NATIONAL AIR NAVIGATION PLAN (NANP)

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W W W . C A A M . G O V . M Y

Executive Summary

The National Aviation Navigation Plan (NANP) is Malaysia's comprehensive master planning document, outlining the strategic direction for the safe, efficient, cost-effective, and environmentally sustainable management of air navigation services. Its core objective is to guide the industry in thorough planning and implementation initiatives, ensuring the future development and delivery of efficient and effective Air Navigation Services.

The NANP delineates Malaysia's planning framework to synchronise with both Regional and Global objectives, fostering a high degree of harmonisation and interoperability with other States. It also establishes the responsibilities for providing safe and efficient air navigation services within Malaysian airspace and for upgrading and modernizing communication, navigation, and surveillance facilities and services.

In alignment with international efforts under the International Civil Aviation Organization (ICAO) Global Air Navigation Plan (GANP), ICAO Aviation System Block Upgrade (ASBU) and the Asia Pacific Seamless ANS Plan, the NANP is structured around the following interconnected domains: Flight Operations, Communication Navigation and Surveillance, Air Traffic Management, Unmanned Aircraft System, Aeronautical Information Management, and Meteorology. These areas are crucial for the modernisation of Malaysia's air navigation systems for the future. The guidelines within the NANP provide the industry with a roadmap for enhancing the capacity of airspace and aerodromes. Future regulatory decisions and key policies regarding air navigation projects and investments in Malaysia will be anchored on the strategic direction set forth in the NANP.

(Dato' Captain Norazman Bin Mahmud)
Chief Executive Officer
Civil Aviation Authority of Malaysia

Abbreviations

ABAS	Aircraft Based Augmentation Systems
ACARS	Aircraft Communications Addressing and Reporting System
ACAS	Airborne Collision Avoidance System
A-CDM	Airport Collaborative Decision-Making
ACIS	Airport Collaborative Information Sharing
ADS-B	Automatic Dependent Surveillance – Broadcast
ADS-C	Automatic Dependent Surveillance – Contract
AeroMACS	Aeronautical Mobile Airport Communications Systems
AIDC	Air Traffic Services Inter-Facility Data Communication
AIS	Aeronautical Information Service
AMHS	ATS/ Aeronautical Message Handling Services
AMO	Aeronautical Meteorological Offices
AMS	Aeronautical Meteorological Stations
APAC	Asia/ Pacific
APANPIRG	Asia/ Pacific Air Navigation Planning and Implementation Regional Work Group.
APA TFG	Asia/Pacific Area Traffic Forecasting Group
APM	Airspace Penetration Monitor
APTA	Airport accessibility
APW	Area Proximity Warning
ARINC	Aeronautical Radio Incorporated
ASBU	Aviation System Block Upgrade
ASUR	Alternative surveillance
ATC	Air traffic control
ATM	Air Traffic Management
ATN/IPS	Aeronautical Telecommunications Network/ Internet Protocol Suite
ATN/OSI	Aeronautical Telecommunications Network/ Open Systems Interconnection
ATS	Air traffic service
CAAM	Civil Aviation Authority of Malaysia
CAR	Civil Aviation Regulation 2016
CAR (FC)	Civil Aviation Regulation 2016 (Fees & Charges)
CCO/CDO	Continuous climb and descent operations
CNS	Communication, Navigation and Surveillance
COMI	Communication infrastructure
CPDLC	Controller Pilot Data Link Communications
CTR	Control zone
DFMC	Dual frequency/ multi-constellation
FASID	Facilities and Services Implementation Document
FICE	FF-ICE
FF-ICE	Flight and Flow Information for a Collaborative Environment
FIR	Flight Information Region
GBAS	Ground Based Augmentation System
GLS	GBAS Landing System
GNSS	Global Navigation Satellite System

HFDL	High frequency data link
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
LCC	Low cost carrier
ILS	Instrument landing system
KLIA	Kuala Lumpur International Airport
LNAV	Lateral navigation
MAHB	Malaysia Airport Holding Berhad
MCMC	Malaysia Communication and Multimedia Commission
MLAT	Multilateration system
MON	Minimum operational network
MSAW	Minimum Safe Altitude Warning
MWO	Meteorological Watch Offices
NAMP	National Airport Master Plan
NAVAIDS	Navigational Aids
NM	Nautical miles
PBCS	Performance Based Communications and Surveillance
PBN	Performance-Based Navigation
RANP	Regional Air Navigation Plan
RNAV	Area Navigation
RNP	Required Navigation Performance
RNP AR APCH	Required Navigation Performance Approach (Authorization Required)
RSEQ	Runway sequencing
SATCOM	Satellite communication
SATVOICE	Satellite voice
SBAS	Satellite Based Augmentation System
SID	Standard Instrument Departure Route
SNET	Safety nets
SSR	Secondary Surveillance Radar (SSR)
SSR-DAPS	Secondary Surveillance Radar (SSR)- Downlink Aircraft Parameters
STAR	Standard Arrival Route
STCA	Short Term Conflict Alert
SUA	Special Use Airspace
SURF	Surface operations
SVGS	Synthetic Vision Guidance System
SWIM	System Wide Information Management
TMA	Terminal Control Area
VDL	VHF Data Link
VNAV	Vertical navigation
WAFS	World Area Forecast System
WGS-84	World Geodetic System-1984

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1 Introduction

1.1 ICAO Global Air Navigation Plan (GANP)

1.1.1 The ICAO Global Air Navigation Plan (GANP) is designed to guide complementary and sector wide air transport progress over 2016–2030 and represents a rolling, 15-year strategic methodology which leverages existing technologies and anticipates future developments based on State/ industry agreed operational objectives in addressing growth and realizing the promise of twenty-first century air traffic management (ATM) through a harmonised global air navigation system.

1.1.2 The objective of ICAO GANP is to increase capacity and improve the efficiency of the global civil aviation system whilst improving and maintaining safety. The GANP encapsulates the framework that includes key civil aviation policies and principles where Regional and State Air Navigation Plans are required to be aligned to and also provides Regions and States with a comprehensive planning tool supporting the harmonization of global air navigation system.

1.1.3 The GANP identifies all potential performance improvements available today, details the next generation of ground and avionics technologies that will be deployed worldwide, and provides the investment certainty needed for States to make strategic decisions for their individual planning purposes**.**

1.1.4 The GANP includes the Aviation System Block Upgrade (ASBU) framework, its modules and its associated technology roadmaps covering areas of; communications, surveillance, navigation, information management and avionics that will eventually realise a fully-harmonised global interoperable air navigation system, described within six-year timeframes for each ASBU Block starting with Block 0 in 2013 and continuing through 2031 and beyond (Refer Figure 1.1). ASBUs and the associated technology roadmaps are integral parts of the GANP and a valuable implementation tool kit.

1.1.5 Deriving from the GANP, the Asia/Pacific- Regional Air Navigation Plan (RANP-APAC) presents the framework for the APAC States in harmonising the APAC region with the global interoperable navigation system. Malaysia's NANP is designed to be in harmony with the RANP-APAC and the ASBU framework included in the GANP.

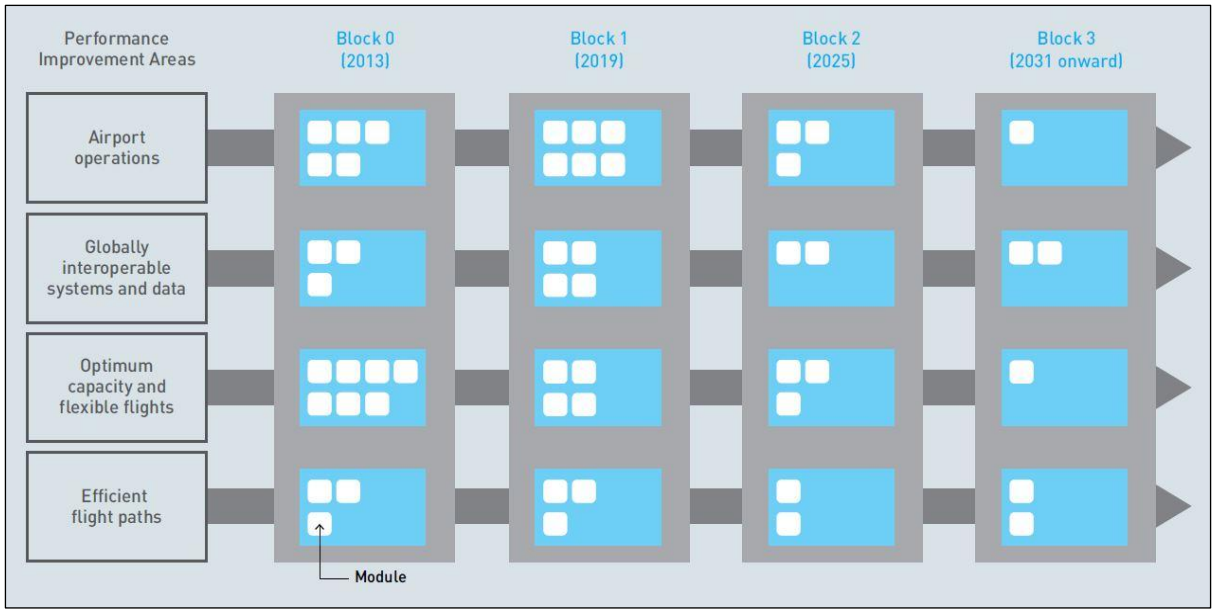

Figure 1. 1: GANP Aviation System Block Upgrades (ASBU) Methodology

Block - is made up of modules that, when combined, enable significant improvements and benefits (within a defined time frame).

Module - a deployable package based on performance or capability. It offers a clear operational benefit, supported by procedures, technology, regulation/ standards as necessary, and a business case. A module will be also characterised by the operating environment within which it may be applied.

Thread - key feature area of the air navigation system that needs to be improved in order to achieve the vision outlined in the Global ATM Operational Concept.

1.1.6 At the global level, ICAO started the ASBU initiatives as a programme framework that developed a set of aviation system solutions or upgrades intended to exploit current aircraft equipage, establish a transition plan and enable global interoperability. ASBUs comprised a suite of modules organised into flexible and scalable building blocks, where each module represented a specific, well bounded improvement.

1.1.7 ASBU are groups of operational improvements to advance air navigational capabilities and improve the performance of their air navigation system in a cost effect way. They are classified into three functional categories:

a) Information;

b) Operational; and

c) CNS Technology & Services

Table 1. 1: Categories of ASBU Threads

INFORMATION	
AMET	Meteorological information provided to support operational efficiency and safety
DAIM	Digital Aeronautical Information Management
FICE	Flight and Flow Information for a Collaborative Environment (FF-ICE)
SWIM	System Wide Information Management
OPERATIONAL	
ACAS	Airborne Collision Avoidance System (ACAS)
ACDM	Airport Collaborative Decision Making
APTA	Improve arrival and departure operations
CSEP	Cooperative Separation
FRTO	Improved operations through enhanced en-route trajectories
GADS	Global Aeronautical Distress and Safety System (GADSS)
NOPS	Network Operations
OPFL	Improved access to optimum flight levels in oceanic and remote airspace
RATS	Remote Aerodrome Air Traffic Services
RSEQ	Improved traffic flow through runway sequencing
SNET	Ground-based Safety Nets
SURF	Surface operations
TBO	Trajectory-based operations
WAKE	Wake Turbulence Separation
CNS TECHNOLOGY & SERVICES	
ASUR	Surveillance systems
COMI	Communication infrastructure
COMS	ATS communication service
NAVS	Navigation systems

1.1.8 A summary of ASBU Elements specified in ICAO GANP 6th Edition (Ref. Appendix 1) in their respective Blocks is illustrated below:

Table 1. 2: ASBU Elements According to Blocks

	BLOCK 0	**BLOCK 1**	**BLOCK 2**	**BLOCK 3**	**BLOCK 4**
INFORMATION					
AMET	AMET B0/1 AMET B0/2 AMET B0/3 AMET B0/4	AMET B1/1 AMET B1/2 AMET B1/3 AMET B1/4	AMET B1/1 AMET B1/2 AMET B1/3 AMET B1/4	AMET B1/1 AMET B1/2 AMET B1/3 AMET B1/4	AMET B1/1 AMET B1/2 AMET B1/3 AMET B1/4

DAIM	-	DAIM B1/1 DAIM B1/2 DAIM B1/3 DAIM B1/4 DAIM B1/5 DAIM B1/6 DAIM B1/7	DAIM B2/1 DAIM B2/2 DAIM B2/3 DAIM B2/4 DAIM B2/5	-	-
FICE	FICE B0/1	-	FICE B2/1 FICE B2/2 FICE B2/3 FICE B2/4 FICE B2/5 FICE B2/6 FICE B2/7 FICE B2/8 FICE B2/9	FICE B3/1	FICE B4/1 FICE B4/2
SWIM	-	-	SWIM B2/1 SWIM B2/2 SWIM B2/3 SWIM B2/4 SWIM B2/5	SWIM B3/1	-
OPERATIONAL					
ACAS	-	ACAS B1/1	ACAS B2/1 ACAS B2/2	-	-
ACDM	ACDM B0/1 ACDM B0/2	ACDM B1/1 ACDM B1/2	ACDM B2/1	ACDM B3/1	-
APTA	APTA B0/1 APTA B0/2 APTA B0/3 APTA B0/4 APTA B0/5 APTA B0/6 APTA B0/7 APTA B0/8	APTA B1/1 APTA B1/2 APTA B1/3 APTA B1/4 APTA B1/5	APTA B2/1 APTA B2/2 APTA B2/3	-	-
CSEP	-	CSEP B1/1 CSEP B1/1 CSEP B1/1 CSEP B1/1	CSEP B2/1 CSEP B2/2 CSEP B2/3	CSEP B3/1 CSEP B3/2	CSEP B4/1
FTRO	FTRO B0/1 FTRO B0/2 FTRO B0/3 FTRO B0/4	FTRO B1/1 FTRO B1/2 FTRO B1/3 FTRO B1/4 FTRO B1/5 FTRO B1/6 FTRO B1/7	FTRO B2/1 FTRO B2/2 FTRO B2/3 FTRO B2/4	-	-
GADS	-	GADS B1/1 GADS B1/2	GADS B2/1 GADS B2/2 GADS B2/3 GADS B2/4	-	-

NOPS	NOPS B0/1 NOPS B0/2 NOPS B0/3 NOPS B0/4 NOPS B0/5	NOPS B1/1 NOPS B1/2 NOPS B1/3 NOPS B1/4 NOPS B1/5 NOPS B1/6 NOPS B1/7 NOPS B1/8 NOPS B1/9 NOPS B1/10	NOPS B2/1 NOPS B2/2 NOPS B2/3 NOPS B2/4 NOPS B2/5 NOPS B2/6 NOPS B2/7 NOPS B2/8	NOPS B3/1 NOPS B3/2 NOPS B3/3	-
OPFL	OPFL B0/1 OPFL B0/2	-	-	-	-
RATS	-	RATS B1/1	-	-	-
RSEQ	RSEQ B0/1 RSEQ B0/2 RSEQ B0/3	RSEQ B1/1	RSEQ B2/1 RSEQ B2/2	RSEQ B3/1 RSEQ B3/2 RSEQ B3/3 RSEQ B3/4	-
SNET	SNET B0/1 SNET B0/2 SNET B0/3 SNET B0/4	SNET B1/1 SNET B1/2	-	-	-
SURF	SURF B0/1 SURF B0/2 SURF B0/3	SURF B1/1 SURF B1/2 SURF B1/3	SURF B3/1		-
TBO	TBO B0/1	TBO B1/1	TBO B2/1 TBO B2/2	TBO B3/1	TBO B4/1
WAKE	-	-	WAKE B2/1 WAKE B2/2 WAKE B2/3 WAKE B2/4 WAKE B2/5 WAKE B2/6 WAKE B2/7 WAKE B2/8	WAKE B3/1 WAKE B3/2	WAKE B4/1 WAKE B4/2
CNS TECHNOLOGY & SERVICES					
ASUR	ASUR B0/1 ASUR B0/2 ASUR B0/3	ASUR B1/1	ASUR B2/1 ASUR B2/2	ASUR B3/1	ASUR B4/1
COMI	COMI B0/1 COMI B0/2 COMI B0/3 COMI B0/4 COMI B0/5 COMI B0/6 COMI B0/7 COMI B0/8 COMI B0/9 COMI B0/10	COMI B1/1 COMI B1/2 COMI B1/3 COMI B1/4	COMI B2/1 COMI B2/2 COMI B2/3	COMI B3/1 COMI B3/2 COMI B3/3 COMI B3/4	-
COMS	COMS B0/1 COMS B0/2	COMS B1/1 COMS B1/2	COMS B2/1 COMS B2/2 COMS B2/3	COMS B2/1 COMS B2/2	-
NAVS	NAVS B0/1 NAVS B0/2 NAVS B0/3 NAVS B0/4	NAVS B1/1	NAVS B2/1 NAVS B2/2 NAVS B2/3	-	-

1.1.9 Although GANP is global in scope, it is not expected that all ASBU modules will be applied worldwide. Some of the ASBU modules contained in the GANP are specialised packages that must be applied wherever there are specific operational requirements or corresponding benefits. Table 1.2 contains comprehensive details about the ASBU elements. It is imperative to refer to this table to gain a comprehensive understanding of the ASBU elements.

1.1.10 Considering the flexibility that ICAO has intentionally built into its Block Upgrade approach, there are nevertheless some elements of the GANP that will need to be considered for worldwide applicability. The characterisation of the particular Block Modules that are considered necessary for the future safety or regularity of international Air Navigation and which may eventually become an ICAO Standard, is essential to the success of the GANP.

1.1.11 Compliance with existing standards is also key to this success. In this context, a wide synchronization of global or regional deployment timelines will sometimes be necessary as well as consideration with respect to possible implementation agreements or mandates.

1.1.12 The Malaysia NANP has extensively considered and selected applicable ASBU modules that will be required for meeting the air navigation objectives of Malaysia, and to be implemented in a time bound manner.

1.2 Regional Air Navigation Plan (RANP)

1.2.1 Regional Air Navigation Plan (RANP) represents the bridge between the global provisions in the ICAO Standards and Recommended Practices (SARPs), the GANP and the States' national plans and current implementation, and are developed to meet those needs of specific areas not covered in the worldwide provisions.

1.2.2 RANP-APAC contains requirements related to the facilities and services to be implemented by the States in the APAC Region in accordance and is used as a repository document for the assignment of responsibilities to those States for the provision of required facilities and services within a specified area in accordance with Article 28 of the Convention on International Civil Aviation.

1.3 Asia/ Pacific Seamless Air Traffic Management (ATM) Plan

1.3.1 As agreed by the Asia/ Pacific Seamless ATM Planning Group (APSAPG), the objective of Seamless ATM is the safe and interoperable provision of harmonised and consistent Air Traffic Management service provided to a flight, appropriate to the airspace category and free of transitions due to a change in the Air Navigation Service provider or Flight Information Region.

1.3.2 The Seamless ATM Plan was developed as part of a suite of ANP-APAC with the aim of facilitating Asia/ Pacific Seamless ATM operations, by developing and deploying ATM solutions capable of ensuring the safety and efficiency of Air

Transport throughout the APAC Region. It provides a framework for a transition to a Seamless ATM environment, in order to meet future performance requirements.

1.3.3 The APAC Seamless ATM Plan Version 4.0 provides a summary of the Block 0, Block 1 and Block 2, and their priority for implementation within the Asia/Pacific Region (Ref. Appendix 2). The allocation of priority is based on factors including its importance in promoting Seamless ANS:

Priority 1 : Critical upgrade assignment based on whether the implementation of an element could bring most benefit to the region or regional upgrade by States and is essential to achieve the service level required globally.

Priority 2 : Recommended upgrade for those elements which would bring benefits to the region and generally to be implemented from 2022, but are encouraged to implement earlier if beneficial.

Priority 3 : Assigned to those elements which may not be universally implemented in the Asia/Pacific Region.

1.3.4 In addition, APAC Seamless ANS Plan introduces a Performance Improvement Plan which includes Preferred Aerodrome/Airspace and Route Specifications (PARS) and Preferred ANS Service Levels (PASL).

1.3.5 Preferred Aerodrome/Airspace and Route Specifications (PARS) Implementation timeline:

a) PARS Phase I (had an expected implementation by 12 November 2015);

b) PARS Phase II (had an expected implementation by 07 November 2019);

c) PARS Phase III (expected implementation by 03 November 2022); and

d) PARS Phase IV (expected implementation by 27 November 2025).

1.3.6 Preferred ANS Levels (PASL) Implementation timeline:

a) PASL Phase I (had an expected implementation by 12 November 2015);

b) PASL Phase II (had an expected implementation by 07 November 2019);

c) PASL Phase III (expected implementation by 03 November 2022); and

d) PASL Phase IV (expected implementation by 27 November 2025).

1.3.7 Appendix 3 provides a summary of the Regional Seamless ANS elements that have been incorporated into the Seamless ANS framework and the expected priority for implementation within the Asia/Pacific Region. The allocation of priority is based on factors including its importance in promoting Seamless ANS.

1.5 National Transportation Policy (NTP) 2019 – 2030 for Malaysia

1.5.1 The Ministry of Transport's National Transportation Policy 2019 – 2030, which has been completed and launched on 17 October 2019, covers a range of policies to increase and enhance the transportation industry through economic competitiveness, inclusivity, and accessibility to the public, in addition to reducing negative impact of the environmental and land use.

1.5.2 The policy announced that any mode of transportation, including aviation should be oriented to safety, efficiency, enhanced competitiveness and integration with other modes of transportation, in addition to the sustainable development of transportation facilities and infrastructure to cater the growth in air traffic and aviation support services.

1.5.3 The policy also recognises the need for different levels of development and process of continuous improvement under Malaysia's aviation sector (i.e. in both safety and security); to comply with international Standards and Recommended Practices (SARPS) that have been set by the International Civil Aviation Organisations (ICAO). Developing guidance, sharing best practices and working in collaboration with industry partners on efficient use of infrastructure are therefore, important to achieve the policy objectives.

1.6 National Air Navigation Plan (NANP) for Malaysia

1.6.1 The National Air Navigation Plan (NANP) Malaysia embraces the principle outlined in the National Transportation Policy (NTU) 2019 – 2030 and it is envisioned to foster the development of air navigation facilities and infrastructure with the overarching aim of establishing a secure, efficient, and dependable air transport network in Malaysia. It also stands as a testament to our commitment to align with the principles and aspirations set forth in the Global Air Navigation Plan (GANP) by the International Civil Aviation Organization (ICAO).

1.6.2 As a signatory to ICAO's mandate for a seamless, safe, and efficient global air navigation system, our national plan serves as a localised manifestation of these global objectives. It reflects our dedication to adopting and adapting international standards, ensuring that our airspace management resonates with the broader harmonization efforts advocated by ICAO.

1.6.3 The NANP provides certainty to the aviation community to harness the benefits of the new technologies and ensure that the transition takes place safely. It also provides the required direction and guidance to the aviation stakeholders to efficiently utilise the existing resources. It aims at exploiting the future capabilities and technology required to deliver a dynamic, efficient and productive ANS system.

1.6.4 The implementation elements discussed in the plan will guide the Air Navigation Service Provider (ANSP) to advance the air navigation system in Malaysia

according to the operational requirements which commensurate with the global requirements and remains adaptable to amendments based on national priorities and as deemed necessary.

1.6.5 For the said purposes, due consideration was accorded to factors such as changes in technology, information management, communication, air traffic management and efficient use of airspace to save fuel, time and less impact on the environment. The NANP also takes into consideration the management of airspace, the increasing demands of the air traffic growth while coping up with aging of existing infrastructure such as radar, ground based nav-aids etc.

1.6.6 This document encapsulates our strategies, delineating our unique approach to augmenting safety measures, optimizing airspace capacity, mitigating environmental impact, and embracing emerging technologies in our air traffic management ecosystem. In the subsequent sections, this document elucidates our localised strategies, priorities, and actionable initiatives meticulously designed to fortify our air navigation system.

1.6.7 Although the NANP has encompassed a greater time horizon for planning, it will be reviewed and updated in every three years to align with the review cycle of the GANP, thus ensuring it remains relevant and current with aviation system changes. The NANP and its subsequent revisions shall be endorsed by the Chief Executive Officer of the Civil Aviation Authority of Malaysia (CAAM).

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2 Airport Operations (AOP)

2.1 Introduction

2.1.1 Airports stand as integral pillars within Malaysia's national economic infrastructure, serving as catalysts for investment, tourism, trade, and commerce. Their role extends beyond mere transportation hubs, actively propelling socio-economic growth across diverse sectors. To optimise national productivity and elevate economic performance, a continual commitment to investment and the modernization of aviation infrastructure at airports is imperative.

2.1.2 The Malaysia NANP outlines the strategic initiatives and solutions aimed at enhancing airport operations, optimizing air traffic flow, and ensuring efficient utilization of airspace capacity within the Malaysia. These measures not only unlock the full spectrum of benefits but also guarantee the sustained, safe, and efficient operation of these vital hubs.

2.2 Current Status of Aerodrome Management in Malaysia

2.2.1 The management of aerodromes in Malaysia falls under the governance of various regulations and oversight bodies:

a) Regulations:

1) Airport authorities in Malaysia operate under the framework provided by the Civil Aviation Act 1969 and the Civil Aviation (Aerodrome Operations) Regulations 2016.

b) Oversight:

1) The Air Navigation Services and Aerodromes Division, as part of Civil Aviation Authority of Malaysia (CAAM), is responsible for ensuring the safety and efficiency of aerodrome operations for public use.

2.2.2 Malaysia has a network of domestic and international airport which are modern and fully equipped. Airports in Malaysia have world-class facilities with a capacity that can accommodate the needs of additional passengers and airline operations either locally and abroad.

2.2.3 Malaysia has 6 international airports, 17 domestic and 12 airport aerodromes (short take off & landing airports, STOLports) to accommodate growing passenger demand and sustain the operation of various types of aircraft.

a) List of International Airports:

1) Kuala Lumpur International Lumpur (KLIA) (KUL/WMKK);
2) Langkawi International Airport (LGK/WMKL);
3) Kuching International Airport (KCH/WBGG);
4) Penang International Airport (PEN/WMKP);
5) Kota Kinabalu International Airport (BKI/WBKK);

6) Senai International Airport (JHB/WMKJ);

b) List of Domestic Airports:

1) Alor Setar Sultan Abdul Halim Airport (AOR/WMKA);
2) Bintulu Airport (BTU/WBGB);
3) Ipoh Sultan Azlan Shah Airport (IPH/WMKI);
4) Kerteh Airport (KTE/WMKE);
5) Kota Bharu Sultan Ismail Petra Airport (KBR/WMKC);
6) Subang Sultan Abdul Aziz Shah Airport (SZB/WMSA);
7) Kuala Terengganu Sultan Mahmud Airport (TGG/WMKN);
8) Kuantan Sultan Haji Ahmad Shah Airport (KUA/WMKD);
9) Labuan Airport (LBU/WBKL);
10) Lahad Datu Airport (LDU/WBKD);
11) Malacca International Airport (MKZ/WMKM);
12) Marudi Airport (MUR/WBGM);
13) Miri Airport (MYY/WBGR);
14) Sandakan Airport (SDK/WBKS);
15) Sibu Airport (SBW/WBGS);
16) Tanjung Manis Airport (TGC/WBTM);
17) Tawau Airport (TWU/WBKW).

c) List of Short Take-Off and Landing (STOLports):

1) Bakelalan Airport (BKM/WBGO);
2) Bario Airport (BBN/WBGZ);
3) Kudat Airport (KUD/WBKT);
4) Lawas Airport (LWY/WBGW);
5) Limbang Airport (LMN/WBGJ);
6) Long Akah Airport (LKH/WBGL);
7) Long Lellang Airport (LGL/WBGF);
8) Long Seridan Airport (ODN/WBGI);
9) Mukah Airport (MKM/WBGK);
10) Mulu Airport (MZV/WBMU);
11) Redang Airport (RDN/WMPR);
12) Tioman Airport (TOD/WMBT).

2.2.4 The current aviation protocols lack specific procedures tailored to helicopter operations, creating a gap in comprehensive guidelines. Addressing this void is imperative for ensuring the safe and efficient integration of helicopters within the broader aviation framework. To bridge this gap, there is a need to establish clear and detailed procedures that encompass all aspects of helicopter operations, encompassing takeoff, landing, ground handling, and communication protocols.

2.3 Implementation Plan

2.3.1 Drawing upon insights derived from industry best practices and adhering to international standards, Malaysia aims to implement cutting-edge technologies

and methodologies. This initiative is designed to enhance aviation infrastructure and elevate the quality of services provided at airports**.**

2.3.2 Among the initiatives include:

a) Pre-Departure Management and Sequencing

1) Pre-departure management solutions optimise traffic flow to the runway by integrating accurate taxi time forecasts and static data-derived route planning. By reducing waiting times at runway holding points and enhancing take-off time predictability, these solutions minimise fuel consumption, improve operational efficiency, and foster stable departure sequences.

2) Stakeholder involved include the Civil Aviation Authorities (CAA), Airport Operators (AO), Airlines (AU) and the Air Navigation Service Providers (ANSP).

3) This solution is ready for implementation across Malaysia, with plans for adoption in accordance with ICAO standards and regional cooperation frameworks.

b) Flow-based Integration of Arrival and Departure Management

1) Integrating arrival and departure management processes enhances traffic flow dynamics and runway sequencing, particularly in single or dependent runway configurations. By coordinating en-route, approach, and tower controllers, airports can achieve precise arrival and departure sequencing, leading to increased operational predictability and capacity.

2) Stakeholder involved include the Civil Aviation Authorities (CAA), Airport Operators (AO), Airlines (AU) and the Air Navigation Service Providers (ANSP).

3) Regional implementation plans are underway, with APAC member states collaborating to deploy this solution at key airports across the region.

c) Remote Tower Services

1) Remote tower services offer a cost-effective alternative for small and medium-sized airports, providing air traffic control services remotely. By deploying sensors and cameras across the airfield, operators can monitor activities in real-time, extending operational hours, enhancing safety, and reducing costs.

2) Stakeholder involved include the Civil Aviation Authorities (CAA), Airport Operators (AO), Airlines (AU) and the Air Navigation Service Providers (ANSP).

3) Successfully implemented in Europe remote tower services have demonstrated effectiveness in optimising airport operations and safety standards. In Malaysia, CAAM has successfully conducted a Request for Information (RFI) session between the 15th -16th April 2024 with all original equipment manufacturers (OEMs) and local partners. The primary objective was to seek information from vendors regarding the specifications required for the preparation of remote air traffic services (RATS) for Senai International Airport. The tender for this project is scheduled to commence in mid-June 2024, encompassing three primary scopes: MSSR and ADS-B, ATM, and Remote Digital and Virtual Tower (RDVT) for Senai International Airport in Johor Bahru.

d) Follow-the-Greens

1) Follow-the-Greens technology guides aircraft movement on the airport surface using illuminated guidance signs or markings. By providing clear visual cues, this solution enhances taxi route adherence, reduces taxiing times, and minimises runway incursions, improving overall airport safety and efficiency.

2) Stakeholder involved include the Civil Aviation Authorities (CAA), Airport Operators (AO), Airlines (AU) and the Air Navigation Service Providers (ANSP).

3) Follow-the-Greens technology is under consideration for implementation at key airports in the APAC region, includes Kuala Lumpur International Airport (KLIA), pending further evaluation and stakeholder consultation.

e) Airport Collaborative Decision Making (A-CDM)

1) Airport Collaborative Decision Making (A-CDM) involves collaborative planning and sharing of real-time operational data among airport stakeholders. By fostering coordination between airlines, ground handlers, air traffic control, and other entities, A-CDM enhances operational efficiency, reduces delays, and improves overall airport performance.

2) Stakeholder involved include the Civil Aviation Authorities (CAA), Airport Operators (AO), Airlines (AU), Ground Handling services and the Air Navigation Service Providers (ANSP).

3) A-CDM implementation is ongoing, with APAC member states integrating collaborative decision-making processes into airport operations, aligning with international best practices and standards.

2.3.3 The integration of industry-leading solutions into the National Air Navigation Plan (NANP) underscores a commitment to enhancing operational efficiency, safety, and sustainability within the Asia-Pacific aviation sector. By embracing innovative

technologies such as pre-departure management, flow-based integration of arrival and departure management, remote tower services, Follow-the-Greens, and Airport Collaborative Decision Making (A-CDM), Malaysia aim to optimise airspace capacity, enhance operational predictability, and foster sustainable growth in the region's aviation ecosystem.

2.3.4 This comprehensive approach to airport development ensures seamless integration with national aviation strategies and objectives, facilitating collaboration among stakeholders and adherence to international standards. Through these initiatives, APAC member states strive to achieve excellence in airport operations and air traffic management, positioning the region as a leader in the global aviation landscape.

2.4 Benefits of Implementation

2.4.1 Among the advantages associated with such implementation encompasses;

Table 2. 1: Airport Initiatives & Benefit of Implementation

Initiatives	Benefits of Implementation
Pre-Departure Management & Sequencing	i) Fuel savings - Reduced waiting time at holding points translates to significant fuel savings, aligning with sustainability objectives. ii) Operational Efficiency - Enhanced predictability streamlines air navigation services, optimizing resource utilization and minimizing delays. iii) Stable Sequencing - Improved departure sequences benefit overall airport operations, contributing to optimised traffic flow.
Flow-based Integration of Arrival and Departure Management	i) Increased Throughput - Enhanced predictability results in higher runway throughput, minimizing fuel burn and optimizing airspace capacity. ii) Improved Coordination - Collaborative integration fosters seamless coordination between controllers, enhancing operational efficiency and safety standards
Remote Tower Services	i) Cost Efficiency: Remote towers reduce operational costs compared to conventional tower facilities, enhancing accessibility and supporting regional economic growth. ii) Enhanced Safety: Advanced sensor technologies ensure safe flight operations across diverse conditions, bolstering safety standards.

Follow-the-Greens	i) Enhanced Safety: Clear visual guidance reduces the risk of runway incursions and ground collisions, enhancing overall airport safety. ii) Efficient Taxiing: Precise route guidance minimises taxiing times, optimizing ground movements and reducing fuel consumption. iii) Improved Traffic Flow: Streamlined taxi operations contribute to optimised traffic flow, enhancing overall airport efficiency.
Airport Collaborative Decision Making (A-CDM)	i) Enhanced Coordination: A-CDM facilitates seamless information sharing and collaboration, leading to improved situational awareness and coordination among stakeholders. ii) Reduced Delays: By optimizing resource allocation and streamlining operational processes, A-CDM helps minimise delays and enhance on-time performance. iii) Improved Predictability: Real-time data sharing enables better planning and decision-making, resulting in increased operational predictability and efficiency.

2.4.2 The formulation of a design procedure for seamless airport operations is paramount. An efficient airport operation design procedure encompasses the orchestration of various elements such as runway layout, terminal configuration, air traffic management, and ground operations.

2.4.3 By intricately designing and streamlining these processes, airports can achieve optimal functionality, minimizing delays, enhancing safety, and providing a seamless experience for both passengers and aviation stakeholders. This involves a holistic approach that considers the interplay of infrastructure, technology, and operational protocols to create a synchronised and efficient airport environment.

3 Communication, Navigation & Surveillance (CNS)

3.1 Introduction

3.1.1 Malaysia's NANP aims to establish a comprehensive framework for the planning and implementation of communication, navigation and surveillance (CNS) facilities and services. This document outlines the specific objectives and strategies align with ICAO Global and Regional plan to ensure the effective provision of air navigation services in compliance with ICAO SARPs.

3.1.2 It is designed to enhance the safety, efficiency, and reliability of air navigation services. This plan includes the implementation of various technologies and procedures, each with specific objectives, detailed actions, and contributions to the overall air navigation system, including areas of communication, navigation and surveillance.

3.2 Dynamic and Requirements

3.2.1 This section details the dynamic elements related to the assignment of responsibilities for CNS facilities and services. It further outlines the mandatory requirements based on regional air navigation agreements and how they align with Article 28 of the Convention on International Civil Aviation.

3.2.2 All CNS facilities and services provided in Malaysia are subjected to Civil Aviation Regulation 2016 (CAR), Regulation 158 and 159, and its associate fees and charges stipulated in Civil Aviation Regulation (Fees and Charges) 2016 (CAR(FC)) and other relevant authorities regulations.

3.2.3 The overall frequency spectrum allotment is assigned by the Malaysia Communication and Multimedia Commission (MCMC), while civil aviation spectrum management is managed by Civil Aviation Authority of Malaysia (CAAM).

3.2.4 The flexible plan elements (i.e. ASBU implementation plan in Malaysia)

a) Communication (COMI & COMS)

The communication aspect of the plan involves the implementation of ACARS, ATN/OSI, VDL Mode 2 Basic, SATCOM Class C Data, HFDL technologies, VDL Mode O/A and AMHS technologies, Ground-Ground ATN/IPS, VDL Mode 2 Multi-Frequency, SATCOM Class B (SB-S) Voice and Data, ATN/IPS, and AeroMACS Ground-Ground technologies, Air Ground ATN/IPS, AeroMACS aircraft mobile connection, and communication links meeting requirements for non-safety-critical communication. These implementations aim to enhance communication capabilities, supporting more efficient and direct communication between pilots and controllers, and improving overall efficiency and reliability.

1) Aeronautical Fixed Service (AFS) Planning and Engineering:

   i) The AFS within the Malaysia NANP is designed to cater to the communication needs of various entities involved in aviation operations, including AIS, ATS, MET, SAR, and aircraft operating agencies.
   ii) It encompasses voice, message, and data communications to ensure effective coordination and information exchange. The planning and engineering of AFS adhere to international standards, with considerations for regional characteristics to optimise its functionality.

2) Aeronautical Fixed Telecommunication Network (AFTN) Planning:

   i) The planning of the AFTN is guided by established principles outlined in the Manual on the Planning and Engineering of the Aeronautical Fixed Telecommunication Network (ICAO Doc 8259).
   ii) This ensures that the network is structured to meet regional requirements while considering specific conditions prevailing in the region or area of operation

3) Transit Time Criteria and Information Dissemination:

   i) The NANP sets transit time criteria for various types of messages, emphasizing timely delivery of critical information.
   ii) It ensures that essential meteorological forecasts, including SIGMET, AIRMET, and TAF bulletins, are available within specified timeframes to support operational needs. Additionally, dissemination means for World Area Forecast System (WAFS) products are established to guarantee their availability across the region.

b) Navigation (NAVS)

The navigation aspect of the plan includes the implementation of SBAS, GBAS, ABAS, MON technologies, Extended GBAS, and DFMC-GBAS, SBAS, ABAS technologies. These implementations aim to enhance navigation capabilities, improve overall accuracy and efficiency, and provide more reliable and accurate information.

1) Systematic Planning of Navigation Aids:

   i) Navigation aid planning in the Malaysia NANP is conducted systematically, recognising the diverse requirements of both long-range and short-range navigation.
   ii) It emphasises the use of navigation systems with RNAV capabilities, including GNSS, to meet the needs of all aircraft while ensuring an adequate basis for the provision of ATS.
   iii) These implementations aim to enhance navigation capabilities, improve overall accuracy and efficiency, and provide more reliable and accurate information.

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ii) It emphasises the use of navigation systems with RNAV capabilities, including GNSS, to meet the needs of all aircraft while ensuring an adequate basis for the provision of ATS.

3) Terminal Area Navigation and Introduction of GNSS-Based Services:

i) Similarly, the plan anticipates the eventual dominance of GNSS for terminal area navigation. It advocates for the introduction of GNSS-based services such as Basic GNSS and SBAS as initial transition steps, ensuring compatibility with existing terminal area ground-based navigation aids.

c) Surveillance (ASUR)

The plan includes the implementation of a community-based surveillance system for airborne aircraft, ADS-B, MLAT, SSR-DAPS technologies, reception of aircraft ADS-B signals from space, and the evolution of ADS-B and Mode S technologies. These implementations aim to enhance surveillance capabilities, improve overall safety, and provide a more comprehensive view of airspace.

1) Comprehensive Surveillance System:

i) Surveillance systems outlined in the NANP are designed to support all phases of flight and meet ATM requirements. The plan emphasises the importance of surveillance as an integral part of ATC operations, particularly in areas with high traffic density or complex airspace structures.

2) Utilization of Radar and ADS/ADS-B:

i) Primary and secondary surveillance radar systems are identified as key components of the surveillance infrastructure. Additionally, the plan acknowledges the potential role of ADS and ADS-B in airspace where radar surveillance is impracticable or cost-ineffective, ensuring the maintenance of safety standards.

3) Enhanced Civil-Military Coordination:

i) The NANP underscores the importance of improved civil-military coordination in utilizing existing surveillance measures effectively. While emphasizing the need for better utilisation of available resources, it does not mandate the installation of new radars unless justified by operational requirements. Instead, it encourages optimizing existing measures for enhanced surveillance and interception capabilities

ii) These implementations aim to enhance safety and efficiency on the ground through advanced tools for surface traffic management, improved guidance and conflict alerting, and improved awareness and alerting.

d) Surface Traffic Management (SURF)

1) The surface traffic management aspect of the plan involves the implementation of advanced surface traffic tools and services, enhanced surface guidance and conflict alerting, and basic ATC surface tools and comprehensive situational awareness.
2) These implementations aim to enhance safety and efficiency on the ground through advanced tools for surface traffic management, improved guidance and conflict alerting, and improved awareness and alerting.

e) Trajectory-based Management (TBO)

1) The trajectory-based management aspect of the plan includes the introduction of trajectory-based management, initial integration of time-based decision-making processes, and pre-departure trajectory synchronization.
2) These implementations aim to enhance efficiency by introducing time-based management, optimizing traffic flow and reducing delays, and contributing to improved decision-making efficiency within the air traffic management system.

3.3 Implementation Plan

3.3.1 The performance objectives of the Plan are expected to be implemented in phases:

a) Phase 1, expected implementation by 12 November 2015 (past);

b) Phase 2, expected implementation by 7 November 2019 (past);

c) Phase 3, expected implementation by 3 November 2022 (past);

d) Phase 4, expected implementation by 27 November 2025; and

e) Phase 5, expected implementation by 23 November 2028.

3.3.2 The regionally agreed Aviation System Block Upgrade (ASBU) modules contribute significantly to the enhancement of Malaysia's aviation system and is further explained in Table 3.1.:

Table 3. 1: ICAO APAC ASBU Implementation Plan & Malaysia Implementation Status

Functional Category	No	Code	Objective	Detailed Actions	Contribution	Priority	Phase	Malaysia Implementation Status
Information	1	**FICE-B0/1**	Implement automated basic AIDC.	Develop and integrate automated AIDC algorithms into the existing communication infrastructure. Ensure compatibility with current systems and protocols.	Implementation is crucial for streamlining data communication, reducing manual errors, and optimizing information exchange, thereby enhancing overall efficiency.	1	2	Implemented in KL FIR and work currently in progress for KK FIR.
	2	**FICE-B2/2**	Introduce a new filing service in Block 2.	Develop a user-friendly interface for filing flight plans, considering existing systems. Establish communication protocols between filing service and relevant ATC and CNS systems.	The new filing service aims to expedite the flight planning process, reducing delays and enhancing overall operational efficiency.	2	5	
	3	**FICE-B2/4**	Introduce a new flight data request service in Block 2.	Develop a standardised platform for requesting and accessing flight data. Implement secure data transmission protocols to protect sensitive information.	The new service facilitates efficient access to critical flight data, supporting better decision-making and enhancing overall system efficiency.	2	5	
	4	**SWIM-B2/1 - 2**	Implement new information services adopted by SWIM TF/6, CNS SG/26, and APANPIRG/ 33.	Collaborate with SWIM TF, CNS SG, and APANPIRG to define information service standards. Develop systems for both providing and consuming information services within SWIM architecture.	Adoption of these new information services enhances collaborative decision-making, improving overall operational efficiency and information sharing.	2	4	In progress for SWIM Trial under SWIM TF/9, SIPG and S3TIG demo.
Operational	5	**APTA-B0/1 – 2**	Implement basic PBN procedures.	Conduct airspace assessments and redesign procedures for PBN implementation. Provide training for aircrew and ATC personnel on new PBN procedures.	Implementation of basic PBN procedures optimises airspace usage, reduces congestion, and improves overall flight efficiency.	1	2	Implemented. *Ref: ICAO APAC-PBNICF/10-IP/04, 19th April 2023

	6	**APTA-B0/3 and 6**	Implement advanced precision approach procedures.	Upgrade ground infrastructure for SBAS/GBAS precision approaches. Develop and implement PBN procedures tailored for helicopter operations.	Advanced precision approaches enhance safety and allow for more efficient use of airspace, especially for helicopters.	3	2	Implemented.
	7	**APTA-B0/4 – 5, 7 – 8**	Implement CDO, CCO, and performance -based aerodrome operating minima.	Develop procedures for continuous descent and climb operations (CDO/CCO). Establish performance-based criteria for aerodrome operating minima.	Implementation of these procedures optimises aircraft trajectories, reduces fuel consumption, and enhances overall operational efficiency.	2	2	Implemented.
	8	**APTA-B1/1 – 5**	Implement advanced PBN approaches and procedures.	Upgrade ground infrastructure to support advanced PBN procedures. Provide specialised training for aircrew and ATC personnel on advanced procedures.	Advanced PBN procedures for high-performance aircraft enhance capacity and efficiency in handling advanced air traffic.	3	4	In progress.
	9	**APTA-B2/1**	Implement GBAS CAT II/III procedures.	Upgrade ground infrastructure to support GBAS CAT II/III precision approaches. Collaborate with stakeholders to ensure system interoperability.	Implementation of advanced precision approaches enhances safety and allows for more efficient use of airspace, particularly in adverse weather conditions.	3	5	Installation completed at KLIA.
	10	**APTA-B2/2**	Implement simultaneous operations to parallel runways.	Conduct runway and airspace assessments to ensure safety during simultaneous operations. Develop procedures for coordination between parallel runways.	Simultaneous operations increase runway throughput, improving overall airport capacity and reducing delays.	3	5	Implemented in KLIA. *Ref: AIP SUPP 10/14
	11	**APTA-B2/3**	Implement PBN Helicopter Steep Approach Operations.	Develop procedures for helicopters to conduct steep approaches. Provide training for aircrew and ATC	Implementation enhances safety and allows for more efficient routing of helicopter traffic.	3	5	

				personnel on the new procedures.				
	12	**APTA-B2/4**	Implement performance-based aerodrome operating minima.	Establish criteria for performance-based aerodrome operating minima for advanced aircraft with SVGS. Collaborate with stakeholders to ensure widespread adoption.	Implementation optimises operational flexibility and efficiency for advanced aircraft.	3	5	Work currently in progress for Senai International Airport (WMKJ).
	13	**DATS-B1/1**	Implement remotely operated aerodrome ATC services.	Develop and deploy technology for remote control of aerodrome ATC services. Conduct comprehensive testing and validation of remotely operated services.	Implementation enhances efficiency in aerodrome operations and can contribute to safety improvements.	3	4	In progress.
	14	**RSEQ-B0/3**	Implement point merge procedures.	Design airspace procedures for point merge operations. Collaborate with ATC and CNS stakeholders for seamless integration.	Implementation improves airspace utilization, reduces delays, and enhances overall capacity.	3	2	Implemented as requires.
	15	**SNET-B0/1 – 4**	Implement STCA, MSAW, APW, APM.	Upgrade surveillance systems to incorporate Short-Term Conflict Alert (STCA) and Minimum Safe Altitude Warning (MSAW). Develop and implement procedures for Advanced Warning (APW) and Airspace Penetration Monitor (APM).	Implementation enhances safety by providing advanced warning and monitoring tools, contributing to the overall safety of airspace operations.	1	2	Implemented.
	16	**SNET-B1/1 – 2**	Implement enhanced STCA.	Upgrade STCA systems to incorporate additional aircraft parameters for enhanced monitoring. Develop procedures tailored for complex Terminal Maneuvering Areas (TMAs).	Enhanced STCA improves safety by considering more parameters and is particularly beneficial in complex airspace configurations.	1	3	Implemented in both KL ATCC.

	17	**SURF-B0/1 – 3**	Implement basic ATC surface tools and comprehensive situational awareness.	Develop and deploy basic tools for ATC surface operations. Upgrade systems to provide comprehensive situational awareness and alerting services.	Implementation enhances safety and efficiency in surface operations through improved awareness and alerting.	2	3	Implemented in KLIA.
	18	**SURF-B1/1 – 5**	Implement advanced surface traffic tools and services.	Upgrade visual aids for advanced surface traffic management. Develop systems for pilot awareness, runway alerting, and enhanced ATC alerting.	Implementation enhances safety and efficiency on the ground through advanced tools for surface traffic management.	2	3	Work currently in progress in KLIA.
	19	**SURF-B2/1 - B2/3**	Implement enhanced surface guidance and conflict alerting.	Develop and deploy systems for enhanced surface guidance for both pilots and vehicle drivers. Implement conflict alerting systems for runway operations.	Implementation enhances safety and efficiency on the ground through improved guidance and conflict alerting.	3	4	In progress.
	20	**TBO-B0/1**	Introduce time-based management.	Develop and deploy systems for time-based management within a flow-centric approach. Ensure coordination and integration with existing traffic management systems.	Implementation enhances efficiency by introducing time-based management, optimizing traffic flow and reducing delays.	2	3	Implemented for both KL FIR and KK FIR.
	21	**TBO-B1/1**	Initial integration of time-based decision-making processes.	Integrate time-based decision-making processes into existing decision support systems. Conduct training for relevant personnel on the new decision-making processes.	Initial integration contributes to improved decision-making efficiency within the air traffic management system.	2	3	Implemented for both KL FIR and KK FIR. Integration with Neighbouring States in Progress.
	22	**TBO-B2/1-B2/2**	Implement pre-departure trajectory synchronization.	Develop systems for pre-departure trajectory synchronization. Extend time-based management capabilities across multiple Flight Information Regions (FIRs).	Implementation enhances efficiency by synchronizing trajectories and extending time-based management across broader airspace regions.	3	5	

Technology	23	**ASUR -B0/1 – 3**	Implement ADS-B, MLAT, SSR-DAPS technologies .	Upgrade ground infrastructure for ADS-B, MLAT, and SSR-DAPS reception and processing. Ensure interoperability with existing surveillance systems.	Implementation enhances surveillance capabilities, improving overall safety and efficiency in air traffic management.	1	2	Implemented. Full coverage in KL FIR and KK FIR.
	24	**ASUR -B1/1**	Implement reception of aircraft ADS-B signals from space.	Collaborate with satellite providers to establish a system for receiving ADS-B signals from space. Ensure integration with existing surveillance systems.	Implementation improves surveillance coverage, particularly in remote areas, enhancing overall safety.	2	3	In proposal stage.
	25	**ASUR -B2/1**	Evolve ADS-B and Mode S technologies .	Research and develop advancements in ADS-B and Mode S technologies. Upgrade ground infrastructure to support evolved technologies.	Implementation ensures the aviation system stays technologically current, improving overall safety and efficiency.	3	5	To review ADS-B mandates.
	26	**ASUR -B2/2**	Implement a community-based surveillance system for airborne aircraft.	Develop and deploy systems for community-based surveillance, leveraging data from airborne aircraft. Establish collaboration mechanisms with aviation stakeholders.	Implementation enhances surveillance capabilities, providing a more comprehensive view of airspace and improving safety.	3	5	
	27	**COMI-B0/1 – 2, 4 – 6**	Implement ACARS, ATN/OSI, VDL Mode 2 Basic, SATCOM Class C Data, HFDL technologies .	Upgrade communication infrastructure to support ACARS, ATN/OSI, VDL Mode 2 Basic, SATCOM Class C Data, and HFDL. Ensure interoperability and compatibility with existing communication systems.	Implementation enhances communication capabilities, improving overall efficiency and reliability.	1	2	Implemented in KL FIR
	28	**COMI-B0/3, 7**	Implement VDL Mode O/A and AMHS technologies .	Upgrade ground infrastructure to support VDL Mode O/A and AMHS. Collaborate with relevant stakeholders for seamless integration.	Implementation improves communication efficiency and reliability, contributing to overall system efficiency.	1	3	Implemented.

	29	**COMI-B1/1**	Implement Ground-Ground ATN/IPS.	Develop and deploy ground-ground ATN/IPS systems. Ensure compatibility and integration with existing aeronautical telecommunication networks. Conduct training for relevant personnel on the new ATN/IPS systems.	Implementation improves ground-ground communication, enhancing overall efficiency in aeronautical telecommunicati on.	1	3	Implemented.
	30	**COMI-B1/2 – 4**	Implement VDL Mode 2 Multi-Frequency, SATCOM Class B (SB-S) Voice and Data, ATN/IPS, and AeroMACS Ground-Ground technologies .	Upgrade ground infrastructure to support VDL Mode 2 Multi-Frequency, SATCOM Class B (SB-S) Voice and Data, ATN/IPS, and AeroMACS Ground-Ground. Collaborate with relevant stakeholders to ensure seamless integration.	Implementation enhances communication capabilities, supporting voice and data transmission for improved overall efficiency.	2	3	Implemented through SATCOM, ADS-C and CPDLC.
	31	**COMI-B2/1**	Implement Air Ground ATN/IPS.	Develop and deploy air-ground ATN/IPS systems. Ensure compatibility with existing ground-ground and air-ground communication systems.	Implementation improves air-ground communication, contributing to overall system efficiency.	3	5	
	32	**COMI-B2/2**	Implement AeroMACS aircraft mobile connection.	Develop and deploy systems for AeroMACS aircraft mobile connection. Collaborate with relevant stakeholders to ensure widespread adoption.	Implementation enhances communication capabilities, especially in airport environments, improving overall system efficiency.	3	5	
	33	**COMI-B2/3**	Implement communicati on links meeting requirement s for non-safety-critical communicati on.	Research and define requirements for non-safety-critical communication. Develop and deploy communication links meeting these requirements.	Implementation provides dedicated communication links for non-safety-critical purposes, optimizing overall communication resources.	3	5	

	34	**COMS -B0/1 – 2**	Implement CPDLC for domestic and procedural airspace and ADS-C for procedural airspace.	Upgrade communication infrastructure to support CPDLC for domestic and procedural airspace and ADS-C for procedural airspace. Ensure compatibility with existing communication systems.	Implementation enhances communication capabilities, supporting more efficient and direct communication between pilots and controllers.	2	3	Implemented for Bay of Bengal (Oceanic)
	35	**COMS -B1/1 – 3**	Implement PBCS approved CPDLC, ADS-C, and SATVOICE for domestic and procedural airspace.	Upgrade communication infrastructure to support PBCS approved CPDLC, ADS-C, and SATVOICE. Ensure compliance with PBCS standards.	Implementation supports more advanced communication capabilities, contributing to increased efficiency in air traffic management.	2	3	In Progress. Reviewing with PBCS's GOLD Standards guidelines. Implemented for Bay of Bengal (Oceanic)
	36	**COMS -B2/1-3**	Implement PBCS approved CPDLC, ADS-C, SATVOICE.	Develop and deploy systems for PBCS approved CPDLC, ADS-C, and SATVOICE. Ensure compliance with PBCS standards.	Implementation supports more advanced communication capabilities, contributing to increased efficiency in air traffic management.	3	5	
	37	**NAVS -B0/1 – 4**	Implement SBAS, GBAS, ABAS, MON technologies .	Upgrade ground infrastructure to support SBAS, GBAS, ABAS, and MON technologies. Ensure interoperability with existing navigation systems.	Implementation enhances navigation capabilities, improving overall accuracy and efficiency.	1	2	GBAS Implemented in KLIA only. In progress for procedures.
	38	**NAVS -B1/1**	Implement Extended GBAS.	Upgrade ground infrastructure to support Extended GBAS. Collaborate with stakeholders to ensure system interoperability.	Implementation expands the capabilities of ground-based augmentation systems, improving navigation accuracy.	3	4	
	39	**NAVS -B2/1-3**	Implement DFMC-GBAS, SBAS, ABAS technologies .	Upgrade ground infrastructure to support DFMC-GBAS, SBAS, and ABAS technologies. Ensure compatibility with existing navigation systems.	Implementation enhances navigation capabilities, providing more reliable and accurate information.	3	5	

3.3.3 In addition, below is additional requirement by ICAO APAC region to be fulfil:

Table 3. 2: ICAO APAC Additional ASBU Requirements

Additional Requirement	Objective	Contribution to Malaysia's Aviation System
Civil/ Military - B0-FRTO	Enhanced En-Route Trajectories: All States should ensure that SUA (Special Use Airspace) are regularly reviewed by the appropriate Airspace Authority to assess the effect on civil air traffic and the activities affecting the airspace.	**Increased Capacity:** Regular review of Special Use Airspace ensures that civil air traffic is minimally impacted, optimizing airspace utilization. **Improved Efficiency:** Proactive assessment of airspace impacts allows for better planning and coordination, reducing the impact on civil air traffic. **Safety Enhancement:** Ensuring the compatibility of civil and military activities contributes to overall airspace safety.
Civil/ Military - Strategic Civil Military Coordination (Regional)	Enhanced En-Route Trajectories: All States should ensure that a national civil/military body coordinating strategic civil-military activities is established.	**Increased Capacity:** Strategic coordination between civil and military authorities ensures optimal use of airspace for both sectors, enhancing overall capacity. **Improved Efficiency:** Coordinated planning and communication between civil and military entities contribute to more efficient airspace management. **Safety Enhancement:** Strategic coordination reduces the risk of conflicts and enhances overall airspace safety.
Civil/ Military - Tactical Civil Military Coordination (Regional)	Enhanced En-Route Trajectories: All States should ensure that formal civil-military liaison for tactical response is established.	**Increased Capacity:** Tactical coordination ensures swift response to dynamic airspace situations, optimizing airspace usage. **Improved Efficiency:** Formal liaison for tactical response facilitates quick decision-making and coordination

		during emergencies or unforeseen events. **Safety Enhancement:** Prompt and effective coordination during tactical responses contributes to overall airspace safety.

3.4 Benefits of Implementation

3.4.1 The planning and provision of CNS facilities and services play a crucial role in the aviation industry. They are fundamental to ensuring safe, efficient, and economic operations. Among the key benefits include;

a) Economy

1) The Air Navigation Plan for Malaysia is designed to significantly improve the economic efficiency of air navigation services.
2) The implementation of advanced communication, surveillance, and navigation technologies, such as ACARS, ATN/OSI, VDL Mode 2 Basic, SATCOM Class C Data, HFDL, SBAS, GBAS, ABAS, MON, will enhance the overall efficiency and reliability of these services.
3) This will result in reduced operational costs, improved service delivery, and increased capacity, all of which contribute to the economic viability of the aviation industry.

b) Efficiency

1) Efficiency is a key focus of the plan. The introduction of time-based management, initial integration of time-based decision-making processes, and pre-departure trajectory synchronization aim to optimise traffic flow and reduce delays.
2) The implementation of advanced surface traffic tools and services, enhanced surface guidance, and conflict alerting, as well as basic ATC surface tools and comprehensive situational awareness, will enhance safety and efficiency on the ground.
3) Furthermore, the implementation of PBCS approved CPDLC, ADS-C, and SATVOICE for domestic and procedural airspace, as well as VDL Mode 2 Multi-Frequency, SATCOM Class B (SB-S) Voice and Data, ATN/IPS, and AeroMACS Ground-Ground technologies, will support more efficient and direct communication between pilots and controllers.

c) Safety Enhancement

1) Safety enhancement is a critical aspect of the plan. The implementation of a community-based surveillance system for airborne aircraft, the reception of aircraft ADS-B signals from space, and the evolution of ADS-

B and Mode S technologies aim to enhance surveillance capabilities and improve overall safety.

2) The implementation of advanced surface traffic tools and services, enhanced surface guidance, and conflict alerting will enhance safety on the ground.
3) The implementation of SBAS, GBAS, ABAS, MON technologies, Extended GBAS, and DFMC-GBAS, SBAS, ABAS technologies will enhance navigation capabilities, improving overall accuracy and safety.
4) The implementation of PBCS approved CPDLC, ADS-C, and SATVOICE, as well as VDL Mode 2 Multi-Frequency, SATCOM Class B (SB-S) Voice and Data, ATN/IPS, and AeroMACS Ground-Ground technologies, will enhance communication capabilities, supporting more efficient and direct communication between pilots and controllers, thereby enhancing safety.

4 Air Traffic Management (ATM)

4.1 Introduction

4.1.1 Malaysia's NANP aims to establish a comprehensive framework for the planning and implementation of air traffic management (ATM) facilities and services. This document outlines the specific objectives and strategies align with ICAO Global and Regional plan to ensure the effective provision of air navigation services in compliance with ICAO SARPs.

4.1.2 It is designed to enhance the safety, efficiency, and reliability of air traffic management for the purpose of air navigation services. This plan includes the implementation of various technologies and procedures, each with specific objectives, detailed actions, and contributions to the overall air navigation system, including areas of communication, navigation and surveillance.

4.2 Current Status in Malaysia

4.2.1 Malaysia Airport Holding Berhad (MAHB) provided a data for an aircraft movement and passengers historical and forecast from year 2000 to 2060.

4.2.1.1 This information provides the data of the following traffic forecasts:

a) Forecasts of air traffic demand for air navigation systems planning;

b) Passenger forecasts;

c) Aircraft movement forecast;

d) Major city-pairs forecasts.

4.2.1.2 The historical data and forecasts meticulously compiled by Malaysia Airport Holding Bhd. (MAHB) pertaining to aerodromes within the Kuala Lumpur and Kota Kinabalu Flight Information Regions (FIRs), specifically concerning passenger and aircraft movements, serve as vital reference points for airspace planning and management initiatives. Notably, these analyses exclude airports under the management of other authorities.

4.2.1.3 The data encompasses historical and projected figures for all major international airports in Malaysia, encompassing Kuala Lumpur International Airport Terminals 1 and 2, Penang International Airport, Kota Kinabalu International Airport, Kuching International Airport, and Langkawi International Airport. Notably, Senai International Airport managed by Senai Airport Terminal Services Sdn. Bhd. has been excluded from this analysis. Additionally, the report includes insights into three key domestic airports: Subang Airport, Kota Bharu Airport, and Miri Airport, identified as having substantial potential for future traffic demand.

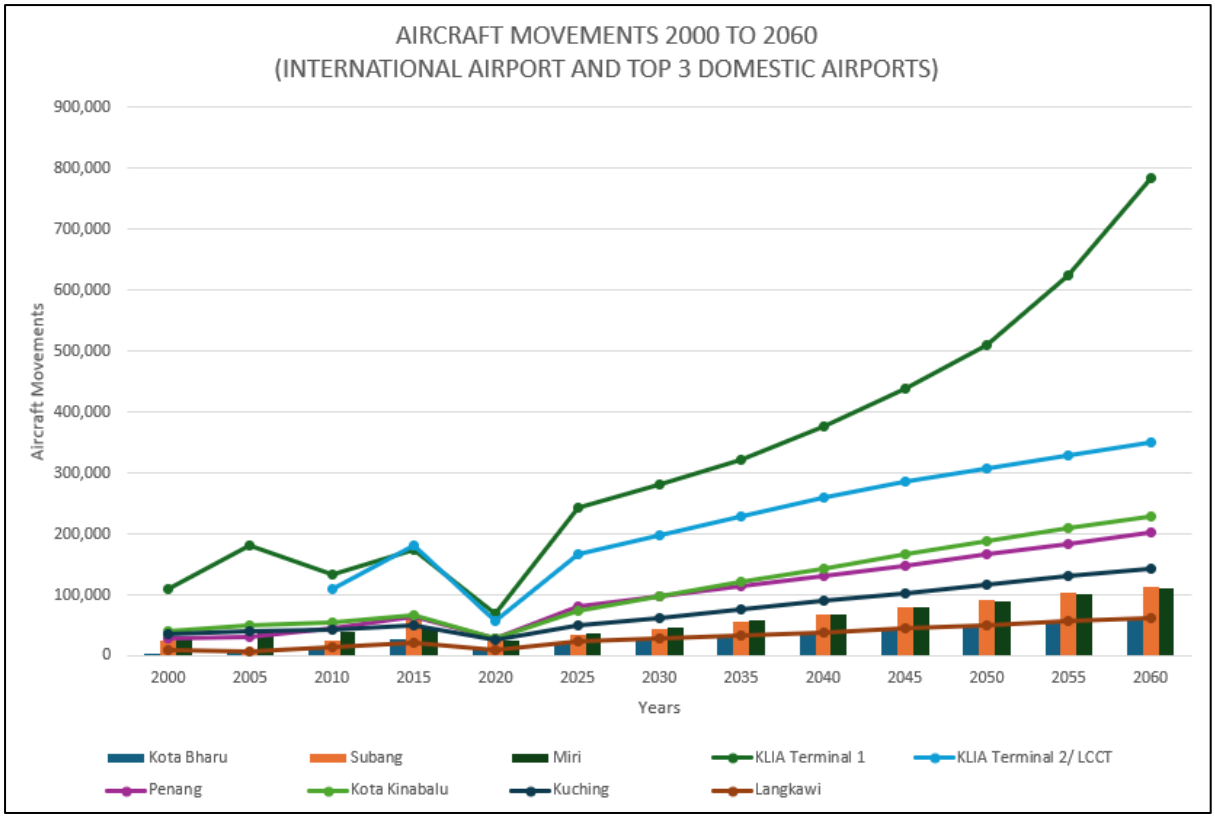


Figure 4. 1: Historical Data Year 2000 to 2020 & Forecasted Data Year 2021 to 2060

(Source: MAHB)

4.2.1.4 The analysis underscores a notable decline in air traffic movement during the tumultuous year of 2020, attributable to the global impact of the Covid-19 pandemic. This downturn registered approximately a 60% reduction in international airport traffic and a 49% decrease in domestic airport movement. However, the forecasted data offers a glimmer of optimism, suggesting a resurgence in air travel by 2025. Projections indicate a remarkable recovery, with international airport traffic expected to surge by 193% and domestic airport activity forecasted to rebound by 49%, relative to 2020 levels.

4.2.1.5 These insights provide invaluable guidance for aviation authorities, enabling informed decision-making in air traffic management strategies. By leveraging these projections, authorities can effectively plan and adapt infrastructure and services to accommodate the anticipated resurgence in air travel demand, ensuring optimal operational efficiency and passenger satisfaction in the years ahead.

4.2.2 International Passengers Forecast

4.2.2.1 Air traffic movement within Malaysia expect to see a growth tripled in the next 40 years. It is believed that the fastest growth will occur in the next 10 years after 2020. A study made by MAHB predicts KLIA will grow to almost 160 million passengers by 2060, followed by Kota Kinabalu with 26 million passengers,

then Penang with 21 million passengers and Kuching with 16 million passengers.

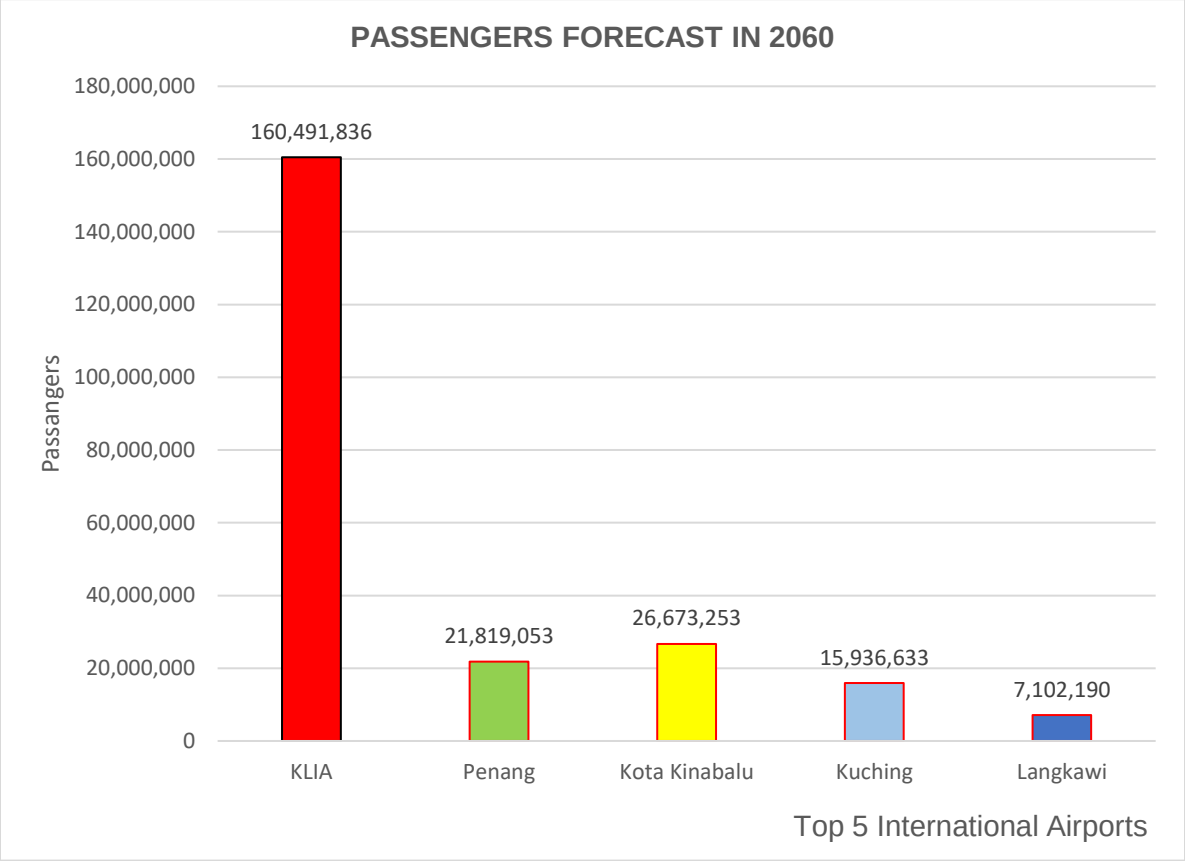


Figure 4. 2: International Airport Passengers Forecast, Year 2060

4.2.2.2 Five (5) largest airports in Malaysia, excluding Senai International Airport accounted for 77% of passenger traffic in 2060. The historical data and forecast for passenger in-scope the airports managed by MAHB are displayed in Table 4.1 below:

Table 4.1: Forecasted Passengers Historical from 2000-2020 & Projections from 2021-2060

	Historical					Projection							
International Airports*	**2000**	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**	**2055**	**2060**
KLIA	16,796,466	23,213,926	34,087,636	48,938,424	13,156,363	62,156,377	72,848,721	83,998,843	96,226,640	108,501,491	121,275,899	138,410,419	160,491,836
Penang	2,740,505	2,834,545	4,166,969	6,258,756	1,826,121	8,705,271	10,583,944	12,262,583	14,080,937	16,000,842	17,972,192	19,934,407	21,819,053
Kota Kinabalu	3,092,326	3,975,136	5,223,454	6,573,461	2,302,514	8,563,184	11,264,025	13,924,847	16,626,130	19,338,076	21,972,951	24,436,233	26,673,253
Kuching	2,545,080	3,354,973	3,684,517	4,772,453	1,780,417	5,537,879	6,918,310	8,378,361	9,912,918	11,487,311	13,053,053	14,555,471	15,936,633
Langkawi	958,066	830,334	1,374,729	2,336,177	967,512	2,637,187	3,237,739	3,824,991	4,457,465	5,121,105	5,797,836	6,466,171	7,102,190
Domestic Airports**	**2000**	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**	**2055**	**2060**
Kota Bharu	512,834	635,397	1,047,755	2,063,747	711,480	1,461,103	1,914,252	2,294,250	2,708,415	3,148,600	3,603,840	4,060,627	4,503,456
Kuala Terengganu	343,186	419,475	520,611	857,239	302,280	669,321	844,470	985,190	1,138,561	1,301,569	1,470,151	1,639,307	1,803,293
Alor Setar	311,224	323,669	400,997	719,029	275,824	576,912	665,094	740,568	822,427	908,971	997,959	1,086,671	1,172,025
Melaka	13,917	27,683	21,687	69,710	29,424	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000
Subang	2,100,727	83,602	1,118,309	3,059,144	949,934	1,423,018	1,870,282	2,352,847	2,861,995	3,388,812	3,918,428	4,433,543	4,915,512
Kuantan	419,441	298,184	220,878	292,109	71,877	207,889	262,802	299,058	337,008	377,045	418,128	459,000	498,243
Ipoh	148,095	74,451	48,508	222,606	100,585	517,619	625,824	737,691	852,991	968,270	1,079,598	1,182,768	1,273,549
Tioman	74,762	54,054	54,056	0	0	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000
Pangkor	6,498	11,193	2,588	0	0	0	0	0	0	0	0	0	0
Redang	0	30,650	48,610	0	5,159	9,000	9,000	9,000	9,000	9,000	9,000	9,000	9,000
Labuan	558,877	642,582	505,903	684,108	270,959	516,092	553,107	581,139	604,443	627,143	641,041	645,576	640,226
Lahad Datu	102,492	116,973	113,442	143,654	59,739	161,535	179,746	194,784	211,174	228,594	246,610	264,686	282,211
Sandakan	452,824	621,513	741,674	853,411	362,692	985,259	1,185,684	1,364,278	1,557,980	1,762,770	1,973,343	2,183,263	2,385,237
Tawau	464,784	680,901	897,848	1,203,792	572,365	1,687,005	2,125,699	2,539,172	2,984,846	3,453,447	3,932,513	4,407,055	4,860,305
Bintulu	352,154	487,077	557,459	800,008	370,437	921,942	1,091,888	1,277,114	1,473,977	1,677,572	1,881,860	2,079,905	2,264,234
Miri	1,049,561	1,594,855	1,694,915	2,249,206	876,402	2,193,138	2,741,289	3,335,745	3,964,152	4,610,218	5,254,186	5,873,669	6,444,846
Sibu	657,375	920,930	1,009,002	1,454,360	571,041	1,548,955	1,779,928	2,031,667	2,299,222	2,575,928	2,853,574	3,122,736	3,373,256
Mulu	31,016	52,914	66,575	51,387	17,917	68,502	74,962	81,052	87,626	94,538	101,604	108,601	115,281
Limbang	0	105,652	50,044	58,300	73,230	88,472	96,815	104,681	113,171	122,098	131,224	140,261	148,888
Mukah				35,935	29,011	83,251	94,531	106,263	118,109	129,678	140,541	150,258	158,409
STOL Sabah	6,809	6,009	793	5,309	636	0	0	0	0	0	0	0	0
STOL Sarawak	202,261	173,956	170,506	127,444	77,243	103,663	109,150	113,884	117,943	122,097	126,399	130,851	135,460
Total MAHB Airports	**33,941,280**	**41,570,634**	**57,829,465**	**83,829,769**	**25,761,162**	**100,842,573**	**121,097,261**	**141,558,008**	**163,587,128**	**185,975,176**	**208,871,929**	**235,800,479**	**267,026,396**
Growth Percentage		**22.48**	**39.11**	**44.96**	**-69.27**	**291.45**	**20.09**	**16.90**	**15.56**	**13.69**	**12.31**	**12.89**	**13.24**

4.2.2.3 In 2023, according to data compiled by OAG Aviation Worldwide Limited, the route between Kuala Lumpur International Airport (KUL) and Singapore Changi Airport (SIN) claimed the top spot as the busiest international airline route globally, with a remarkable total of 4.9 million seats sold. Consequently, the southern sector of the Kuala Lumpur Flight Information Region (FIR) has become pivotal in orchestrating the significant influx and outflow of air traffic between these prominent aviation hubs.

2023 Ranking	Route	Route Name	Seats	2019 Ranking	2023 vs 2019	2022 Ranking	2023 vs 2022
1	KUL-SIN	Kuala Lumpur - Singapore Changi	4,891,952	2	-12%	3	50%
2	CAI-JED	Cairo - Jeddah	4,795,712		42%	1	38%
3	HKG-TPE	Hong Kong - Taipei	4,568,280	1	-43%		130%
4	ICN-KIX	Seoul Incheon - Osaka Kansai	4,218,484		22%		356%
5	ICN-NRT	Seoul Incheon - Tokyo Narita	4,155,418		29%		227%
6	DXB-RUH	Dubai - Riyadh	3,990,076		27%	2	20%
7	CGK-SIN	Jakarta - Singapore Changi	3,910,502	3	-29%	10	81%
8	JFK-LHR	New York JFK - London Heathrow	3,878,590	8	1%	4	24%
9	BKK-SIN	Bangkok - Singapore Changi	3,478,474	9	-9%	8	47%
10	BKK-ICN	Bangkok - Seoul Incheon	3,362,968		9%		111%

OAG Schedules Analyser
Columns 2023 vs 2022 and 2023 vs 2019 show % variance in airline capacity between the two years.

OAG

Figure 4.3: Top 10 Busiest Global International Flight Routes of 2023

4.2.3 Domestic Passengers Forecast

4.2.3.1 Domestic passengers forecast expect to see a growth tripled as well in the next 40 years. A study made by MAHB predicts the top three (3) domestic airports will grow to almost more than four (4) million passengers by 2060, led by Miri with 6.4 million passengers, then Subang and Tawau with approximately 5 million passengers. MAHB airports traffic volumes will increase from a total 84 million passengers in 2015 to about 267 million in 2060.

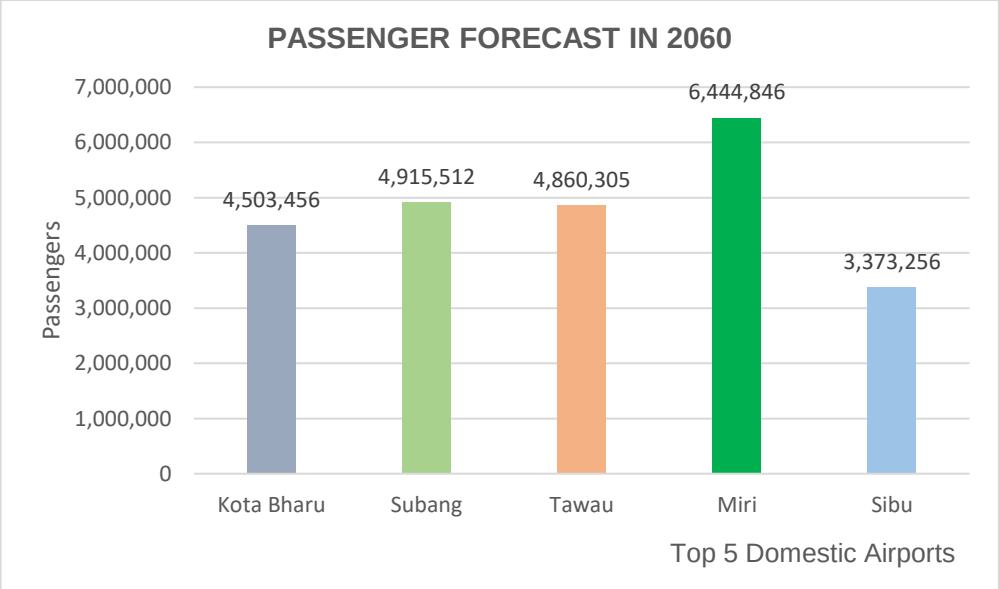


Figure 4.4: Domestic Airport Passengers Forecast, Year 2060

Table 4.2: Aircraft Movements Historical from 2000 to 2020 & Projections from 2021 to 2060

	Historical					Projection							
International Airports*	**2000**	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**	**2055**	**2060**
KLIA	109,339	181,341	244,179	353,270	124,529	409,026	478,479	551,596	635,737	722,484	817,012	953,210	1,134,497
Penang	27,672	31,173	44,753	64,527	28,497	80,787	98,034	113,538	130,323	148,036	166,213	184,294	201,645
Kota Kinabalu	39,889	49,680	55,089	66,945	29,214	74,271	97,348	120,250	143,454	166,642	189,049	209,857	228,626
Kuching	34,551	39,430	42,940	50,738	25,069	49,871	62,320	75,459	89,267	103,440	117,541	131,079	143,533
Langkawi	8,947	8,021	13,274	22,232	10,385	22,987	28,228	33,349	38,864	44,652	50,554	56,384	61,931
Domestic Airports**	**2000**	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**	**2055**	**2060**
Kota Bharu	4,588	8,765	13,180	28,228	13,117	19,678	25,780	30,898	36,476	42,404	48,535	54,687	60,651
Kuala Terengganu	3,210	4,623	5,959	10,625	5,090	7,923	9,996	11,662	13,477	15,406	17,402	19,404	21,345
Alor Setar	2,968	3,267	4,513	9,472	4,288	5,443	6,275	6,987	7,760	8,576	9,416	10,253	11,058
Melaka	458	1,328	584	1,536	478	412	412	412	412	412	412	412	412
Subang	25,423	8,988	24,509	62,911	29,091	34,612	44,810	55,741	67,220	79,102	91,061	102,718	113,661
Kuantan	3,782	3,500	2,628	3,906	978	2,008	2,539	2,886	3,249	3,632	4,026	4,417	4,794
Ipoh	2,117	1,145	844	3,684	1,445	4,045	4,844	5,662	6,509	7,360	8,188	8,961	9,648
Tioman	2,000	1,668	1,662	0	0	473	473	473	473	473	473	473	473
Pangkor	520	530	174	0	0	0	0	0	0	0	0	0	0
Redang		1,110	1,356	0	316	768	768	768	768	768	768	768	768
Labuan	7,261	9,292	11,988	13,168	5,987	8,329	8,924	9,374	9,748	10,113	10,336	10,409	10,323
Lahad Datu	2,556	3,010	2,860	3,646	2,504	3,806	4,236	4,590	4,976	5,387	5,811	6,237	6,650
Sandakan	9,214	10,876	12,095	11,267	5,289	7,930	9,543	10,981	12,540	14,188	15,883	17,573	19,198
Tawau	6,428	8,531	9,723	12,401	6,351	12,916	16,313	19,516	22,973	26,608	30,324	34,004	37,517
Bintulu	11,642	13,146	10,994	12,197	6,235	9,013	10,674	12,485	14,409	16,400	18,397	20,333	22,135
Miri	32,706	40,302	39,509	45,039	24,902	37,712	47,137	57,359	68,165	79,275	90,350	101,006	110,831
Sibu	15,301	16,683	17,899	18,252	7,120	14,718	16,917	19,314	21,861	24,495	27,138	29,701	32,086
Mulu		2,620	1,726	2,381	1,208	3,224	3,528	3,814	4,123	4,449	4,781	5,111	5,425
Limbang		5,490	1,947	2,226	2,372	3,799	4,158	4,496	4,860	5,244	5,635	6,024	6,394
Mukah					3,150	5,103	5,794	6,513	7,239	7,948	8,614	9,210	9,709
STOL Sabah		814	167	440	214	0	0	0	0	0	0	0	0
STOL Sarawak		14,322	13,538	16,455	10,958	12,775	13,451	14,035	14,535	15,047	15,577	16,126	16,694
Total MAHB Airports	**350,572**	**469,655**	**578,090**	**815,546**	**348,787**	**831,630**	**1,000,981**	**1,172,156**	**1,359,419**	**1,552,541**	**1,753,497**	**1,992,647**	**2,270,006**
Growth Percentage		**33.97**	**23.09**	**41.08**	**-57.23**	**138.43**	**20.36**	**17.10**	**15.98**	**14.21**	**12.94**	**13.64**	**13.92**

4.2.4 En-route Airspace Status

4.2.4.1 The evaluation of the current status of enroute airspace implementation and enhancement, focusing on two Flight Information Regions (FIRs) – Kuala Lumpur and Kota Kinabalu, indicates that Malaysia has commenced the initial phase of airspace enhancement. This strategic initiative aims to accommodate the anticipated increase in air traffic and passenger movement. Furthermore, Malaysia is concurrently ensuring provision for conventional aircraft operations to support recovery efforts following the Covid-19 pandemic.

4.2.4.2 In the Kuala Lumpur FIR, a total of 85 ATS routes are operational, comprising 49 Performance-Based Navigation (PBN) routes that have been successfully implemented. The remaining 36 routes are conventional and are designated to accommodate conventional aircraft operations, including those of the Malaysia Flying Academy for navigation flying activities.

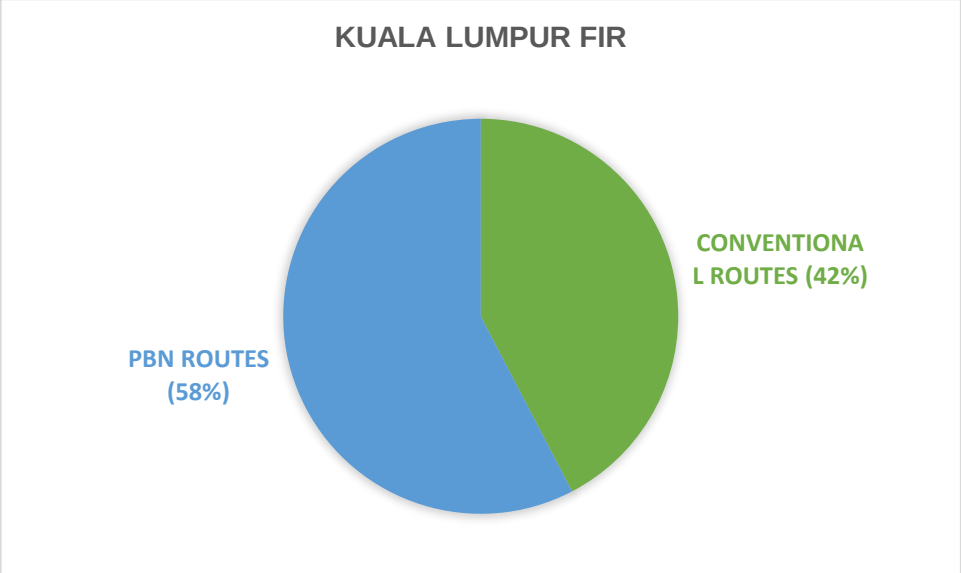


Figure 4. 5: ATS Route Distribution Kuala Lumpur FIR

4.2.4.3 Similarly, within the Kota Kinabalu FIR, there are a total of 45 ATS routes. Among these, 15 PBN routes have been established, while the remaining routes serve conventional aircraft operations. This allocation aligns with the overarching objective of facilitating conventional aircraft operations within the region.

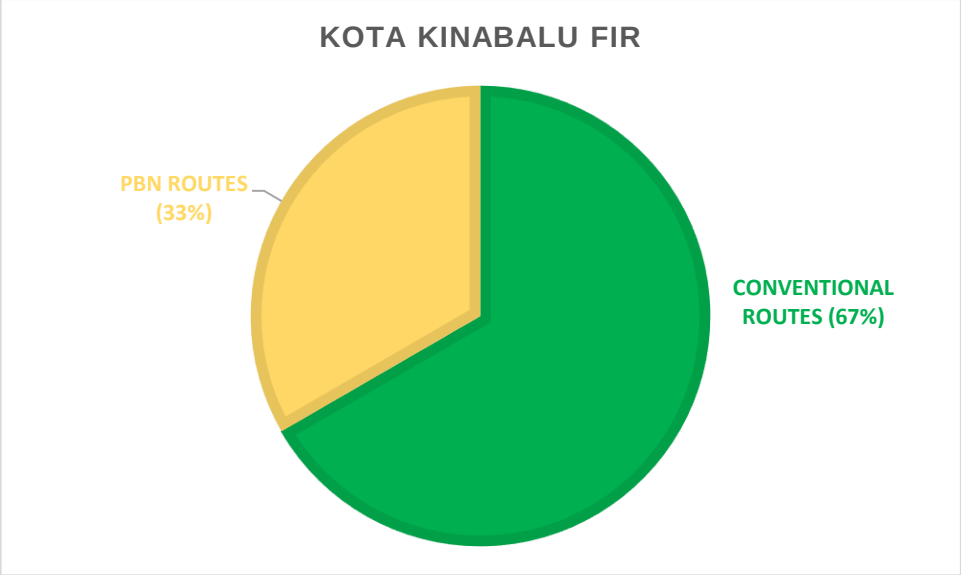


Figure 4. 6: ATS Route Distribution Kota Kinabalu FIR

4.2.4.4 Nevertheless, the complete implementation of Performance-Based Navigation (PBN) routes within the Kuala Lumpur and Kota Kinabalu Flight Information Regions (FIRs) remains contingent upon the implementation plan established by CAA Malaysia. This timeline is subject to the readiness of stakeholders and the coordination efforts with neighbouring states. The ultimate goal is to establish city pair routes that seamlessly connect and serve the entirety of the Asia-Pacific (APAC) region for major aerodromes.

4.2.5 Terminal Airspace Status

4.2.5.1 Implementing and operationalising PBN procedures across all terminal airspace in Malaysia will establish consistent navigation standards and optimise air traffic operations for enhanced efficiency.

4.2.5.2 Malaysia has made significant progress, with the current status at around 85% completion, as mentioned in the Table 4.3 and Table 4.4 below. Setting a target to achieve 100% implementation by the end of 2025 demonstrates Malaysia's commitment to modernizing its air navigation system and aligning with international standards.

4.2.5.3 With only 15% remaining to reach full implementation, Malaysia is poised to focus on addressing any remaining challenges, such as infrastructure upgrades, regulatory compliance, and stakeholder engagement, to ensure a smooth transition to PBN operations across all sectors of its airspace.

Table 4. 3: Malaysia PBN Implementation Status (International Airport)

NO	INTERNATIONAL AIRPORT	ICAO CODE	RWY	PBN SID	PBN STAR	PBN APPROACH		
						LNAV	LNAV/ VNAV	RNP (AR)
1	Kuala Lumpur International	WMKK	14L	✓	✓	✓	✓	
			32R	✓	✓	✓	✓	✓
			14R	✓	✓	✓	✓	
			32L	✓	✓	✓	✓	
			15	✓	✓	✓	✓	
			33	✓	✓	✓	✓	✓
2	Penang International	WMKP	04	✓	✓	✓	✓	✓
			22	✓	✓	✓	✓	✓
3	Langkawi International	WMKL	03	✓	N/U	✓	✓	✓
			21	N/U	✓	N/U	N/U	N/U
4	Senai International	WMKJ	16	✓	✓	✓	✓	✓
			34	✓	✓	N/U	N/U	✓
5	Kuching International	WBGG	07	✓	✓	✓	✓	✓
			25	✓	✓	✓	✓	✓
6	Kota Kinabalu International	WBKK	02	✓	✓	✓	✓	✓
			20	✓	✓	✓	✓	✓

Table 4. 4: Malaysia PBN Implementation Status (Domestic Airport)

NO	DOMESTIC AIRPORT	ICAO CODE	RWY	PBN SID	PBN STAR	PBN APPROACH		
						LNAV	LNAV/ VNAV	RNP (AR)
7	Alor Setar / Sultan Abdul Halim	WMKA	04	N/U	✓	✓	✓	✓
			22	✓	N/U	N/U	N/U	N/U
8	Kota Bharu/Sultan Ismail Petra	WMKC	10	✓	✓	✓	✓	✓
			28	✓	✓	✓	✓	✓
9	Kuantan	WMKD	18	✓	✓	✓	✓	
			36	✓	✓	✓	✓	
10	Ipoh/Sultan Azlan Shah	WMKI	04	✓	N/U	✓	✓	✓
			22	N/U	✓	N/U	N/U	N/U
11	Malacca	WMKM	03	✓	✓	✓	✓	
			21	✓	✓	✓	✓	
12	Kuala Terengganu/ Sultan Mahmud	WMKN	04	✓	✓	✓	✓	✓
			22	✓	✓	✓	✓	✓
13	Subang/Sultan Abdul Aziz Shah	WMSA	15	✓	✓	✓	✓	
			33	✓	N/U	✓	✓	
14	Bintulu	WBGB	17	✓	✓	✓	✓	✓
			35	✓	✓	✓	✓	✓
15	Miri	WBGR	02	✓	✓	✓	✓	✓
			20	✓	✓	✓	✓	✓
16	Sibu	WBGS	13	✓	✓	✓	✓	✓
			31	✓	✓	✓	✓	✓
17	Labuan	WBKL	14	✓	✓	✓	✓	✓
			32	✓	✓	✓	✓	✓
18	Sandakan	WBKS	08	✓	✓	✓	✓	
			26	✓	✓	✓	✓	✓
19	Tawau	WBKW	06	✓	✓	✓	✓	✓
			24	✓	✓	✓	✓	✓
20	Mukah	WBGK	15	✓	✓	✓	✓	
			33	✓	✓	✓	✓	

Legend:
✓ Implemented
✓ In Progress
N/U Not Usable

4.2.6 Airspace Approval for Other Activity based on Flexible Use of Airspace (FUA) Principles.

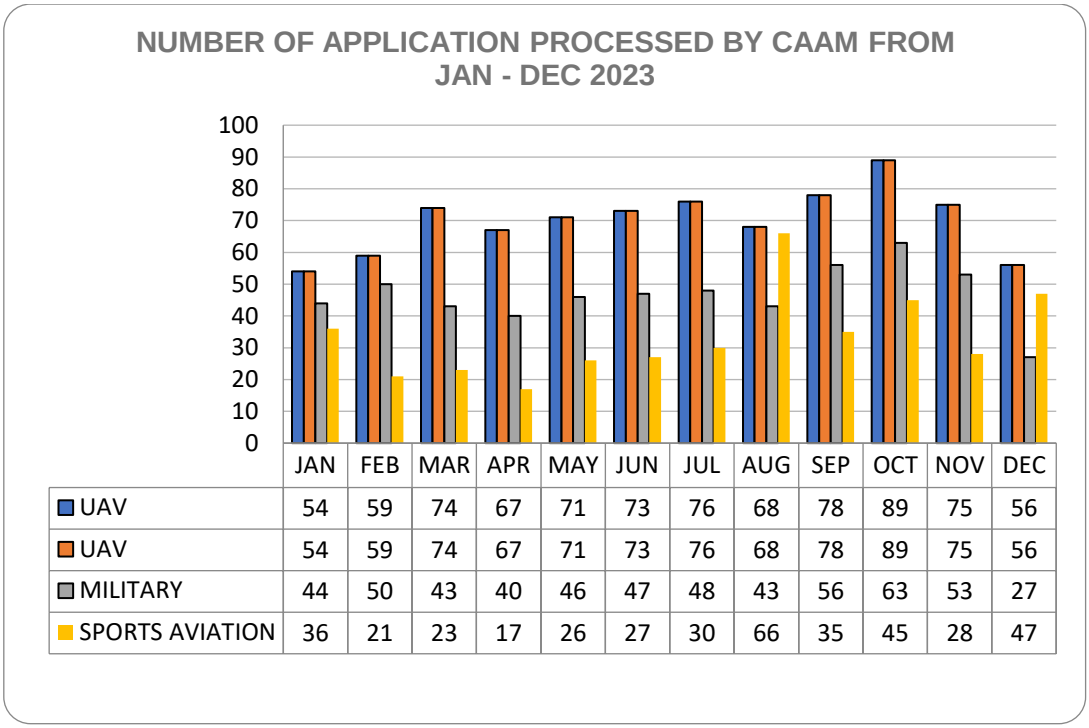
4.2.6.1 Ensuring airspace approval from the authority prior to commencing air activity in Malaysia is imperative due to the escalating popularity of aerial and sports aviation endeavours, such as kite flying and unmanned aircraft operation. These activities pose potential hazards, particularly when conducted near airports or airbases, creating distractions for pilots during critical phases like take-off and landing. Moreover, the presence of objects like drones in airspace zones can lead to engine ingestion, endangering lives and causing substantial damage to both aerial and ground assets.

4.2.6.2 In accordance with Malaysian regulations, the operation of unmanned aircraft systems (drones) is restricted in specified areas, including controlled airspace classes A, B, and C, as well as within aerodrome traffic zones, and above 400 feet from ground level, unless authorised by the relevant authority. The application process outlined in Regulation 189 of the Malaysian Civil Aviation Regulations (MCAR 2016) ensures adherence to safety protocols and prevents the unauthorised dropping of objects from drones.

4.2.6.3 Understanding the distinction between controlled and uncontrolled airspace underscores the necessity for authorization regardless of airspace classification. While controlled airspace is overseen by air traffic controllers, uncontrolled airspace still mandates approval from CAAM under Regulation 140 of the Malaysian Civil Aviation Regulations (MCAR 2016) before conducting UAS operations.

4.2.6.4 In order to ensure the safety of civil aircraft, any activities that may pose a potential hazard within the Kuala Lumpur and Kota Kinabalu FIRs, whether over Malaysian territory or over the high seas, must be coordinated with CAAM. If such activities are to take place over adjacent states FIR, approval must first be sought from their appropriate authority (i.e. Ministry of Foreign Affairs, state or Air Navigation Service Provider, ANSP), after which coordination with CAAM is required for the purpose of NOTAM promulgation if applicable. This process is essential to ensure that all relevant parties are informed and that appropriate measures are taken to mitigate any potential risks to civil aviation.

4.2.6.5 In 2023, CAAM has processed a total of 1,801 airspace activities consisting of UAV, military and sport aviation as follows:



	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
UAV	54	59	74	67	71	73	76	68	78	89	75	56
UAV	54	59	74	67	71	73	76	68	78	89	75	56
MILITARY	44	50	43	40	46	47	48	43	56	63	53	27
SPORTS AVIATION	36	21	23	17	26	27	30	66	35	45	28	47

Figure 4. 7: Approval for Airspace Activities by CAAM in 2023

4.2.6.6 Embracing internationally recognised principles of airspace management, civil-military collaboration, and safety risk assessment is fundamental within Malaysia's aviation framework. This approach optimises the utilisation of Kuala Lumpur (KL) and Kota Kinabalu (KK) Flight Information Regions (FIRs), accommodating the diverse requirements of civil and military users while prioritising safety and national interests.

4.2.6.7 A comprehensive evaluation of Malaysia's current airspace structure is indispensable for identifying deficiencies, resolving challenges, and meeting the needs of all stakeholders. By integrating Flexible Use of Airspace (FUA) principles and formulating a strategic, forward-looking airspace redesign plan, Malaysia can foster a more efficient and adaptable airspace management system.

4.3 Implementation Plan

4.3.1 Air Traffic Management (ATM) Operational Requirements

4.3.1.1 The Global ATM Operational Concept (ICAO Doc 9854) makes it necessary to adopt an airspace concept able to provide an operational scenario that includes route networks, minimum separation standards, assessment of obstacle clearance, and a communication, navigation and surveillance (CNS) infrastructure that satisfies specific strategic objectives, including safety, access, capacity, efficiency, and environment.

4.3.1.2 In this regard, the following programs will be developed:

a) Traffic and cost benefit analysis;

b) Necessary updates on automation;

c) Operational simulations in different scenarios;

d) ATC personnel training;

e) Flight plan processing;

f) Flight procedure design training to include PBN concepts and;

g) Aeronautical Radio Incorporated (ARINC) -424 coding standard;

h) Enhanced electronic data and processes to ensure appropriate level of AIS data accuracy, integrity and timeliness;

i) World Geodetic System (WGS) -84 implementation in accordance with ICAO Annex 15 (Aeronautical Information Services);

j) Uniform classification of adjacent and regional airspaces, where practicable;

k) RNAV/RNP applications for Standard Instrument Departure Routes (SIDs) and Standard Arrival Route (STARs);

l) Coordinated RNAV/RNP routes implementation; and

m) RNP approach with vertical guidance.

4.3.2 Phase 1 Implementation Plan

4.3.2.1 Route Operations

4.3.2.1.1 During the planning phase of the implementation of PBN routes, inputs from all aviation stakeholders will be gathered to obtain operational needs and requirements. These needs and requirements will be used to derive airspace concepts and to select appropriate PBN navigation specification.

4.3.2.1.2 The application of RNP-4 navigation specifications will replace existing RNAV-10/RNP-10 Oceanic routes and RNP-2 will be considered in the near future. Prior to implementation of RNP-4, air traffic demands, ATC workload, and fleet readiness statistics will be considered and all stakeholders will be consulted.

4.3.2.1.3 For other routes on key traffic flows and city pairs, the application of RNAV-2 or RNP-2 navigation specifications is expected. The international routes identified are from KLIA to Singapore, Bangkok, Jakarta and Ho Chi Minh City. The domestic route will be from KLIA to Kuching and Kota Kinabalu.

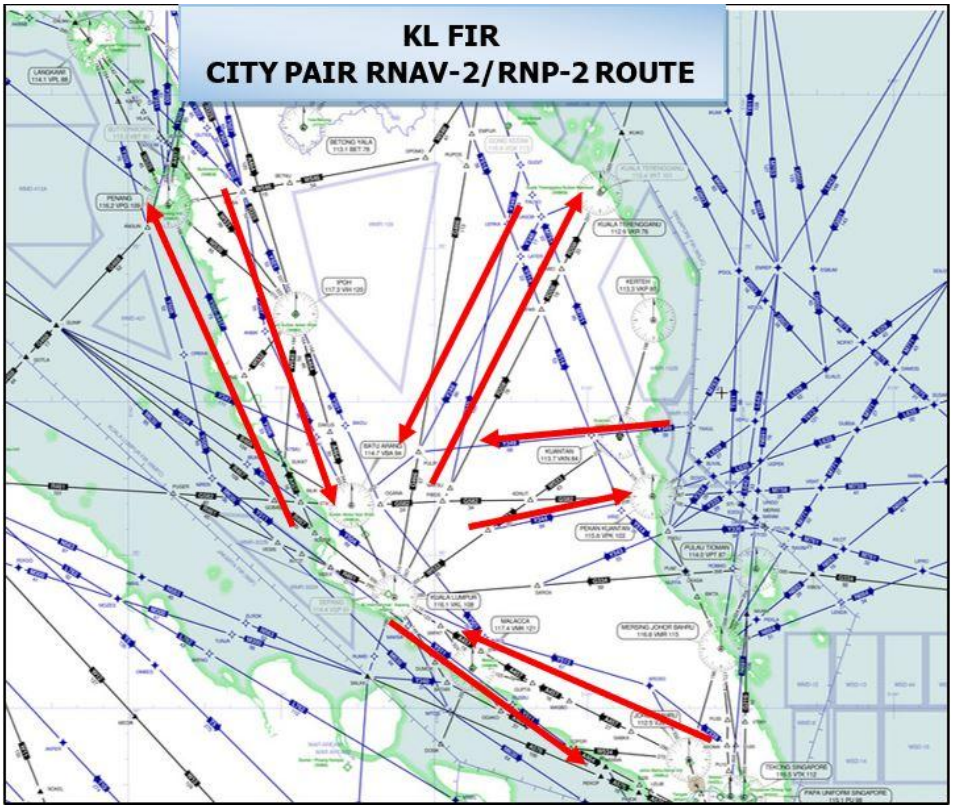


Figure 4. 8: KL FIR City pair RNAV/RNP 2 Routes

4.3.2.2 Terminal Control Area (TMA) Operations

4.3.2.2.1 In TMAs and control zones (CTRs) operations the application of RNP-1 and RNAV-1 SID/STAR will be implemented at all Aerodrome in Malaysia. Conventional procedure will be made available to accommodate mixed operations (PBN equipped and non-equipped) aircraft.

4.3.2.3 Instrument Approaches Procedures

4.3.2.3.1 The application of RNP APCH with LNAV/VNAV procedures will be implemented at all airports. Conventional approach procedures and conventional navigation aids will be maintained for non-equipped aircraft. ILS currently available at all instrument airports is expected to be satisfactorily operational for the next 10 years (Refer Table 4.5). RNP-AR APCH procedures will be introduced in selected airports where operational benefits can be obtained.

Table 4. 5: Aerodromes with Instrument Landing System (ILS) in Malaysia Year 2023

No	Airport	Runway	Year Installed	Age (In Years)
1	Johor Bahru	16	2010	13
2	KLIA	32L	2016	7
3	KLIA	32R	2016	7
4	KLIA	14L	2016	7
5	KLIA	14R	2016	7
6	KLIA	33	2014	9
7	KLIA	15	2014	9
8	Langkawi	03	2013	10
9	Penang	04	2013	10
10	Kuching	25	2008	15
11	Kota Kinabalu	02	2014	9
12	Alor Star	04	2023	0
13	Kota Bharu	10	2023	0
14	Kuantan	36	2012	11
15	Ipoh	04	2021	2
16	Kerteh	34	2013	10
17	Melaka	03	2011	12
18	Kuala Terengganu	04	2010	13
19	Subang	15	2023	0
20	Bintulu	17	2017	6
21	Miri	02	2015	8
22	Sibu	13	2023	0
23	Labuan	14	2008	15
24	Sandakan	08	2017	6
25	Tawau	24	2023	0

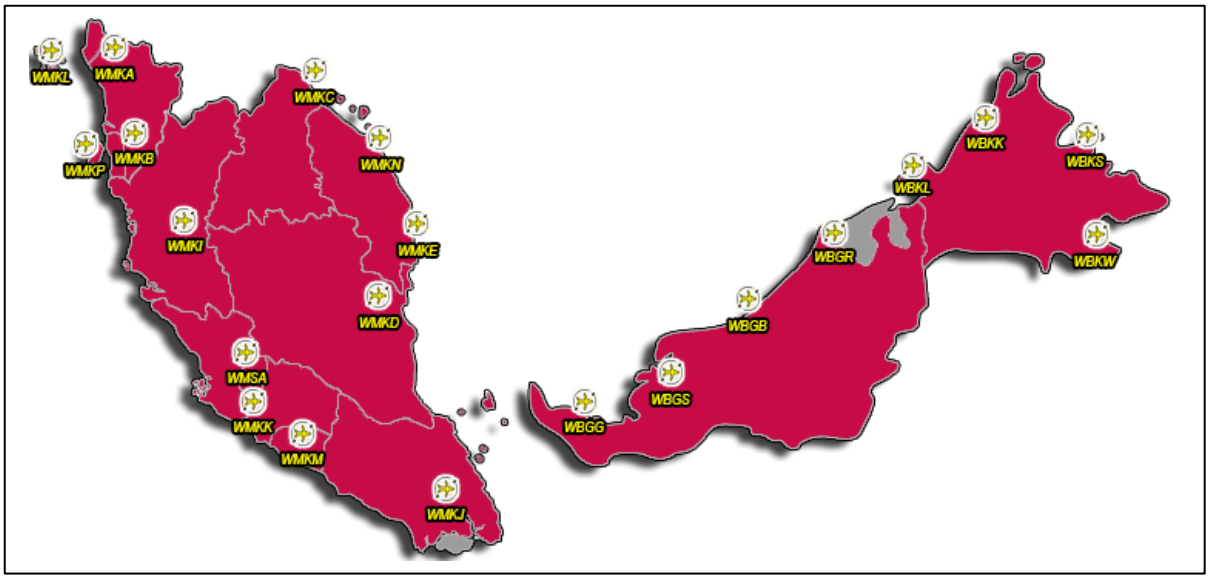


Table 4. 6: Summary Table & Implementation Targets (Phase 1)

Phase 1 (2022 - 2025)		
Airspace	**Preferred Nav. Specifications**	**Acceptable Nav. Specifications**
Route – Oceanic	RNP-4	RNAV-10
Route – Domestic en-route (City pair)	RNAV-2 / RNP-2	RNAV-5
TMA – Arrival & Departure	RNP-1 or RNAV-1 at aerodrome with adequate navigation infrastructure.	
Approach	RNP APCH (LNAV/VNAV) RNP-AR APCH GBAS Landing System (GLS) CAT 1 (GBAS)	
Implementation Targets • RNP APCH (LNAV/VNAV) 80% by 2023, 90% by 2024 and 100% by 2025. Priority will be given to International Aerodrome and aerodrome with international flights. • Re-defining existing conventional routes into PBN navigation specification by 2025 • Implementation of additional RNAV/RNP routes		

4.3.3 Phase 2 Implementation Plan

4.3.3.1 En-Route Operations

4.3.3.1.1 The implementations of additional RNAV/RNP routes with higher nav spec will be considered to improved airspace utilisation dan provide optimum climb and descent gradient. Existing conventional routes that do not affect operation will be remove gradually after consultation with stakeholders.

4.3.3.1.2 With the utilisation of Automatic Dependent Surveillance–Broadcast (ADSB) and Controller Pilot Data Link Communications (CPDLC), the application of RNP routes in the Oceanic airspace is expected. This will permit the use of smaller lateral and longitudinal separation, such as 30 NM based on the RNP 4 and RNP 2 navigation specification. The fleet readiness status will be considered during the planning.

4.3.3.1.3 In this phase, the establishment of a backup system in case of Global Navigation Satellite System (GNSS) failure or the development of contingency procedures will be developed.

4.3.3.2 Terminal Control Area (TMA) Operations

4.3.3.2.1 It is expected that the application of RNP-1/RNAV-1 SIDs and STARs is completed in the beginning of this phase. The application of Continuous climb and descent operations (CCO/CDO), Advance RNP and RNP-AR Departure will depend on aircraft navigation capability and stakeholder readiness. In TMAs of high air traffic complexity and movement, the use of total PBN procedure will be mandatory. In TMAs of less air traffic complexity, mixed operations of PBN and conventional procedure will be permitted (PBN equipped or non-PBN equipped).

4.3.3.3 Instrument Approach Procedures

4.3.3.3.1 In this phase, the application of Ground Based Augmentation System (GBAS) or Satellite Based Augmentation System (SBAS) in all international aerodrome is expected. These applications may also serve as a back-up to precision approaches and provide vertical guided approaches for the runways without precision approach capability.

4.3.3.3.2 The extended application of RNP AR Approaches will be considered for all airports where there are operational benefits.

Table 4. 7: Summary Table & Implementation Targets (Phase 2)

PHASE 2 (2022 - 2025)		
Airspace	**Preferred Nav. Specifications**	**Acceptable Nav. Specifications**
Route – Oceanic	RNP-2	RNAV-4
Route – Domestic En-Route (City Pair)	RNP-2 ADVANCE RNP RNP 0.3 (Helicopter Only)	RNAV-2 / RNP-2
TMA – Arrival	CCO & CDO RF LEGS RNP-AR DP ADVANCE RNP RNP 0.3 (Helicopter Only)	
Approach	RNP APCH LNAV/VNAV RNP-AR APCH GLS CAT II/III (GBAS) MULTI-FREQ GBAS/SBAS	
Implementation Targets • Implementation of better Nav Spec to improve in term of safety, access, capacity, environment and economy. • Implementation of Advance RNP in all phase of flight.		

4.3.4 Summary of ATM Implementation Plan

4.3.4.1.1 In this phase, GNSS is expected to be a primary navigation infrastructure for PBN implementation. Malaysia will work co-operatively on a regional basis to implement PBN procedure at all phase of flight in order to facilitate seamless and inter-operable systems and undertake coordinated research and development programs on PBN implementation and operation.

4.3.4.1.2 Moreover, during this phase, Malaysia will consider segregating traffic according to navigation capability and granting preferred routes to aircraft with better navigation performance.

4.3.4.1.3 With the expectation that precision approach capability using GNSS and its augmentation systems will become available. Malaysia will mandate 100% used of PBN for all traffic to Malaysia Airspace by 2028.

4.3.5 Transitional Strategies (NAVAIDS Decommissioning)

4.3.5.1.1 During transition to PBN, sufficient ground infrastructure for conventional navigation systems will remain available to serve non-equipped flights. Before existing ground infrastructure is considered for removal, users will be

given reasonable transition time to allow them to equip appropriately to attain equivalent PBN-based navigation performance. Malaysia will approach removal of existing ground infrastructure with caution to ensure that safety is not compromised. Performance of safety assessment and consultation with users through regional air navigation planning process will be necessary.

4.3.5.1.2 Malaysia will coordinate to ensure that harmonised separation standards and procedures are developed and introduced concurrently in both FIRs along major traffic flows to allow for a seamless transition towards PBN.

4.3.5.1.3 Malaysia will cooperate on a multinational basis to implement PBN in order to facilitate seamless and inter-operable systems and undertake coordinated research and development programs on PBN implementation and operation.

4.3.5.1.4 Malaysia will consider segregating traffic according to navigation capability and granting preferred routes to aircraft with better navigation performance**,** taking into consideration of the needs of State/Military aircraft.

4.3.5.1.5 Malaysia will encourage operators and other airspace users to equip with PBN-capable avionics. This can be achieved through early introductions of RNP approaches, preferably those with vertical guidance.

4.3.6 Safety Assessment & Monitoring Requirements

4.3.6.1.1 In order to achieve these targets, the need for a safety assessment is also necessary to ensure that safety is not compromised and risks are identified and mitigated at all levels.

4.3.6.1.2 To ensure that the introduction of PBN applications within Malaysia Flight Information Region (FIR) is undertaken in a safe manner, in accordance with relevant ICAO provisions, implementation shall only take place following the conduct of a safety assessment that has demonstrated that an acceptable level of safety will be met.

4.3.6.1.3 This assessment may also need to demonstrate that levels of risk associated with specific PBN implementations are acceptable. Additionally, ongoing periodic safety reviews will be undertaken where required in order to establish that operations continue to meet acceptable levels of safety.

4.3.6.1.4 The Civil Aviation Authority of Malaysia (CAAM) will ensure that a safety assessment and, where required, ongoing monitoring of the PBN implementations are conducted. The CAAM may seek assistance from other relevant body in the government agencies (i.e. institutional department) to undertake such activities.

4.4 Benefits of Implementation

4.4.1 The better planning of Air Traffic Management (ATM) play a pivotal role in enhancing various aspects of the aviation industry, including safety, operational efficiency, environmental sustainability, economic viability, and security.

a) Safety:

1) PBN routes employ cutting-edge navigation technologies, like satellite-based systems, which significantly reduce the risk of accidents due to human error or adverse weather conditions.
2) This precision navigation minimises accidents and delays, ensuring safer journeys for passengers and cargo while optimizing the overall management of air traffic.

b) Operational Efficiency:

1) PBN routes streamline ATM by offering clearer routing options and reducing reliance on congested airways. This results in smoother operations, fewer delays, and increased reliability, benefiting airlines, airports, and the broader aviation sector.
2) By optimizing airspace utilization and minimizing congestion, PBN enhances operational efficiency and security by reducing the likelihood of mid-air collisions or unauthorised intrusions.

c) Environmental Impact:

1) The implementation of PBN leads to shorter flight paths and decreased fuel consumption, thereby reducing carbon emissions and promoting environmental sustainability.
2) This aligns with global efforts to combat climate change while also yielding cost savings for airlines through compliance with emissions regulations and potential environmental incentives within the realm of ATM.

d) Economic Operations:

1) PBN enables more direct and optimised flight paths, resulting in reduced distances travelled and lower fuel consumption, thereby lowering operating expenses for airlines.
2) Additionally, by enhancing overall flight efficiency and reducing flight times, PBN contributes to savings in crew costs, aircraft utilisation, and operational efficiency within the context of ATM.

e) Security:

1) Advanced navigation technologies employed in PBN, coupled with improved situational awareness for pilots, significantly enhance flight safety and security within the framework of ATM.
2) These routes minimise navigational errors, provide real-time information on nearby aircraft and potential threats, and enable better decision-

making by pilots. Thus, fostering a safer and more secure air transportation system, bolstering resilience against security threats.

4.4.2 In summary, the implementation of PBN not only enhances safety, operational efficiency, environmental sustainability, economic viability, and security within the aviation industry but also contributes to a more resilient and secure air transportation system overall, under the purview of Air Traffic Management.

5 Unmanned Aircraft System (UAS)

5.1 Introduction

5.1.1 Objective

5.1.1.1 The objective of this National Air Navigation Plan for Unmanned Aircraft Systems (UAS) is to establish a structured framework for the integration and management of UAS operations within the national airspace. It aims to ensure the safety, efficiency, and security of UAS operations while fostering innovation and growth in the UAS industry.

5.1.1.2 This plan encompasses all aspects related to UAS operations, including management of remotely piloted aviation, advanced air mobility (AAM), ground infrastructure, safety, security, risk assessment, and optimization of flight and airspace use. It also addresses the expected evolution of U-space in accordance with technological advancements and regulatory developments.

5.2 Current Status in Malaysia

5.2.1 All UAS activities in Malaysia are regulated and enforced under Civil Aviation Regulation: Regulation 140, 141, 142, 143 and 144, and Civil Aviation Directive: CAD 6011 Part (I), cad 6011 Part (II) and CAD 6011 Part (V).

5.2.2 The unmanned aerial system (UAS) industry in Malaysia is steadily growing, with increasing interest and adoption across various sectors. The Civil Aviation Authority of Malaysia (CAAM) has been actively working on regulations and guidelines to govern the safe and responsible use of drones in Malaysian airspace. These regulations aim to ensure the integration of UAS into the national airspace system while mitigating potential safety and security risks.

5.2.3 Several initiatives and projects involving UAS are underway in Malaysia, including applications in agriculture, surveillance, mapping, and delivery services. The government and industry players are collaborating to explore the full potential of UAS technology while addressing regulatory, operational, and infrastructure challenges.

5.2.4 The current status of UAS in Malaysia reflects a promising landscape with opportunities for further growth and development in various sectors, driven by advancements in technology and supportive regulatory frameworks.

5.2.5 The increasing utilisation of UAS necessitates a comprehensive plan to effectively integrate them into the national airspace system. With advancements in technology and regulatory frameworks, it becomes imperative to outline a roadmap for the phased implementation of U-space services to support safe and efficient UAS operations.

Source: Civil Aviation Authority of Malaysia

YEAR	NUMBER OF UAS IMPORTED INTO MALAYSIA	NUMBER OF APPROVAL TO FLY (ATF) GRANTED
2016	10,081	-
2017	16,792	-
2018	14,418	-
2019	5,560	-
2020	18,944	252
2021	19,909	348
2022	25,179	605
2023	-	865
TOTAL	**111,883**	**2,070**

NUMBER OF UAS SERVICE PROVIDER BASED ON CATEGORY				
Remote Pilot Training Organisation (RPTO)	UAE Aerial Work Certificate Operator (UAWC)	Special UAS Project Approval Operator (SUP)	Authorisation to Fly Operator (ATF)	**TOTAL**
5	2	5	370	**382**

Figure 5. 1: Statistic of UAS Activities in Malaysia

5.3 Implementation Plan

5.3.1 Foundations of U-space (Before 2023)

5.3.1.1 This phase focuses on establishing regulatory frameworks, setting up registries, and defining geographic areas in compliance with existing UAS regulations. UAS operations rely on manual coordination and authorization processes, with limited capabilities for beyond visual line of sight (BVLOS) flights.

5.3.2 Initial U-space Implementation (2023-2030)

5.3.2.1 With the enforcement of U-space regulations, a limited range of services becomes available, aiding in operation authorization and airspace management. U-space airspaces are defined, allowing for controlled and uncontrolled UAS operations. BVLOS operations become more feasible, and surveillance technologies play a crucial role in enhancing operational safety.

5.3.3 General U-space (Beyond 2030)

5.3.3.1 As UAS traffic increases, U-space airspace volumes are expanded, and tactical conflict resolution becomes routine. UAS traffic in controlled airspace is managed through U-space means, while dynamic capacity management ensures efficient airspace utilization. New flight rules, such as UFR, are introduced to accommodate diverse UAS operations.

5.3.4 Advanced U-space

5.3.4.1 In this phase, UAS operations become ubiquitous, with U-space services extensively utilised by both unmanned and manned aircraft. Tactical services and UFR are commonplace, contributing to enhanced airspace management and safety. UAS integration into national airspace reaches an advanced stage, with autonomous collision avoidance capabilities implemented across the board.

5.3.5 Full U-space Integration

5.3.5.1 U4 deployment signifies the predominance of uncrewed aerial operations. UAS and manned aircraft alike rely on U-space services, operating under unified flight rules. UAS airspace is extensively defined, with autonomous collision avoidance systems ensuring airspace safety.

5.4 Benefits of Implementation

5.4.1 Enhanced Safety

5.4.1.1 The phased implementation of U-space services enhances safety by providing real-time surveillance, conflict resolution, and airspace management capabilities. This leads to reduced risks of mid-air collisions and improves overall airspace safety.

5.4.2 Improved Efficiency

5.4.2.1 Efficient airspace utilization, streamlined authorization processes, and enhanced traffic management contribute to improved operational efficiency for UAS operators. This results in reduced flight delays, optimised routes, and increased productivity.

5.4.3 Facilitated Innovation

5.4.3.1 The implementation of U-space services fosters innovation within the UAS industry by providing a conducive environment for experimentation and development of new technologies. This facilitates the introduction of advanced UAS capabilities and promotes growth and competitiveness in the market.

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6 Aeronautical Information Management (AIM)

6.1 Introduction

6.1.1 Aeronautical Information Management (AIM) plays a pivotal role in modern aviation, ensuring the efficient management, dissemination, and utilization of aeronautical information critical for safe and seamless air navigation. This section outlines Malaysia's strategic approach to enhancing AIM practices in alignment with international standards and regional imperatives, emphasizing the significance of AIM in fostering effective airspace management.

6.1.2 Underpinning safe, efficient air transport is the Aeronautical Information Service (AIS), which collates, maintains and publishes aeronautical information of lasting character essential to air navigation, including details of regulations, procedures and other information pertinent to the operation of aircraft within the area of responsibility of the Malaysia.

6.1.3 The AIS, and its transition to the AIM environment, is a key enabler of all current and future air navigation activities. To satisfy new requirements for air navigation in a collaborative decision-making (CDM) environment the transition to AIM will provide aeronautical data and information in a digital format that facilitates graphical display, complies with international standards and agreed, common exchange formats and is accessible system-wide by all stakeholders in real-time.

6.1.4 The Aeronautical Information Management (AIM) plan was developed to guide and assist Aeronautical Information Service provider in meeting the challenges of transitioning from legacy paper-based AIPs to the digital world of AIM, as envisioned in the GANP and the ICAO Roadmap for Transition from AIS to AIM.

6.1.5 Quality-managed, timely aeronautical information is fundamental in supporting current and future aviation systems, supported by collaboration between ICAO States to improve the harmonization and interoperability of all processes and systems supporting air navigation. Collaboration in the provision of aeronautical information and data will benefit States facing resource challenges, and the broader Asia Pacific Region through the overall improvement in the availability, timeliness and quality of aeronautical information.

Positioning of the 21 Steps of the Roadmap in the 3 Phases

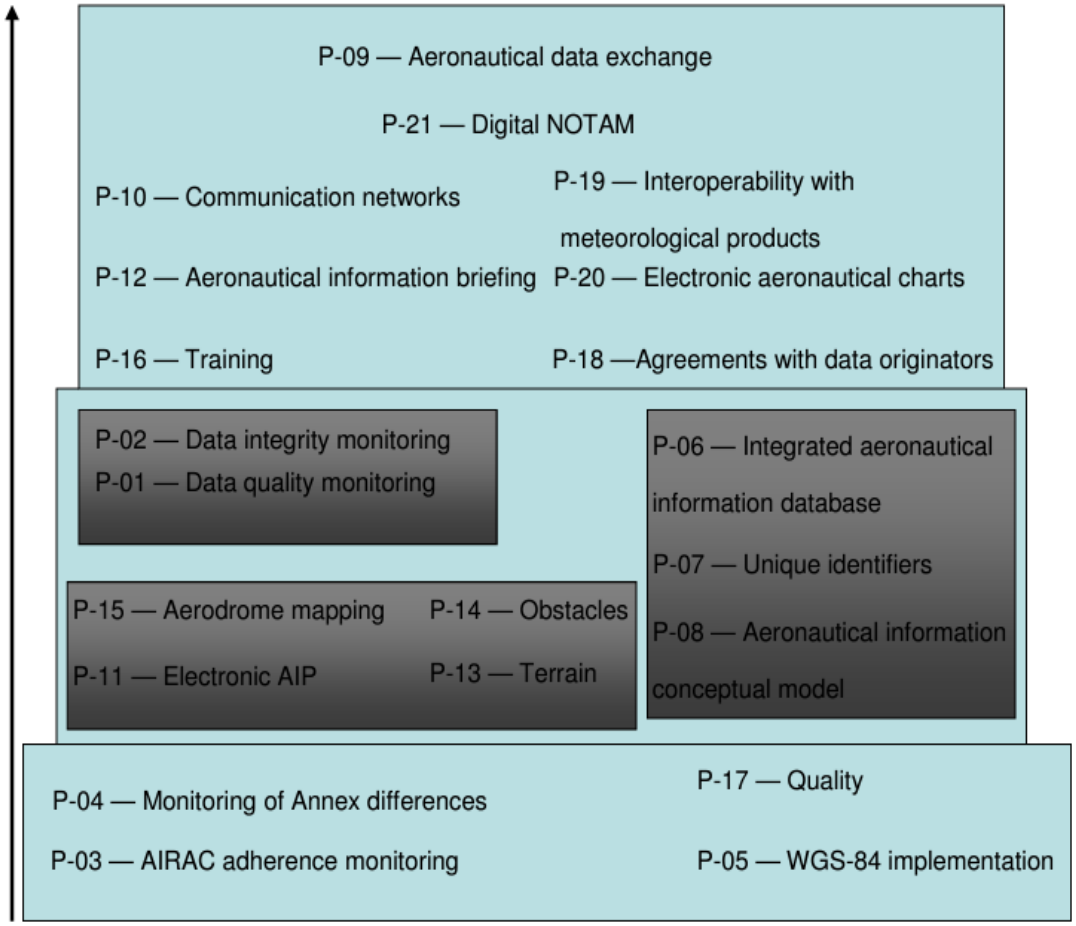

Figure 6. 1: ICAO AIS AIM Roadmap

6.1.6 In the AIM field, the main ASBU blocks which are relevant for Seamless ANS are as follows:

Table 6. 1: AIM related ASBU Blocks

ASBU Module	Module Title	Target Date	Remarks
B0 - DATM	Service Improvement through Digital Aeronautical Information Management (AIM)	2018	The initial introduction of digital processing and management of information from origination to publication 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.
B1 - DATM	Service Improvement through Integration of all Digital AIM Information	2019 - 2025	This module addresses the need for increased information integration and will support a new concept of ATM information exchange fostering access via internet-protocol-based tools.
B1 - SWIM	Performance Improvement through the application of SWIM applications and infrastructure	2019 - 2025	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 maximise interoperability.
B2 - SWIM	Enabling Airborne Participation in Collaborative ATM through SWIM	2025 - 2031	This module 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.

6.2 Current Status in Malaysia

6.2.1 Malaysia has embarked on a journey towards modernizing its AIM infrastructure to meet the evolving needs of the aviation industry. While significant strides have been made in the designation of responsibilities for AIS/AIM facilities and services, there remains a need for further development and integration of AIM systems and processes. Malaysia acknowledges the importance of enhancing AIM capabilities to ensure compliance with international standards and to facilitate collaborative decision-making in air navigation operations.

6.2.2 In recent years, Malaysia has made significant progress in modernizing its AIM infrastructure, aligning with international standards and embracing technological advancements. Since 2018, Malaysia has successfully implemented the Integrated Aeronautical Information Package (IAIP) in electronic form. This implementation marked a substantial shift from traditional paper-based aeronautical information services to a more dynamic, digital approach. The electronic IAIP offers several advantages, including real-time accessibility, improved data accuracy, and easier distribution of critical aeronautical information. It serves as a comprehensive source of information necessary for safe and

efficient air navigation, encompassing a wide range of data from aerodrome information to navigational aids and air traffic services.

6.2.3 Additionally, Malaysia is on the cusp of completing the implementation of Electronic Terrain and Obstacle Data (ETOD). This project represents a significant component of the global shift towards more sophisticated data management in air navigation. ETOD is essential for various modern navigation applications, including Performance-Based Navigation (PBN) and advanced flight planning. The successful implementation of ETOD will greatly enhance the safety and efficiency of flight operations by providing accurate and up-to-date terrain and obstacle data to pilots and air traffic management systems.

6.2.4 These advancements in AIM demonstrate Malaysia's commitment to adopting innovative solutions to meet the evolving needs of the aviation industry. The country's progress in digitalising its aeronautical information services positions it well for future initiatives aimed at further enhancing air navigation safety and efficiency. As part of the National Aviation Navigational Plan, building on these foundations will be crucial for achieving Malaysia's aspirations in line with ICAO's Global Aviation Navigational Plan and the Aviation System Block Upgrades.

6.3 Implementation Plan

6.3.1 Malaysia's implementation plan for AIM encompasses strategic initiatives aimed at strengthening the efficiency and effectiveness of aeronautical information management. Key components of this plan include:

a) the establishment of an authoritative Integrated Aeronautical Information Database (IAID),

b) delineation of transition timelines from AIS to AIM, and

c) the formulation of robust quality management systems to ensure the accuracy and integrity of aeronautical data.

6.3.2 Collaborative efforts with relevant stakeholders are prioritised to streamline implementation processes and address challenges encountered during the transition.

6.3.3 The implementation plan will be executed in three phases over a 15-year timeline:

Table 6. 2: AIM Implementation Plan

AIM Capability Phase 1 (To Be Implemented Immediately)	
1	Developed policy and enacted primary legislation and supporting regulations for Annex 4 and Annex 15 SARPS, and PANS-AIM Procedures including: • establishment of an organisational structure for the safety oversight of aeronautical information service providers; • requirements for monitoring of differences from Annex 4 and Annex 15 SARPS; • requirements for aeronautical information/data originators; • requirement for AIS quality management systems and processes to be established by all entities in the end-to-end AIS data chain.
2	Ensured National Air Navigation Plans include implementation planning for each of the performance expectations of the Regional Plan for Collaborative AIM.
3	Established AIS either as a separate entity within, or separated from the civil aviation administration.
4	Developed competency requirements for AIS personnel, including English language proficiency requirements, supported by a program of regular performance assessment.
5	Established regular programs of engagement with all stakeholders.
6	Established quality management processes for aeronautical information.
7	Established formal agreements between AIS providers and aeronautical data originators.
8	Provided full access to relevant ICAO Annexes and Documents to all personnel having responsibility for the reception, management, publication and/or distribution of aeronautical information and aeronautical data.
9	Ensured compliance of all aeronautical products with common reference systems WGS-84, MSL/EGM-96 and UTC.

AIM Capability Phase 2 (Current Year – 2028)	
1	Adapted policy, primary legislation and supporting regulations to support digital data sets of aeronautical information and associated products.
2	Adapted training, competency and performance assessment of AIS personnel for digital data sets and eAIP.
3	Implemented and maintained quality management systems encompassing all functions of the AIS.
4	Established and maintained digital databases of aeronautical information (PANS-AIM Appendix 1).
5	Managed terrain, obstacle and aerodrome mapping data through the establishment of: • a terrain database, from which terrain data sets conforming with Annex 15 Section 5.3.3.3 may be generated • an obstacle database, from which obstacle data sets conforming with Annex 15 Section 5.3.3.4 may be generated • an aerodrome mapping database, from which aerodrome mapping data sets conforming with Annex 15 Section 5.3.4 may be generated.
6	Implemented internet-accessible electronic AIP generated from digital database of aeronautical information.

AIM Capability Phase 3 (Current Year – 2030)	
1	Adapted policy, primary legislation and supporting regulations to support automated exchange of aeronautical data in a SWIM environment.
2	Adapted competency development and performance assessment of AIS personnel to support the automated exchange of aeronautical data and production of electronic charts in a SWIM environment.
3	Commenced aeronautical information exchange through digital data sets, integrated briefing and electronic charts in a SWIM environment.

6.3.4 Each phase will involve substantial investments in technology, human resources, policy and regulation updates, quality assurance, security, and environmental sustainability considerations.

6.5 Benefits of Implementation

6.5.1 A modernised AIM infrastructure will support the growth of Malaysia's aviation sector, attracting more international airlines and fostering economic development.

6.5.2 Compliance with ICAO standards will ensure seamless integration of Malaysia's AIM systems with global air traffic management, enhancing international cooperation and flight operations across borders.

6.5.3 Additionally, the implementation of such is foresee to bring;

a) Improved accuracy and timeliness of aeronautical data will significantly enhance air navigation safety, operational efficiency and overall airspace management capabilities.

b) Improved data management and dissemination mechanisms facilitate enhanced situational awareness for airspace users, leading to safer and more efficient air navigation operations.

c) Efficient air traffic management will contribute to reduced fuel consumption and emissions, aligning with global environmental sustainability goals.

d) The transition to digital platforms for AIP production fosters real-time access to aeronautical information, promoting operational flexibility and cost-effectiveness.

6.5.4 AIM implementation reinforces Malaysia's commitment to international standards and regional cooperation, positioning the country as a responsible and proactive member of the global aviation community.

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7 Meteorology (MET)

7.1 Introduction

7.1.1 Ensuring the safety and efficiency of global air transportation requires a robust framework for meteorological services and forecasting tailored to the specific needs of aviation stakeholders.

7.1.2 In Malaysia, the Malaysian Meteorological Department (MET Malaysia) is an agency under the Ministry of Natural Resources and Environmental Sustainability, and is responsible for the provision of aeronautical meteorological services for domestic and international air navigation.

7.1.3 The following Meteorological Watch Offices (MWO), Aeronautical Meteorological Offices (AMO) and Aeronautical Meteorological Stations (AMS), as listed in Table 6.1.1, have been assigned to providing aeronautical meteorological services including meteorological observations, warnings, forecasts and weather reports.

Table 7. 1: List of MWO, AMO and AMS with their locations:

No.	Location	ICAO Airport Code	Role
1	Sepang/ KL International Airport	WMKK	MWO, AMO, AMS
2	Kota Kinabalu International Airport	WBKK	MWO, AMO, AMS
3	Penang International Airport	WMKP	AMO, AMS
4	Kuantan Airport	WMKD	AMO, AMS
5	Pulau Langkawi International Airport	WMKL	AMS
6	Malacca Airport	WMKM	AMS
7	Senai International Airport	WMKJ	AMS
8	Kuching International Airport	WBGG	AMO, AMS
9	Bintulu Airport	WBGB	AMS
10	Miri Airport	WBGR	AMS
11	Sibu Airport	WBGS	AMS
12	Labuan Airport	WBKL	AMS
13	Sandakan Airport	WBKS	AMS
14	Tawau Airport	WBKW	AMS

7.1.4 The Meteorological Watch Offices (MWO), Aeronautical Meteorological Offices (AMO) and Aeronautical Meteorological Stations (AMS) listed above operate throughout the 24 hours and provide the following services for Civil Aviation Authority:

Table 7. 2: Roles & Responsibilities of MWO, AMO & AMS

Meteorological Watch Offices (MWO)	a. Maintaining continuous watch over meteorological conditions affecting flight operations within its FIR. b. Preparing, supplying and disseminating SIGMET and AIRMET information to the designated FIR. c. Providing meteorological forecast products for local region and FIR region. d. Disseminating meteorological forecast products provided by the global meteorological forecast centre. e. Preparing and disseminating aeronautical meteorological warning (aerodrome, en–route and FIR) to Air Traffic Services (ATS). f. Disseminating advisory of volcanic ash and tropical cyclone phenomenon received from Volcanic Ash Advisory Centre (VAAC) and Tropical Cyclone Advisory Centre (TCAC). g. Providing meteorological consultation, briefing and flight documentation to ATS. h. Disseminating space weather advisory received from the Space Weather Centre.
Aeronautical Meteorological Offices (AMO)	a. Providing meteorological service for aerodromes serving domestic and international air navigation. b. Maintain continuous survey of meteorological condition over the aerodromes for which it is designated to prepare forecasts. c. Associating with an aerodrome control tower or approach control unit (APP) for the provision of meteorological information.
Aeronautical Meteorological Stations (AMS)	a. Making routine and special observation, and supplying meteorological reports at aerodrome for the use of local and international air navigation. b. Disseminating specific types of observations and related reports either locally, or to other AMO and AMS.

7.2 Implementation Plan

7.2.1 Meteorological Products Supported by Automated Decision Systems or Aids using IWXXM (AMET-B1/1 - 4)

a) Objective – Meteorological information to support automated decision processes or aids involving meteorological information translation, ATM impact conversion and ATM decision support.

b) Applicability – to domestic and international airport. All aeronautical meteorological product should be supported by automated decision systems or aids using IWXXM consistent with AMET- B1/1-4.

Table 7. 3: Meteorological Products Supported by Automated Decision System

Meteorological observations information (AMET – B1/1, ICAO GANP 6th Edition)	Transition of Meteorological observations from traditional alphanumeric code (TAC) form to data-centric information to better support the common understanding on the various operational constraints, capabilities and needs. The following SWIM-compliant observational parameters and phenomena will begin to be made available to user by 2025 in IWXXM schema as SWIM platform requirement: a. Wind speed and direction (aerodrome) including gusts b. Wind speed and direction en-route c. Air temperature and dew point temperature (aerodrome) d. Air temperature and dew point temperature (or equivalent) en- route e. Pressure (aerodrome) (i.e. QNH/QFE) f. Visibility (aerodrome) (horizontal), Runway visual range (RVR) g. Cloud type (of operational significance) h. Cloud coverage, bases, tops and layers i. Thunderstorms, Lightning, Convection (TCU & CB) j. Precipitation (i.e. drizzle, rain, hail) k. Weather (i.e. funnel cloud, squall, smoke, haze, mist, fog) l. Turbulence, Wind shear m. Tropical cyclones n. Volcanic ash o. Space weather events p. Tsunami Characteristics of the meteorological information include: i. Time (i.e. observation time) ii. Units of measurement iii. Resolution (spatial) iv. Geo Location (2D context, point, line or polyhedron) v. Movement vi. Severity, Accumulation, Intensity vii. Range (Max.- Min.)

	viii. Variations ix. Data sample period x. Auto or Human (Observed, Measured or Calculated) xi. Amendment / Correction xii. Operational Status xiii. Source xiv. Thresholds xv. Format (TAC, Gridded, Graphical, IWXXM) xvi. Data quality flag xvii. Runway identification or location identifier xviii. Effects/impact on aviation systems (i.e. communications, navigation & surveillance systems) xix. Radiation (exposure)
Meteorological forecast and warning information (AMET – B1/2, ICAO GANP 6th Edition)	Availability of Meteorological forecast and warning information for automated support for decision processes or aids and performance- based requirements, involving meteorological information, meteorological information translation, ATM impact conversion and ATM decision processes.
Climatological and historical meteorological information (AMET-B1/3, ICAO GANP 6th Edition)	From 2025 onwards, MET Malaysia plans to upgrade existing climatological and historical meteorological products, as recognised in the ASBU element AMET-B0/3, through gradual implementation for the provision of climatological and historical meteorological information. Climatology parameters such as en-route winds, airport surface temperature, surface wind etc. will be enhanced and prepared to be made available to users to support the design and planning of infrastructure, flight routes and airspace management. Provision of historical meteorological observations, forecasts, advisories and warnings in support of incident and accident investigations will also be implemented in stages.

Dissemination of meteorological information (AMET – B1/4, ICAO GANP 6th Edition)	AMET-B1/1-4 requires Meteorological information in traditional alphanumeric code (TAC) products to be replaced by the ICAO Meteorological Information Exchange Model (IWXMM). Human - readable products to be derived from the IWXMM information. • MET Malaysia successfully completed modules in AMET-B0/1-4 by providing meteorological observational products, meteorological forecast and warning products, historical products and partially conducting the dissemination of meteorological products using IWXXM schema through Aeronautical Fixed Telecommunication Network (AFTN) as System Wide Information Management (SWIM) compliant requirement. The complete migration of AFTN to Aeronautical Message Handling System (AMHS) will be implemented by 2025. As a member country of the International Civil Aviation Organization (ICAO), MET Malaysia has also been given access to The World Area Forecast System (WAFS) Internet File Service (WIFS), which is aviation- related weather information required to support international air traffic management and flight operations. WIFS provides access to WAFS products and OPMET (Operational Meteorological) data as defined in ICAO Annex 3 – Meteorological Service for International Air Navigation, Chapter 3. These products are provided as follows: Grid Point data in GRIB2 format, Significant Weather (SIGWX) in PNG, BUFR formats and alphanumeric formats as well as other character-oriented OPMET information required for pre-flight planning and flight documentation. As a WIFS users, MET Malaysia are allowed to extract, process, visualise the data and responsible for disseminating such information.

7.2.2 Implementation plan beyond 2025:

Table 7. 4: Implementation Plan Beyond Year 2025

AMET Block 2	Integrated meteorological information in support of enhanced operational ground and air decision making process, particularly in the planning phase and near-term.
AMET Block 3	Integrated meteorological information in support of enhanced operational ground and air decision-making processes, for all flight phases and corresponding air traffic management operations.
AMET Block 4	Integrated meteorological information supporting both air and ground decision making for all phases of flight and ATM operations, especially for implementing immediate weather mitigation strategies.

7.2.3 The implementation of AMET Block 2, Block 3 and Block 4 will be based on the progress of completion of Block 1 and APAC Regional requirements.

7.3 Benefits of Implementation

7.3.1 Among the benefits from the implementation includes;

Table 7. 5: Benefits of Implementation

Capacity	Optimised use of airspace capacity.
Efficiency	Coordinated arriving air traffic (enroute to terminal area to aerodrome) and coordinated departing air traffic (aerodrome to terminal area to enroute) will translate to reduced arrival and departure holding times and thus reduced fuel consumption. Additionally, the optimisation of aerodrome forecasts and the dissemination of meteorological observations and reports will streamline flight planning and operations. Pilots will have access to real-time weather information for departure, destination, and en-route alternates, enabling them to make informed decisions and optimise routing to avoid adverse weather conditions. This, in turn, will reduce delays, fuel consumption, and operational costs for airlines and improve overall airspace capacity and efficiency.
Environmental	Reduce fuel consumption through optimised departure and arrival profiling/scheduling.
Interoperability	Gate-to-gate seamless operations through common access to, and use of, the availability AWFS (World Area Forecast Centre), IAVW and tropical cyclone watch forecast information.
Participation, Collaboration & Coordination	Common understanding of operational constraints, capabilities and needs, based on expected (forecast) meteorological conditions. This fosters collaboration among aviation stakeholders, including meteorological agencies, airport authorities, airlines, and air traffic services providers. By defining clear protocols and standards for the exchange of meteorological information, the plan promotes seamless coordination and communication, ensuring that all relevant parties have access to the necessary data for safe and efficient operations.
Predictability	Decreased variance between the predicted and actual air traffic schedule (Block time variability, flight-time error/buffer built into schedules).

Safety	Increased situational awareness and improved consistent and collaborative decision-making. Enhanced medium-level SIGWX forecasts and streamlined meteorological services at aerodromes will provide pilots and operators with timely and accurate weather information, reducing the risk of weather-related incidents and accidents.
Compliance with Regulatory Requirements	By aligning procedures with international standards and guidelines, the implementation plan helps States and aviation authorities ensure compliance with regulatory requirements related to meteorological services and flight operations. This not only enhances safety but also strengthens the credibility and reputation of the aviation industry, fostering trust among passengers & stakeholders.
Resilience to Changing Weather Patterns	As climate change continues to impact global weather patterns, the implementation of robust meteorological services and forecasting capabilities will be essential for adapting to evolving conditions. By investing in advanced technologies and forecasting techniques, the aviation industry can better anticipate and mitigate the effects of extreme weather events, ensuring continued safe and reliable operations in the face of uncertainty.

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8 Appendices

8.1 Appendix 1 – ICAO ASBU Elements (GANP – 6th Edition)

(Chapter 1, 1.1.7. refers)

INFORMATION	
AMET	***Meteorological information provided to support operational efficiency & safety***
AMET-B0/1	Meteorological observations products
AMET-B0/2	Meteorological forecast & warning products
AMET-B0/3	Climatological & historical meteorological products
AMET-B0/4	Dissemination of meteorological products
AMET-B1/1	Meteorological observations information
AMET-B1/2	Meteorological forecast & warning information
AMET-B1/3	Climatological & historical meteorological information
AMET-B1/4	Dissemination of meteorological information
AMET-B2/1	Meteorological observations information
AMET-B2/2	Meteorological forecast & warning information
AMET-B2/3	Climatological & historical meteorological information
AMET-B2/4	Meteorological information service in SWIM
AMET-B3/1	Meteorological observations information
AMET-B3/2	Meteorological forecast & warning information
AMET-B3/3	Climatological & historical meteorological information
AMET-B3/4	Meteorological information service in SWIM
AMET-B4/1	Meteorological observations information
AMET-B4/2	Meteorological forecast & warning information
AMET-B4/3	Climatological & historical meteorological information
AMET-B4/4	Meteorological information service in SWIM
DAIM	***Digital Aeronautical Information Management***
DAIM-B1/1	Provision of quality-assured aeronautical data & information
DAIM-B1/2	Provision of Aeronautical Information Publication (AIP) data sets
DAIM-B1/3	Provision of digital terrain data sets
DAIM-B1/4	Provision of digital obstacle data sets
DAIM-B1/5	Provision of digital aerodrome mapping data sets
DAIM-B1/6	Provision of digital instrument flight procedure data sets
DAIM-B1/7	NOTAM improvements
DAIM-B2/1	Dissemination of aeronautical information in a SWIM environment
DAIM-B2/2	Daily Airspace Management information to support flight & flow
DAIM-B2/3	Aeronautical information to support higher airspace operations
DAIM-B2/4	Aeronautical information requirements tailored to UTM
DAIM-B2/5	NOTAM replacement

FICE	***Flight & Flow Information for a Collaborative Environment (FF-ICE)***
FICE-B0/1	Automated basic inter facility data exchange (AIDC)
FICE-B2/1	Planning Service
FICE-B2/2	Filing Service
FICE-B2/3	Trial Service
FICE-B2/4	Flight Data Request Service
FICE-B2/5	Notification Service
FICE-B2/6	Publication Service
FICE-B2/7	Flight information management service for higher airspace operations
FICE-B2/8	Flight information management service for low altitude operations
FICE-B2/9	Flight information management support for inflight re-planning
FICE-B3/1	Flight information management services for enhanced trajectory operations
FICE-B4/1	Integrated flight information management system for end-to-end global flight planning
FICE-B4/2	Real-time participation of operators in flight information
SWIM	***System Wide Information Management***
SWIM-B2/1	Information service provision
SWIM-B2/2	Information service consumption
SWIM-B2/3	SWIM registry
SWIM-B2/4	Air/Ground SWIM for non-safety critical information
SWIM-B2/5	Global SWIM process
SWIM-B3/1	Air/Ground SWIM for safety critical information
OPERATIONAL	
ACAS	***Airborne Collision Avoidance System***
ACAS-B1/1	ACAS improvements
ACAS-B2/1	New collision avoidance system
ACAS-B2/2	New collision avoidance capability as part of an overall detect & avoid system for RPAS
ACDM	***Airport Collaborative Decision Making***
ACDM-B0/1	Airport CDM Information Sharing (ACIS)
ACDM-B0/2	Integration with ATM Network function
ACDM-B1/1	Airport Operations Plan (AOP)
ACDM-B1/2	Airport Operations Centre (APOC)
ACDM-B2/1	Total Airport Management (TAM)
ACDM-B3/1	Full integration of ACDM & TAM in TBO
APTA	***Improve Arrival & Departure Operations***
APTA-B0/1	PBN Approaches (with basic capabilities)
APTA-B0/2	PBN SID & STAR procedures (with basic capabilities)
APTA-B0/3	SBAS/GBAS CAT I precision approach procedures
APTA-B0/4	CDO (basic)

APTA-B0/5	CDO (basic)
APTA-B0/6	PBN Helicopter Point in Space (PinS) Operations
APTA-B0/7	Performance based aerodrome operating minima – advanced aircraft
APTA-B0/8	Performance based aerodrome operating minima – basic aircraft
APTA-B1/1	PBN Approaches (with advanced capabilities)
APTA-B1/2	PBN SID & STAR procedures (with advanced capabilities)
APTA-B1/3	Performance based aerodrome operating minima – Advanced aircraft with SVGS
APTA-B1/4	CDO (advanced)
APTA-B1/5	CDO (advanced)
APTA-B2/1	GBA CAT II/III precision approach procedures
APTA-B2/2	Simultaneous operations to parallel runways
APTA-B2/3	PBN Helicopter Steep Approach Operations
CSEP	***Cooperative Separation***
CSEP-B1/1	Basic airborne situational awareness during flight operations (AIRB)
CSEP-B1/2	Visual Separation on Approach (VSA)
CSEP-B1/3	Performance Based Longitudinal Separation Minima
CSEP-B1/4	Performance Based Lateral Separation Minima
CSEP-B2/1	Interval Management (IM) Procedure
CSEP-B2/2	Cooperative separation at low altitudes
CSEP-B2/3	Cooperative separation at higher airspace
CSEP-B3/1	Interval Management (IM) Procedure with complex geometries
CSEP-B3/2	Remain Well Clear (RWC) functionality for USA/RPAS
CSEP-B4/1	Airborne separation
FRTO	***Improved Operations Through Enhanced Enroute Trajectories***
FRTO-B0/1	Direct routing (DCT)
FRTO-B0/2	Airspace planning & Flexible Use of Airspace (FUA)
FRTO-B0/3	Pre-validated & coordinated ATS routes to support flight & flow
FRTO-B0/4	Basic conflict detection & conformance monitoring
FRTO-B1/1	Free Route Airspace (FRA)
FRTO-B1/2	Required Navigation Performance (RNP) routes
FRTO-B1/3	Advanced Flexible Use of Airspace (FUA) & management of real time airspace data
FRTO-B1/4	Data sectorisation
FRTO-B1/5	Enhanced conflict detection tools & conformance monitoring
FRTO-B1/6	Multi-sector planning
FRTO-B1/7	Trajectory Options Set (TOS)
FRTO-B2/1	Local components of integrated ATFM & ATC Planning function (INAP)

FRTO-B2/2	Local components of Dynamic Airspace Configurations (GADSS)
FRTO-B2/3	Large Scale Cross Border Free Route Airspace (FRA)
FRTO-B2/4	Enhanced Conflict Resolution Tools
GADS	***Global Aeronautical Distress & Safety System (GADSS)***
GADS-B1/1	Aircraft Tracking
GADS-B1/2	Contact directory service
GADS-B2/1	Autonomous Distress Tracking
GADS-B2/2	Distress tracking information management
GADS-B2/3	Post Flight Localization
GADS-B2/4	Flight Data Recovery
NOPS	***Network Operations***
NOPS-B0/1	Initial integration of collaborative airspace management with air traffic flow management
NOPS-B0/2	Collaborative Network Flight Updates
NOPS-B0/3	Network Operation Planning basic features
NOPS-B0/4	Initial Airport/ATFM slots & A-CDM Network Interface
NOPS-B0/5	Dynamic ATFM slot allocation
NOPS-B1/1	Short term ATFM measures
NOPS-B1/2	Enhanced Network Operations Planning
NOPS-B1/3	Enhanced integration of airspace management with air traffic flow management
NOPS-B1/4	Dynamic Traffic Complexity Management
NOPS-B1/5	Full integration of airspace management with air traffic flow management
NOPS-B1/6	Initial Dynamic Airspace Configurations
NOPS-B1/7	Enhanced ATFM slot swapping
NOPS-B1/8	Extended Arrival Management supported by the ATM Network function
NOPS-B1/9	Target Times for ATFM purposes
NOPS-B1/10	Collaborative Trajectory Options Programme (CTOP)
NOPS-B2/1	Optimised ATM Network Services in the initial TBO context
NOPS-B2/2	Enhanced dynamic airspace configuration
NOPS-B2/3	Collaborative Network Operation Planning
NOPS-B2/4	Multi ATFM slot swapping & airspace users priorities
NOPS-B2/5	Further airport integration within Network Operation Planning
NOPS-B2/6	AFTM adapted for cross-border Free Route Airspace (FRA)
NOPS-B2/7	UTM Network operations
NOPS-B2/8	Higher upper airspace network operations
NOPS-B3/1	ATM Network Services in full TBO context
NOPS-B3/2	Cooperative Network Operations Planning
NOPS-B3/3	Innovative airspace architecture

OPFL	***Improved Access to Optimum Flight Levels In Oceanic & Remote Airspace***
OPFL-B0/1	In Trail Procedure (ITP)
OPFL-B0/2	Climb & Descend Procedure (CDP)
RATS	***Remote Aerodrome Air Traffic Services***
RATS-B1/1	Remotely Operated Aerodrome Air Traffic Services
RSEQ	***Improved Traffic Flow Through Runway Sequencing***
RSEQ-B0/1	Arrival management
RSEQ-B0/2	Departure management
RSEQ-B0/3	Point merge
RSEQ-B1/1	Extended arrival metering
RSEQ-B2/1	Integration of arrival and departure management
RSEQ-B2/2	Arrival management in terminal airspace with multiple airports
RSEQ-B3/1	Departure management in terminal airspace from multiple airports
RSEQ-B3/2	Extended arrival management supporting overlapping operations into multiple airports
RSEQ-B3/3	Increased utilization of runway capacity by improved real-time runway scheduling
RSEQ-B3/4	Improved operator fleet management in runway sequencing
SNET	***Ground-based Safety Nets***
SNET-B0/1	Short Term Conflict Alert (STCA)
SNET-B0/2	Minimum Safe Altitude Warning (MSAW)
SNET-B0/3	Area Proximity Warning (APW)
SNET-B0/4	Approach Path Monitoring (APM)
SNET-B1/1	Enhanced STCA with aircraft parameters
SNET-B1/2	Enhanced STCA in complex TMAs
SURF	***Surface Operations***
SURF-B0/1	Basic ATCO tools to manage traffic during ground operations
SURF-B0/2	Comprehensive situational awareness of surface operations
SURF-B0/3	Initial ATCO alerting service for surface operations
SURF-B1/1	Advanced features using visual aids to support traffic management during ground operations
SURF-B1/2	Comprehensive pilot situational awareness on the airport surface
SURF-B1/3	Enhanced ATCO alerting service for surface operations
SURF-B1/4	Routing service to support ATCO surface operations management
SURF-B1/5	Enhanced vision systems for taxi operations
SURF-B2/1	Enhanced surface guidance for pilots and vehicle drivers
SURF-B2/2	Comprehensive vehicle driver situational awareness on the airport surface
SURF-B2/3	Conflict alerting for pilots for runway operations

SURF-B3/1	Optimization of surface traffic management in complex situations
TBO	***Trajectory-based Operations***
TBO-B0/1	Introduction of time-based management within a flow centric approach
TBO-B1/1	Initial Integration of time-based decision-making processes
TBO-B2/1	Pre-departure trajectory synchronization within a flight centric & network performance approach
TBO-B2/2	Extended time-based management across multiple FIRs for active flight synchronisation
TBO-B3/1	Network based on-demand synchronization of trajectory-based operations
TBO-B4/1	Total airspace management performance system
WAKE	**Wake Turbulence Separation**
WAKE-B2/1	Wake turbulence separation minima based on 7 aircraft groups
WAKE-B2/2	Dependent parallel approaches
WAKE-B2/3	Independent segregated parallel operations
WAKE-B2/4	Wake turbulence separation minima based on leader/follower static pairs-wise
WAKE-B2/5	Enhanced dependent parallel approaches
WAKE-B2/6	Enhanced independent segregated parallel operations
WAKE-B2/7	Time based wake separation minima for arrival based on leader/follower static pair-wise
WAKE-B2/8	Time based wake separation minima for departure based on leader/follower static pair-wise
WAKE-B3/1	Time based dependent parallel approaches
WAKE-B3/2	Time based independent segregated parallel operations
WAKE-B4/1	Enroute Wake Encounter Ground based Prediction
WAKE-B4/2	Enroute Wake Encounter on-board flight management /mitigation
CNS Technology & Services	
ASUR	***Surveillance Systems***
ASUR-B0/1	Automatic Dependent Surveillance – Broadcast (ADS-B)
ASUR-B0/2	Multilateration cooperative surveillance systems (MLAT)
ASUR-B0/3	Cooperative Surveillance Radar Downlink of Aircraft Parameters (SSR-DAPS)
ASUR-B1/1	Reception of aircraft ADS-B signals from space (SB ADS-B)
ASUR-B2/1	Evolution of ADS-B and Mode S
ASUR-B2/2	New community-based surveillance system for airborne aircraft (low and higher airspace)
ASUR-B3/1	New non-cooperative surveillance system for airborne aircraft (medium altitudes)
ASUR-B4/1	Further evolution of ADS-B and MLAT

COMI	***Communication Infrastructure***
COMI-B0/1	Aircraft Communication Addressing and Reporting System (ACARS)
COMI-B0/2	Aeronautical Telecommunication Network/Open System Interconnection (ATN/OSI)
COMI-B0/3	VHF Data Link (VDL) Mode 0/A
COMI-B0/4	VHF Data Link (VDL) Mode 2 Basic
COMI-B0/5	Satellite communications (SATCOM) Class C Data
COMI-B0/6	High Frequency Data Link (HFDL)
COMI-B0/7	ATS Message Handling System (AMHS)
COMI-B1/1	Ground-Ground Aeronautical Telecommunication Network/Internet Protocol Suite (ATN/IPS)
COMI-B1/2	VHF Data Link (VDL) Mode 2 Multi-Frequency
COMI-B1/3	SATCOM Class B Voice and Data
COMI-B1/4	Aeronautical Mobile Airport Communication System (AeroMACS) Ground-Ground
COMI-B2/1	Air-Ground ATN/IPS
COMI-B2/2	Aeronautical Mobile Airport Communication System (AeroMACS) aircraft mobile connection
COMI-B2/3	Links meeting requirements for non-safety critical communication
COMI-B3/1	VHF Data Link (VDL) Mode-2 Connectionless
COMI-B3/2	SATCOM Class A voice and data
COMI-B3/3	L-band Digital Aeronautical Communication System (LDACS)
COMI-B3/4	Links meeting requirements for safety critical communication
COMS	***ATS Communication Service***
COMS-B0/1	CPDLC (FANS 1/A & ATN B1) for domestic and procedural airspace
COMS-B0/2	ADS-C (FANS 1/A) for procedural airspace
COMS-B1/1	PBCS approved CPDLC (FANS 1/A+) for domestic and procedural airspace
COMS-B1/2	PBCS approved ADS-C (FANS 1/A+) for procedural airspace
COMS-B1/3	SATVOICE (incl. routine communications) for procedural airspace
COMS-B2/1	PBCS approved CPDLC (B2) for domestic and procedural airspace
COMS-B2/2	PBCS Approved ADS-C (B2) for domestic and procedural airspace
COMS-B2/3	PBCS approved SATVOICE (incl. routine communications) for procedural airspace
COMS-B3/1	Extended CPDLC (B2 incl. Adv-IM and dynamic RNP) for dense and complex airspace
COMS-B3/2	Extended ADS-C (B2 incl. Adv-IM and dynamic RNP) for dense and complex airspace

NAVS	Navigation Systems
NAVS-B0/1	Ground Based Augmentation Systems (GBAS)
NAVS-B0/2	Satellite Based Augmentation Systems (SBAS)
NAVS-B0/3	Aircraft Based Augmentation Systems (ABAS)
NAVS-B0/4	Navigation Minimal Operating Networks (Nav. MON)
NAVS-B1/1	Extended GBAS
NAVS-B2/1	Dual Frequency Multi Constellation (DF MC) GBAS
NAVS-B2/2	Dual Frequency Multi Constellation (DF MC) SBAS
NAVS-B2/3	Dual Frequency Multi Constellation (DF MC) ABAS

8.2 Appendix 2 – ASBU Block B0, Block 1 & B2 Priorities within APAC Region

(Chapter 1, 1.3.3. refers)

Cat.	Element	Description	APAC Regional Priority
Information			
AMET B0	AMET-B0/1	Meteorological observations products	Priority 1
	AMET-B0/2	Meteorological forecast & warning products	
	AMET-B0/3	Climatological & historical meteorological products	
	AMET-B0/4	Dissemination of meteorological products	
AMET B1	AMET-B1/1	Meteorological products supported by automated decision systems or aids using IWXXM	Priority 2
	AMET-B1/2		
	AMET-B1/3		
	AMET-B1/4		
AMET B2	AMET-B2/1	Integrated meteorological observations in support of enhanced ATM and airport decision-making processes, particularly in the near-term.	Priority 3
	AMET-B2/2		
	AMET-B2/3		
	AMET-B2/4		
DAIM B1	DAIM-B1/1	Provision of quality-assured aeronautical data & information	Priority 1
	DAIM-B1/2	Provision of Aeronautical Information Publication (AIP) data sets	
	DAIM-B1/3	Provision of digital terrain data sets	
	DAIM-B1/4	Provision of digital obstacle data sets	
	DAIM-B1/5	Provision of digital aerodrome mapping data sets	
	DAIM-B1/6	Provision of digital instrument flight procedure data sets	
	DAIM-B1/7	Provision of digital NOTAM improvements	Priority 2
DAIM B2	DAIM B2/1	Integrated aeronautical information service in a SWIM environment in support of enhanced operational ground and air decision-making processes for all phases of flight	Priority 3
	DAIM B2/2		
	DAIM B2/3		
	DAIM B2/4		
	DAIM B2/5		
FICE B0	FICE-B0/1	Automated basic inter facility data exchange (AIDC)	Priority 1
FICE B2	FICE-B2/2	To enhance ATS flight plan processing including constraints evaluation and enhanced flight information sharing - Filing Service	Priority 2
	FICE-B2/4	Flight Data Request service	Priority 2
SWIM B2	SWIM-B2/1	Information service provision	Priority 2
	SWIM-B2/2	Information service consumption	Priority 2

Cat.	Element	Description	APAC Regional Priority
Operational			
ACDM B0	ACDM-B0/1	Airport CDM Information Sharing (ACIS)	Priority 1
	ACDM-B0/2	Airport CDM integration with ATM Network	Priority 2
ACDM B1	ACDM-B1/1	Airport Operations Plan (AOP)	Priority 2
	ACDM-B1/2	Airport Operations Centre (APOC)	
ACDM B2	ACDM-B2/1	Airport Operations Plan (AOP), Airport Operations Centre (APOC) & Total Airport Management	Priority 3
	ACDM-B2/2		
	ACDM-B2/3		
APTA B0	APTA-B0/1	PBN Approaches (with basic capabilities) [Ref. PARS 7.4, 7.5, 7.10, 7.13, 7.14, 7.21]	Priority 1
	APTA-B0/2	PBN SID & STAR procedures (with basic capabilities) [Ref. PARS 7.4, 7.5, 7.10, 7.13, 7.14, 7.21]	
	APTA-B0/3	SBAS/GBAS CAT I precision approach procedures [Ref. PARS 7.5, 7.6, 7.10, 7.13, 7.14, 7.21]	Priority 3
	APTA-B0/4	CDO (basic) [Ref. PARS 7.14, 7.19, 7.21]	Priority 2
	APTA-B0/5	CCO (basic) [Ref. PARS 7.14, 7.19, 7.21]	Priority 2
	APTA-B0/6	PBN Helicopter Point in Space (PinS) Operations [Ref. PARS 7.14, 7.19, 7.21]	Priority 3
	APTA-B0/7	Performance based aerodrome operating minima – advanced aircraft [Ref. PARS 7.14, 7.19, 7.21]	Priority 2
	APTA-B0/8	Performance based aerodrome operating minima – basic aircraft [Ref. PARS 7.14, 7.19, 7.21]	Priority 2
APTA B1	APTA-B1/1	PBN Approaches (with advanced capabilities) [Ref. PARS 7.14, 7.21, 7.22, 7.23]	Priority 3
	APTA-B1/2	PBN SID & STAR procedures (with advanced capabilities) [Ref. PARS 7.14, 7.21, 7.22, 7.23]	Priority 3
	APTA-B1/4	CDO (advanced) P1 [Ref. PARS 7.14, 7.21, 7.22, 7.23]	Priority 3
	APTA-B1/5	CCO (advanced) [Ref. PARS 7.14, 7.21, 7.22, 7.23]	Priority 3
APTA B2	APTA-B2/1	GBAS CAT II/III precision approach procedures	Priority 3
	APTA-B2/2	Simultaneous operations to parallel runways	Priority 3
	APTA-B2/3	PBN Helicopter Steep Approach Operations	Priority 3
	APTA-B2/4	Performance based aerodrome operating minima – Advanced aircraft with SVGS [Ref. PARS 7.14, 7.21, 7.22, 7.23]	Priority 3
CSEP B1	CSEP-B1/1	Basic airborne situational awareness during flight operations (AIRB)	Priority 2
	CSEP-B1/2	Visual Separation on Approach (VSA)	
	CSEP-B1/3	Performance Based Longitudinal Separation Minima	

	CSEP-B1/4	Performance Based Lateral Separation Minima	
CSEP B2	CSEP-B2/1	Interval management procedure; cooperative separation at low altitudes and higher airspace	Priority 3
	CSEP-B2/2		
	CSEP-B2/3		
DATS B1	DATS-B1/1	Digital Aerodrome Air Traffic Services	Priority 3
FRTO B0	FRTO-B0/1	Direct routing (DCT)	Priority 1
	FRTO-B0/2	Airspace planning & Flexible Use of Airspace (FUA)	
	FRTO-B0/3	Pre-validated & coordinated ATS routes to support flight & flow (Flexible routings)	
	FRTO-B0/4	Basic conflict detection & conformance monitoring	
FRTO B1	FRTO-B1/1	Free Route Airspace (FRA)	Priority 2
	FRTO-B1/2	Required Navigation Performance (RNP) routes	
	FRTO-B1/3	Advanced Flexible Use of Airspace (FUA) & management of real time airspace data (ASM)	
	FRTO-B1/4	Data dynamic sectorisation	
	FRTO-B1/5	Enhanced conflict detection tools & conformance monitoring P1	
	FRTO-B1/6	Multi-sector planning	
	FRTO-B1/7	Trajectory Options Set (TOS)	
FRTO B2	FRTO-B2/1	Integrated ATFM and ATC Planning; Dynamic Airspace Configuration; Cross border FRA; Enhanced Conflict Resolution Tools	Priority 3
	FRTO-B2/2		
	FRTO-B2/3		
	FRTO-B2/4		
NOPS B0	NOPS-B0/1	Initial integration of collaborative airspace management with air traffic flow management	Priority 1
	NOPS-B0/2	Collaborative Network Flight Updates	
	NOPS-B0/3	Network Operation Planning basic features	
	NOPS-B0/4	Initial Airport/ATFM slots & A-CDM Network Interface	
	NOPS-B0/5	Dynamic ATFM slot allocation	
NOPS B1	NOPS-B1/1	Short term ATFM measures	Priority 2
	NOPS-B1/2	Enhanced Network Operations Planning	
	NOPS-B1/3	Enhanced integration of airspace management with air traffic flow management	
	NOPS-B1/4	Dynamic Traffic Complexity Management	
	NOPS-B1/5	Full integration of airspace management with air traffic flow management	
	NOPS-B1/6	Initial Dynamic Airspace Configurations	
	NOPS-B1/7	Enhanced ATFM slot swapping	
	NOPS-B1/8	Extended Arrival Management supported by the ATM Network function	
	NOPS-B1/9	Target Times for ATFM purposes	
	NOPS-B1/10	Collaborative Trajectory Options Programme (CTOP)	
NOPS B2	NOPS-B2/1	Optimised ATFM in initial TBO context; Enhanced Dynamic airspace configuration	Priority 3
	NOPS-B2/2		
	NOPS-B2/3	Collaborative network operation planning	Priority 3
	NOPS-B2/4	Multi ATFM slow swapping & Airspace User priorities	Priority 3
	NOPS-B2/5	Further airport integration	Priority 3
	NOPS-B2/6	ATFM for Cross Border FRA	Priority 3
	NOPS-B2/7	UTM Network Operations	Priority 3
	NOPS-B2/8	Higher Upper airspace network operations	Priority 3

OPFL B0	OPFL-B0/1	In Trail Procedure (ITP)	Priority 3
OPFL B1	OPFL-B1/1	Climb & Descend Procedure (CDP)	Priority 3
OPFL B2	OPFL-B2/1	Separation minima using ATS surveillance when VHF not available	Priority 3
RSEQ B0	RSEQ-B0/1	Arrival management	Priority 1
	RSEQ-B0/2	Departure management	
	RSEQ-B0/3	Point merge	Priority 3
RSEQ B1	RSEQ-B1/1	Extended arrival metering	Priority 2
RSEQ B2	RSEQ-B2/1	Integration of Arrival & Departure Management	Priority 3
SNET B0	SNET-B0/1	Short Term Conflict Alert (STCA)	Priority 1
	SNET-B0/2	Minimum Safe Altitude Warning (MSAW)	
	SNET-B0/3	Area Proximity Warning (APW)	
	SNET-B0/4	Approach Path Monitoring (APM)	
SNET B1	SNET-B1/1	Enhanced STCA with aircraft parameters	Priority 2
	SNET-B1/2	Enhanced STCA in complex TMAs	
SURF B0	SURF-B0/1	Basic ATCO tools to manage traffic during ground operations	Priority 2
	SURF-B0/2	Comprehensive situational awareness of surface operations	
	SURF-B0/3	Initial ATCO alerting service for surface operations	
SURF B1	SURF-B1/1	Advanced features using visual aids to support traffic management during ground operations	Priority 2
	SURF-B1/2	Comprehensive pilot situational awareness on the airport surface	
	SURF-B1/3	Enhanced ATCO alerting service for surface operations	
	SURF-B1/4	Routing service to support ATCO surface operations management	
	SURF-B1/5	Enhanced vision systems (EVS) for taxi operations	
SURF B2	SURF-B2/1	Enhanced surface guidance for pilots and vehicle drivers; Conflict alerting for pilots for runway operations	Priority 3
	SURF-B2/2		
	SURF-B2/3		
TBO B0	TBO-B0/1	Introduction of time-based management within a flow centric approach	Priority 2
	TBO-B1/1	Initial Integration of time-based decision-making processes	Priority 2
TBO B2	TBO-B2/1	Pre-departure Trajectory synchronization; extended Time-based management across multiple FIRs.	Priority 3
	TBO-B2/2		
WAKE B2	WAKE-B2/1	Wake Separation Minima based on 7 aircraft groups; Time based Wake separation minima on final approach.	Priority 3
	WAKE-B2/2		

Cat.	Element	Description	APAC Regional Priority
CNS Technology & Services			
ASUR B0	ASUR-B0/1	Automatic Dependent Surveillance – Broadcast (ADS-B)	
	ASUR-B0/2	Multilateration cooperative surveillance systems (MLAT)	
	ASUR-B0/3	Cooperative Surveillance Radar Downlink of Aircraft Parameters (SSR-DAPS)	
ASUR B1	ASUR-B1/1	Reception of aircraft ADS-B signals from space (SB ADS-B)	
ASUR B2	ASUR-B2/1	Evolution of ADS-B and Mode S	Priority 3
	ASUR-B2/2	Community based surveillance system for airborne aircraft (low and higher airspace)	Priority 3
COMI B0	COMI-B0/1	Aircraft Communication Addressing and Reporting System (ACARS)	Priority 2
	COMI-B0/2	Aeronautical Telecommunication Network/Open System Interconnection (ATN/OSI)	
	COMI-B0/4	VHF Data Link (VDL) Mode 2 Basic	
	COMI-B0/5	Satellite communications (SATCOM) Class C Data	
	COMI-B0/6	High Frequency Data Link (HFDL)	
	COMI-B0/3	VHF Data Link (VDL) Mode 0/A	Priority 1
	COMI-B0/7	ATS Message Handling System (AMHS)	
COMI B1	COMI-B1/1	Ground-Ground Aeronautical Telecommunication Network/Internet Protocol Suite (ATN/IPS)	Priority 2
	COMI-B1/2	VHF Data Link (VDL) Mode 2 Multi-Frequency	
	COMI-B1/3	SATCOM Class B Voice and Data	
	COMI-B1/4	Aeronautical Mobile Airport Communication System (AeroMACS) Ground-Ground	
COMI B2	COMI-B2/1	Air Ground ATN/IPS	Priority 3
	COMI-B2/2	AeroMACS, aircraft mobile connection	Priority 3
	COMI-B2/3	Links meeting requirements for non-safety critical communication	Priority 3
COMS B0	COMS-B0/1	CPDLC (FANS 1/A & ATN B1) for domestic and procedural airspace	Priority 2
	COMS-B0/2	ADS-C (FANS 1/A) for procedural airspace	
COMS B1	COMS-B1/1	PBCS approved CPDLC (FANS 1/A+) for domestic and procedural airspace	Priority 2
	COMS-B1/2	PBCS approved ADS-C (FANS 1/A+) for procedural airspace	
	COMS-B1/3	SATVOICE (incl. routine communications) for domestic & procedural airspace	
COMS B2	COMS-B2/1	PBCS approved CPDLC, ADS-C, SATVOICE	Priority 3
	COMS-B2/2		

	COMS-B2/3		
NAVS B0	NAVS-B0/1	Ground Based Augmentation Systems (GBAS)	Priority 2
	NAVS-B0/2	Satellite Based Augmentation Systems (SBAS)	
	NAVS-B0/3	Aircraft Based Augmentation Systems (ABAS)	
	NAVS-B0/4	Navigation Minimal Operating Networks (Nav. MON)	
NAV B1	NAV-B1/1	Extended GBAS	Priority 3
NAV B2	BAV-B2/1	DFMC, GBAS, SBAS, ABAS Extended GBAS	Priority 3
	NAVS-B2/2		
	NAVS-B2/3		

Note: The following two ASBU elements are considered to be implemented universally, hence not included in the table above.

ACAS-B1/1: ACAS Improvements (TCAS Version 7.1); and

GADS-B1/1-2: Aircraft Tracking & Contact directory service (An appropriate enhanced SAR system and systems to support aircraft tracking capability should be established consistent with the provisions of Annex 12 and to support GADS-B1/1-2, and in accordance with the Asia/Pacific SAR Plan).

Ref. APAC Seamless ATM Plan Version 4.0

8.3 Appendix 3 – Asia/Pacific Seamless ANS Regional Elements Priority

(Chapter 1, 1.3.7)

Category	Regional Seamless ANS Element	Phase / Priority
Operational		
PARS (*Preferred Aerodrome/ Airspace & Route Specifications*)	**Aerodrome Management & Coordination** – All international aerodromes should enable, in accordance with an Airport Master Plan, aerodrome management & coordination services: a) When traffic density requires, an appropriate apron management service to regulate aircraft operations in coordination with ATS; b) ATS coordination (including meetings & agreements) related to: airport development & maintenance planning; local authority coordination (environmental, noise abatement, & obstacles); c) Regular airport capacity analysis, which included a detailed assessment of passenger, airport gate, apron, taxiway & runway capacity.	Phase II Priority 2
	Optimization of Runway Capacity Facilities – Where practicable, all international aerodromes should provide, in accordance with an Airport Master Plan, the following facilities to optimise runway capacity: a) Additional runway(s) with adequate separation between runway centerlines for parallel independent operations; b) Parallel taxiways, rapid exit taxiways at optimal locations to minimise runway occupancy times & entry/exit taxiways; c) Rapid exit taxiway indicator lights (distance to go information to the nearest rapid exit taxiway on the runway); d) Twin parallel taxiways to separate arrivals & departures; e) Perimeter taxiways to avoid runway crossings; f) Adequate manoeuvring area signage (to expedite aircraft movement); g) Holding bays; h) Additional apron space in contact stands for quick turnarounds; i) Short length or tailored runways to segregate low speed aircraft; j) Taxi bots or towing systems, preferably controlled by pilots, to ensure efficiency & the optimal fuel loading for departure; and k) Advanced visual docking guidance systems.	Phase II Priority 3

	ADS-B, SSR Mode S & PBN Airspace a) ADS-B – Unless supported by alternative means of ATS surveillance (such as radar, where there are no plans for ADS-B), all Category T airspace supporting international aerodromes should be designated as non - exclusive or exclusive as appropriate ADS-B airspace requiring operation of ADS-B OUT using 1090ES with DO-260/260A & 260B capability to support ASUR-B0/1; b) SSR Mode – All Category T airspace supporting international aerodromes should require the carriage of an operable mode S transponder within airspace where Mode S radar services are provided to support ASUR-B0/3. c) PBN Airspace – All Category T airspace supporting international aerodromes should be designated as non-exclusive or exclusive PBN airspace as appropriate to allow operational priority for PBN approved aircraft, except for State aircraft, to facilitate seamless operations and offtrack events such as weather deviations to support APTA-B0/1 – 3 & 6.	Phase II Priority 2
	Flight Level Orientation Scheme (FLOS) – All States should use the ICAO Table of Cruising Levels (FLOS) based on feet as contained in Annex 2 Appendix 3.	Phase II Priority 2
	Civil-Military SUA Management – Civil-Military Airspace expectations are as follows: a) Special Use Airspace (SUA) should only be established after due considerations of its effect on civil air traffic by the appropriate Airspace Authority to ensure it will be; i. Used for the purpose that it is established, ii. Used regularly, iii. As small as possible, including any internal buffers, required to contain the activity therein, iv. If applicable, operated in accordance with FUA principles & activated only when it is being utilised. b) SUA should be regularly reviewed to ensure the activities that effect the airspace, the size & timing of such activity are accurately reflected by the SUA type, dimensions, activation notice & duration of activation.	Phase II Priority 1
	Unmanned Aircraft Systems – States should implement regulations supporting the integration of UAS operations in non-segregated airspace, using a risk-based approach & in accordance with the Asia/Pacific Regional Guidance for the Regulation of UAS, as a minimum.	Phase II Priority 2
PASL (*Preferred ANS Service Levels*)	**Adjacent ATS Sector Coordination** – All ATS sectors providing ATS surveillance in adjacent airspace should have direct speech circuits or digital voice communications, meeting pre-established safety & performance requirements, and where practicable, automated hand-off procedures that allow the TOC of aircraft without the necessity for voice communications, unless an aircraft requires special handling.	Phase II Priority 2

PASL (*Preferred ANS Service Levels*)	**ATC Horizontal Separation** – All ATC units should authorise the use of the horizontal separation minima stated in ICAO Doc 4444 (PANS ATM), or as close to the separation minima as practicable, considering such factors as: a) The automation of the ATM system, including automated hand-off between sectors; b) The capability of the ATC communication systems; c) The performance of the ATS surveillance system, including data-sharing or overlapping coverage at TOC points; and d) Ensuring the competency of air traffic controllers to apply the full tactical capability of ATS surveillance systems.	Phase II Priority 2
	Flight Level Allocation Schemes (FLAS) – Priority for FLAS level allocations should be given to higher density ATS routes over lower density ATS routes. FLAS should comply with Annex 2, Appendix 3a unless part of an OTS. FLAS other than OTS should only be utilised for safety & efficiency reasons within: a) Category R airspace with the agreement of all ANSPs that provide services: within the airspace concerned; & within adjacent airspace which is affected by the FLAS; or b) Category S airspace with the agreement of all ANSPs that provide services: where crossing track conflictions occur within 50NM of the FIRB; & ATS surveillance coverage does not overlap the FIRB concerned, or ATS surveillance data is not exchanged between the ATC units concerned.	Phase II Priority 2
	ATC Sector Capacity – All ATC sectors should have a nominal aircraft capacity figure based on a scientific capacity study & safety assessment, to ensure safe & efficient aircraft operations.	Phase II Priority 2
	Electronic Flight Progress Strip – ATC systems should utilise electronic flight progress strips wherever automation systems allow the capability due to efficiency and transcription error/data mismatch issues	Phase II Priority 2
	Enhanced SAR System – An appropriate enhanced SAR system & systems to support aircraft tracking capability should be established consistent with the provisions of Annex 12 and to support GADS-B1/1 – 2, and in accordance with the Asia/Pacific SAR Plan.	Phase II Priority 1
	ANSP Human & Simulator Performance– The following systems should be established to support human performance in the delivery of a Seamless ANS service. The systems should consider all the elements of the SHEL Model (Software, Hardware, Environment and Liveware-humans), in accordance with the ICAO Human Factors Digest No. 1 and related reference material: a) Human performance training for all managers of operational air navigation services (such as aerodrome operators, ATC organisations and aeronautical telecommunications), such training to include the importance of;	Phase II Priority 1

	i. A proactive organisational culture where managers & operational staff are informed & safety is a first priority, using open communications & an effective team management approach; ii. Assessment and management of risks by safety review & assessment teams comprising multidisciplinary operational staff & managers which review safety performance & assess significant proposals for change to ATM systems, particularly those related to human capabilities and limitations; iii. Human factors in; a. Air safety investigation, b. System design (ergonomics) c. Effective training (e.g. use of simulators), d. Fatigue management, e. Automated safety nets, and f. Contingency planning. iv. Effective Safety Reporting Systems that: a. Are non-punitive, supporting a 'Just Culture', b. Promote open reporting to management, c. Focus on preventive (systemic), not corrective (individual) actions in response to safety concerns, incidents & accidents. b) Human performance-based training and procedures for operational staff providing ATS, including; i. The application of tactical, surveillance-based ATC separation, control techniques near minimum ATC separations, and ii. Responses to ATM contingency operations, irregular/abnormal operations & safety net alerts. c) Human performance-based training and procedures for staff providing operational air navigation services (such as aerodrome staff operating 'airside', air traffic controllers & aeronautical telecommunications technicians) regarding the importance of an effective safety reporting culture and "Just Culture".	
	Civil-Military Strategic & Tactical Coordination	Priority 1
	Civil-Military Common Procedures & Training	Priority 2
PASL (*Preferred ANS Service Levels*)	Civil-Military ATM expectations are as follows: a) A national Civil-Military body should be formed to coordinate strategic civil-military activities (military training should be conducted in locations and/or at times that do not adversely affect civilian operations, particularly those associated with major aerodromes);	Phase II

	b) Formal civil-military liaison should take place for tactical responses by encouraging military participation at civil ATM meetings & within ATC Centers; c) Integration of civil & military ATM systems using joint procurement, & sharing of ATS surveillance data (especially from ADS-B systems) should be provided as far as practicable; d) Joint provision of Civil-Military navigation aids & aerodromes; e) Common training should be conducted between civil & military ATM units in areas of common interest, and f) Civil & Military ATM units should utilise common procedures as far as practicable.	
PASL (*Preferred ANS Service Levels*)	**Ballistic Launches/Space Re-Entry Management**– All States with organisations that conduct ballistic launch or space re-entry activities should ensure: a) The development of written coordination agreements between the State civil aviation authority & the launch/re-entry agency concerned; b) That strategic coordination is conducted between the State civil aviation authority & any States affected by the launch/re-entry activity at least 14 days prior to the proposed activity, providing notice of at least; i. Three days for the defined launch window, ii. 24 hours for the actual planned launch timing. c) That consideration of affected airspace users & ANSPs is made after consultation, so that the size of the airspace affected is minimised & the launch window is optimised for the least possible disruption to other users; and d) That communication is established with affected ANSPs to provide accurate & timely information on the launch/re-entry activity to manage tactical responses (for example, emergencies& activity completion);	Phase II Priority 1
CNS Technology & Services		
PASL (*Preferred ANS Service Levels*)	**ATS Surveillance Data Sharing** – Subject to appropriate filtering, ATS surveillance data, particularly from ADS-B, should be shared with neighbouring ATC units to support ASUR-B0/1-2 P1.	Phase II Priority 2
	Civil-Military Integrated Systems & Facilities Civil-Military ATM expectations are as follows: a) A national Civil-Military body should be formed to coordinate strategic civil-military activities (military training should be conducted in locations and/or at times that do not adversely affect civilian operations, particularly those associated with major aerodromes); b) Formal civil-military liaison should take place for tactical responses by encouraging military participation at civil ATM meetings & within ATC Centers; c) Integration of civil & military ATM systems using joint procurement, & sharing of ATS surveillance data	Phase II Priority 2

	(especially from ADS-B systems) should be provided as far as practicable; d) Joint provision of Civil-Military navigation aids & aerodromes; e) Common training should be conducted between civil & military ATM units in areas of common interest, and f) Civil & Military ATM units should utilise common procedures as far as practicable.	
PASL (*Preferred ANS Service Levels*)	**Departure Clearance (DCL)** – All ATM systems serving international aerodromes should implement Data-Link Departure Clearance (DCL) compliant with EUROCAE WG78/RTCA SC 214 standards.	Phase III Priority 2

Note: All Category R and S upper controlled airspace should require the carriage of an operable S mode transponder within airspace where Mode S radar services are provided to support ASURB0/3.

ADS-B (using 1090ES), MLAT or radar surveillance systems should be used to provide coverage of all Category S airspace as far as practicable, and Category T airspace supporting international aerodromes, consistent with ASUR-B0/1 – 2. Data from ATS surveillance systems should be integrated into operational ATC aircraft situation displays (standalone displays of ATS surveillance data should not be used operationally)

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