2 (-12%)	17,300 (6%)	17 (72%)	43.4 (0%)	269.7 (0%)
Non-VMC	14	2.6 (-9%)	8.0 (-6%)	41.6 (-6%)	14,500 (6%)	9 (37%)	47.0 (0%)	280.7 (0%)
All	100	2.1 (-15%)	5.7 (-12%)	32.7 (-11%)	16,800 (6%)	16 (70%)	43.9 (0%)	271.2 (0%)

Element 3:

Only at locations where PBN STARs can be published to shorten typically flown terminal routing options, or to improve flow interaction, or improve vertical profiles.

Environment

Element 1: Reduced emissions as a result of reduced fuel burn (IFSET)

Element 3: Reduced emissions as a result of reduced fuel burn (IFSET)

Safety

Element 1: RNAV STARs facilitate executing stabilized approaches.

Element 3: More consistent flight paths and stabilized approach paths.

Implementation Challenges

Ground system Implementation

None

Avionics Implementation

None

Procedures Availability

None

Operational Approvals

None

Notes

None