PBN Implementation Plan – Sri Lanka

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DEFINITIONS & ABBREVIATIONS

Aircraft-Based Augmentation System (ABAS) An augmentation system that augments and/or integrates the information obtained from the other GNSS elements with information available on board the aircraft.

Note. - The most common form of ABAS is receiver autonomous integrity monitoring (RAIM).

Approach procedure with vertical guidance (APV): An instrument procedure which utilizes lateral and vertical guidance but does not meet the requirements established for precision approach and landing operations.

ATS surveillance service: Term used to indicate a service provided directly by means of an ATS surveillance system.

ATS surveillance system: A generic term meaning variously, ADS-B, PSR, SSR or any comparable ground based system that enables the identification of aircraft.

Note - A comparable ground-based system is one that has been demonstrated, by comparative assessment or other methodology, to have a level of safety and performance equal to or better than mono-pulse SSR.

Area navigation (RNAV): A method of navigation which permits aircraft operation on any desired flight path within the coverage of station-referenced navigation aids or within the limits of the capability of self-contained navigation aids, or a combination of these.

Note - Area navigation includes Performance Based Navigation as well as other RNAV operations that do not meet the definition of Performance Based Navigation.

Mixed Navigation Environment: An environment where different navigation specifications may be applied within the same airspace (e.g. RNP 10 routes and RNP 4 routes in the same airspace) or where operations using conventional navigation are allowed together with RNAV or RNP applications.

Navigation Aid (Navaid) Infrastructure: Navaid Infrastructure refers to space-based and or ground based navigation aids available to meet the requirements in the navigation specification.

Navigation Function: The detailed capability of the navigation system (such as the execution of leg transitions, parallel offset capabilities, holding patterns, navigation data bases) required to meet the Airspace Concept.

Note: Navigational functional requirements are one of the drivers for selection of a particular Navigation Specification. Navigation functionalities (functional requirements) for each Navigation Specification can be found in PBN Manual Volume II, Parts B and C.

Navigation Specification: A set of aircraft and air crew requirements needed to support Performance based navigation operations within a defined airspace. There are two kinds of navigation specifications, RNAV and RNP. A RNAV specification does not include requirements for on-board performance monitoring and alerting. A RNP specification includes requirements for on-board performance monitoring and alerting.

Navigation Application: The application of a navigation specification and the supporting Navaid infrastructure, to routes, procedures, and/or defined airspace volume, in accordance with the intended Airspace Concept.

Note: The navigation application is one element, along with, communication, surveillance and ATM procedures meeting the strategic objectives in a defined Airspace Concept.

Performance Based Navigation: Performance Based Navigation specifies system performance requirements for aircraft operating along an ATS route, on an instrument approach procedure or in a designated airspace. Performance requirements are defined in terms of accuracy, integrity, continuity, availability and functionality needed for the proposed operation in the context of a particular Airspace Concept.

Procedural control: Air traffic control service provided by using information derived from sources other than an ATS surveillance system

Receiver Autonomous Integrity Monitoring (RAIM): A form of ABAS whereby a GNSS receiver processor determines the integrity of the GNSS navigation signals using only GPS signals or GPS signals augmented with altitude (baro aiding). This determination is achieved by a consistency check among redundant pseudo-orange measurements. At least one additional satellite needs to be available with the correct geometry over and above that needed for the position estimation for the receiver to perform the RAIM function.

RNAV Operations: Aircraft operations using area navigation for RNAV applications. RNAV operations include the use of area navigation for operations which are not developed in accordance with the PBN Manual.

RNAV System: A navigation system which permits aircraft operation on any desired flight path within the coverage of station-referenced navigation aids or within the limits of the capability of self-contained aids, or a combination of these. A RNAV system may be included as part of a Flight Management System (FMS).

RNP Route: An ATS Route established for the use of aircraft adhering to a prescribed RNP Specification

RNP System: An area navigation system which supports on-board performance monitoring and alerting.

RNP Operations: Aircraft operations using a RNP System for RNP applications.

Satellite based augmentation system (SBAS): A wide coverage augmentation system in which the user receives augmentation from a satellite-based transmitter.

Standard instrument arrival (STAR): A designated instrument flight rule (IFR) arrival route linking a significant point, normally on an ATS route, with a point from which a published instrument approach procedure can be commenced.

Standard instrument departure (SID): A designated instrument flight rule (IFR) departure route linking the aerodrome or a specified runway of the aerodrome with a specified significant point, normally on a designated ATS route, at which the en-route phase of a flight commences.

ABBREVIATIONS

The following is a list of abbreviations used in this document;

4DT	Four Dimensional Trajectories
ADS-B	Automatic Dependent Surveillance - Broadcast
ADS-C	Automatic Dependent Surveillance - Contract
ANSP	Air Navigation Service Provider
APCH	Approach
APV	Approach Procedures with Vertical Guidance
ATC	Air Traffic Control
ATM	Air Traffic Management
ATS	Air Traffic Service
AWS	Automated Weather Station
Baro-VNAV	Barometric Vertical Navigation
CAASL	Civil Aviation Authority of Sri Lanka
CDO	Continuous Descent Operations
CFIT	Controlled Flight into Terrain
CNS/ATM	Communication Navigation Surveillance/Air Traffic Management
CPDLC	Controller Pilot Data Link Communications
CTA	Controlled Airspace
DME	Distance Measuring Equipment
FANS	Future Air Navigation System
FMS	Flight Management System
GNSS	Global Navigation Satellite System
ICAO	International Civil Aviation Organization
IFR	Instrument Flight Rules
ILS	Instrument Landing System
INS	Inertial Navigation System
NDB	Non Directional Beacon
OCA	Oceanic Control Area
PBN	Performance Based Navigation
RAIM	Receiver Autonomous Integrity Monitoring

1 Introduction

This PBN Implementation Plan of Sri Lanka meets the intent of ICAO Assembly Resolution A36-23 and addresses the particular needs of the Sri Lankan aviation environment. It has been produced in accordance with the guidelines of the Asia/Pacific Regional PBN Implementation Plan. The plan outlines how the ICAO PBN concept will be implemented in Sri Lanka to deliver improvements to aviation safety, airspace access, capacity, predictability, operational efficiency and to minimize adverse environmental impact from aviation activities. This plan is not binding and will be subject to changes as PBN development and user requirements evolve.

The strategic objectives of the Sri Lanka's PBN Implementation Plan are to:

1) Provide a high-level strategy for the evolution of navigation applications to be implemented within Sri Lankan airspace/Colombo Flight Information Region (FIR) in the short term (up to 2012), medium term (2013 - 2016) and long term (beyond 2016) in accordance with the implementation goals of Assembly resolution A36-23;

2) Implement a strategy based on the concepts of PBN (includes RNAV and RNP specifications), that will be applied to IFR aircraft operations using instrument approaches, and ATS routes (including SIDs and STARs) in both oceanic and domestic airspace;

3) Ensure that the implementation of the navigation portion of the CNS/ATM system is based on clearly established operational requirements;

4) Ensure that navigation, surveillance, communications and ATM infrastructure is capable of supporting the operational airspace concept and the associated operational applications;

5) Establish equipment requirements that minimize the number of equipment types required on board aircraft and on the ground;

6) Establish common airworthiness and operational approvals for flight operations utilizing PBN;

7) Provide a means of accommodating mixed-equipage operations; and;

8) Recommend strategies to facilitate delivery of benefits and encourage equipage.

This PBN Implementation Plan of Sri Lanka is intended to assist the main stakeholders of the aviation community in Sri Lanka to plan a gradual transition to the RNAV and RNP concepts.

Furthermore, Sri Lanka's PBN Implementation plan provides a strategy for the evolution of the navigation applications to be implemented in Sri Lanka in the short term (2008-2012) and medium term (2013-2016), which is based on the concepts of Area Navigation (RNAV) and Required Navigation Performance (RNP) in accordance with ICAO Doc. 9613: *Performance Based Navigation Manual*, and will be applied to aircraft operations involving instrument approaches, standard departure (SID) routes, standard arrival (STAR) routes, and ATS routes in oceanic and continental areas.

Every effort is being taken by Sri Lanka to be within ICAO APAC Region's Implementation targets for various categories of airspace for the Short Term (2008 – 2012) and for the Medium Term (2013 – 2016) which have been projected in tabular forms in the Regional Plan to facilitate easy reference, and for the long term (2016 and beyond) where it has been envisaged that GNSS will be the primary navigation infrastructure while noticing that it is also expected that precision approach capability using GNSS and its augmentation system will become available in the long term.

1.1 Background

Ground based navigation aids have been the basis of IFR navigation for aircraft since the Second World War. Sri Lanka has relied upon ground based navigation aids (NDB, VOR/DME and ILS),which aircraft use to navigate along fixed routes (route navigation) and to conduct instrument approach procedures to land at Bandaranaike International Airport, Colombo, Colombo Airport, Ratmalana (RMA) (Civil Domestic) and mostly visual approaches at other domestic military aerodromes manned by SLAF.

Ground based navigation systems limit the safety and efficiency of aircraft operations because of their inherent characteristics e.g. with the exception of ILS, they do not support approaches with vertical guidance. Ground navaids are constrained by the location, accuracy, terrain and other performance limitations associated with the aid. To overcome the constraints of route navigation on the modern fleets of aircraft, new navigation specifications have been developed to provide performance specifications firstly through RNAV specifications and more recently by Required Navigation Performance (RNP). These are based on new navigation technologies including Global Navigation Satellite System (GNSS) and onboard aircraft systems. Area navigation allows an aircraft to fly any pre-defined path with high accuracy. The flight path is usually defined as a straight line between two points in space but some systems also have the capability to accurately fly curved paths. Area navigation systems generally have linear lateral performance requirements and they are recognized as necessary enablers to optimize aircraft operations, increase terminal area safety and provide flexibility in placement of aircraft flight path to minimize aircraft noise intrusion on the community. The key difference between the RNAV and RNP specifications is the **onboard monitoring and alerting** function that is associated with RNP.

The PBN concept represents a major shift from sensor-based to performance-based navigation.

The significant improvements in navigational performance provided by RNP and four dimensional trajectory (4DT - includes time dimension) will also be utilized by modern ATM systems to improve the sequencing of IFR Flights. Any sequencing delays that are needed in the future will be managed in a more strategic manner so that excess fuel burn can be minimized. This will deliver reduced operating costs to aircraft operators and improved environmental outcomes to both the local and global community.

2 Performance Based Navigation (PBN)

Performance based navigation (PBN) is a concept that encompasses both area navigation (RNAV) and required navigation performance (RNP). Performance based navigation is increasingly seen as the most practical solution for regulating the expanding domain of navigation systems.

Under the traditional approach, each new technology is associated with a range of system-specific requirements for obstacle clearance, aircraft separation, operational aspects (e.g. arrival and approach procedures), aircrew operational training and training of air traffic controllers. However, this system-specific approach imposes an unnecessary effort and expense on States, airlines and air navigation services (ANS) providers.

Performance based navigation eliminates the need for redundant investment in developing criteria and in operational modifications and training. Rather than build an operation around a particular system, under performance based navigation the operation is defined according to the operational goals, and the available systems are then evaluated to determine whether they are supportive.

The advantage of this approach is that it provides clear, standardized operational approvals which enable harmonized and predictable flight paths which result in more efficient use of existing aircraft capabilities, as well as improved safety, greater airspace capacity, better fuel efficiency, and resolution of environmental issues.

The PBN concept specifies aircraft RNAV system performance requirements in terms of accuracy, integrity, availability, continuity and functionality needed for the proposed operations in the context of a particular Airspace Concept. The PBN concept represents a shift from sensor-based to performance-based navigation. Performance requirements are identified in navigation specifications, which also identify the choice of navigation sensors and equipment that may be used to meet the performance requirements. These navigation specifications are defined at a sufficient level of detail to facilitate global harmonization by providing specific implementation guidance for States and operators.

Under PBN, generic navigation requirements are defined based on the operational requirements. Operators are then able to evaluate options in respect of available technologies and navigation services that could allow these requirements to be met. The chosen solution would be the most cost effective for the operator, rather than a solution being imposed as part of the operational requirements. Technologies can evolve over time without requiring the operation itself to be revisited, as long as the requisite performance is provided by the RNAV system. As part of the future work of the ICAO, it is anticipated that other means for meeting the requirements of the Navigation Specifications will be evaluated and may be included in the applicable Navigation Specifications, as appropriate.

ICAO's Performance Based Navigation (PBN) concept aims to ensure global standardization of RNAV and RNP specifications and to limit the proliferation of navigation specifications in use worldwide. It is a new concept based on the use of Area Navigation (RNAV) systems. Significantly, it is a move from a limited statement of required performance accuracy to more extensive statements for required performance in terms of accuracy, integrity, continuity and availability, together with descriptions of how this performance is to be

achieved in terms of aircraft and flight crew requirements.

2.1 Benefits of PBN and Global Harmonization

PBN offers a number of advantages over the sensor-specific method of developing airspace and obstacle clearance criteria. These include;

• Reduces need to maintain sensor-specific routes and procedures, and their associated costs. For example, moving a single VOR ground facility can impact dozens of procedures, as that VOR can be used on routes, VOR approaches, as part of missed approaches, etc. Adding new sensor specific procedures will compound this cost, and the rapid growth in available navigation systems would soon make system-specific routes and procedures unaffordable.

• Avoids need for development of sensor-specific operations with each new evolution of navigation systems, which would be cost-prohibitive.

• Allows more efficient use of airspace (route placement, fuel efficiency, noise abatement).

• Clarifies the way in which RNAV systems are used.

• Facilitates the operational approval process for operators by providing a limited set of navigation specifications intended for global use.

RNAV and RNP specifications facilitate more efficient design of airspace and procedures, which collectively result in improved safety, access, capacity, predictability, operational efficiency and environmental effects. Specifically, RNAV and RNP may:

• Increase safety by using three-dimensional (3D) approach operations with course guidance to the runway, which reduce the risk of controlled flight into terrain.

• Improve airport and airspace access in all weather conditions, and the ability to meet environmental and obstacle clearance constraints.

• Enhance reliability and reduce delays by defining more precise terminal area procedures that feature parallel routes and environmentally optimized airspace corridors. Flight management systems (FMS) will then be poised to save operators time and money by managing climb, descent, and engine performance profiles more efficiently.

• Improve efficiency and flexibility by increasing use of operator-preferred trajectories airspace- wide, at all altitudes. This will be particularly useful in maintaining schedule integrity when convective weather arises.

• Reduce workload and improve productivity of air traffic controllers.

Performance-based navigation will enable the needed operational improvements by leveraging current and evolving aircraft capabilities in the near term that can be expanded to address the future needs of aviation stakeholders and service providers.

2.2 Area Navigation (RNAV)

2.2.1 Capabilities

RNAV is the less capable of the two kinds of PBN navigation specifications, RNAV and RNP. RNAV specifications do not require on board navigation performance monitoring and alerting. RNAV tracks (e.g.: RNAV 5, RNAV 2, RNAV 1) will normally require monitoring by ATC surveillance systems to achieve desired performance and separation safety standards. Within Colombo FIR In oceanic airspace this surveillance is provided by ADS-C and in domestic airspace by Area Radar and Approach Radar Systems. When ADS-B is installed and operational surveillance will also be provided by ADS-B also.

2.2.2 The RNAV Specifications intended to use in SL Airspace

a) RNAV 10: intended to use in Oceanic airspace (referred to as RNP 10)
b) RNAV 5: Intended to use for short distance continental routes
c) RNAV 2: (no plan to use this specification in SL airspace)
d) RNAV 1: intended to use in Terminal airspace for SIDS and STARS

2.3 Required Navigation Performance (RNP)

2.3.1 Capabilities

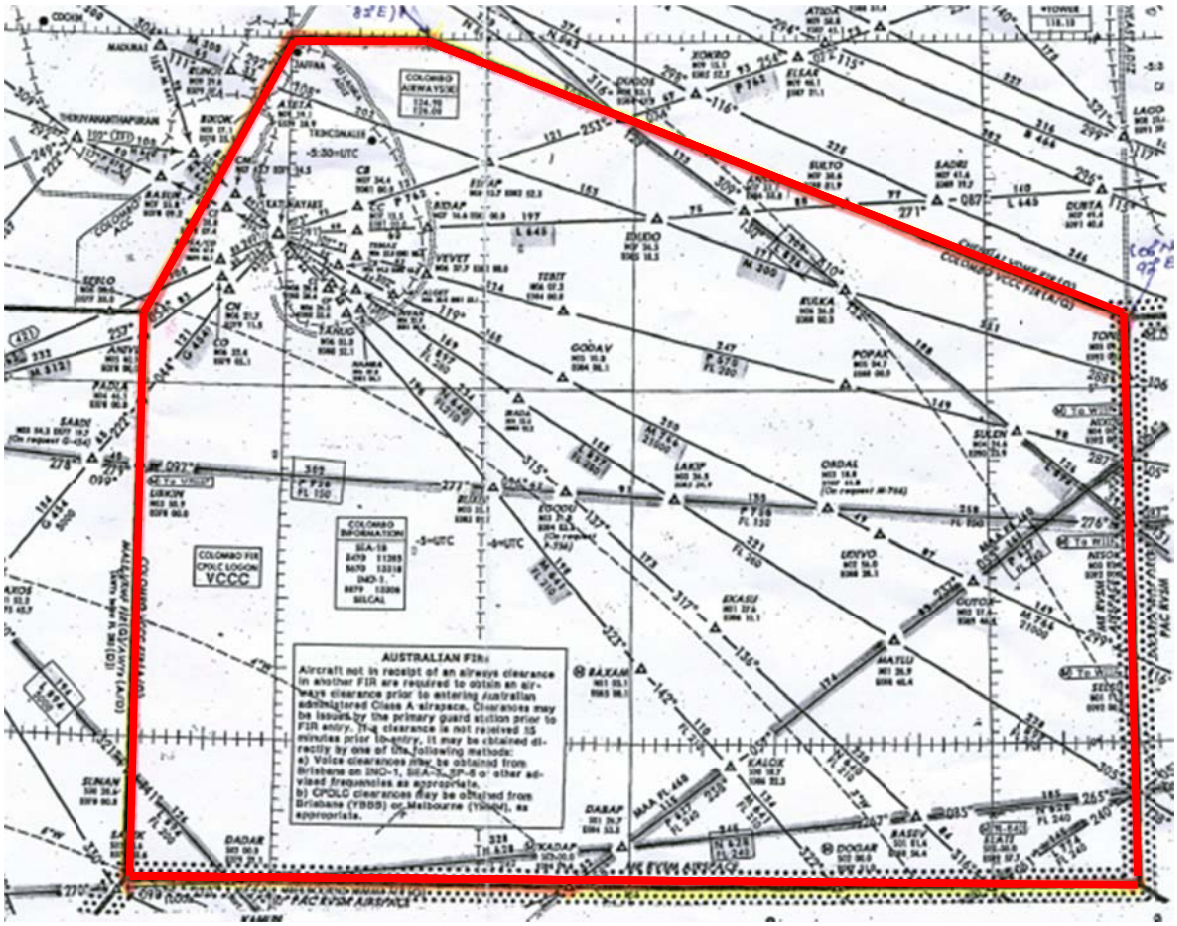
RNP is the more capable of the two families of PBN navigation specifications RNAV and RNP. RNP specifications requires on board navigation performance monitoring and alerting. This assured aircraft performance allows lower separation standards to be applied and therefore ATC surveillance is not required. The on board navigation performance monitoring and alerting is a necessary enabler for many new ATM applications. Some of the RNP navigation specifications enable the application of more sophisticated functions available in RNP capable aircraft to further improve safety, reduce environmental impact and increase operating efficiency (e.g.: RNP AR APCH).

2.3.2 The RNP Specifications intended to use in SL Airspace:

a) RNP 4: intended to use in oceanic operations (30/30 separation)
b) RNP 2: (no plan to use this specification in SL airspace)
c) RNP 1: (no plan to use this specification in SL airspace)
d) RNP APCH: intended to useApproach Procedures with APV where required and feasible
e) RNP AR APCH: (no plan to use this specification in SL airspace at present)

3 Sri Lanka Airspace, Airports and CNS Infrastructure

3.1 Colombo Flight Information Region



The extent of the Colombo FIR is approximately 62500 Square Miles. Approximately 85% of the airspace in the FIR is oceanic airspace. Airspace above FL280 is classified as “Class A” Airspace. Boundaries of Colombo FIR are as follows;

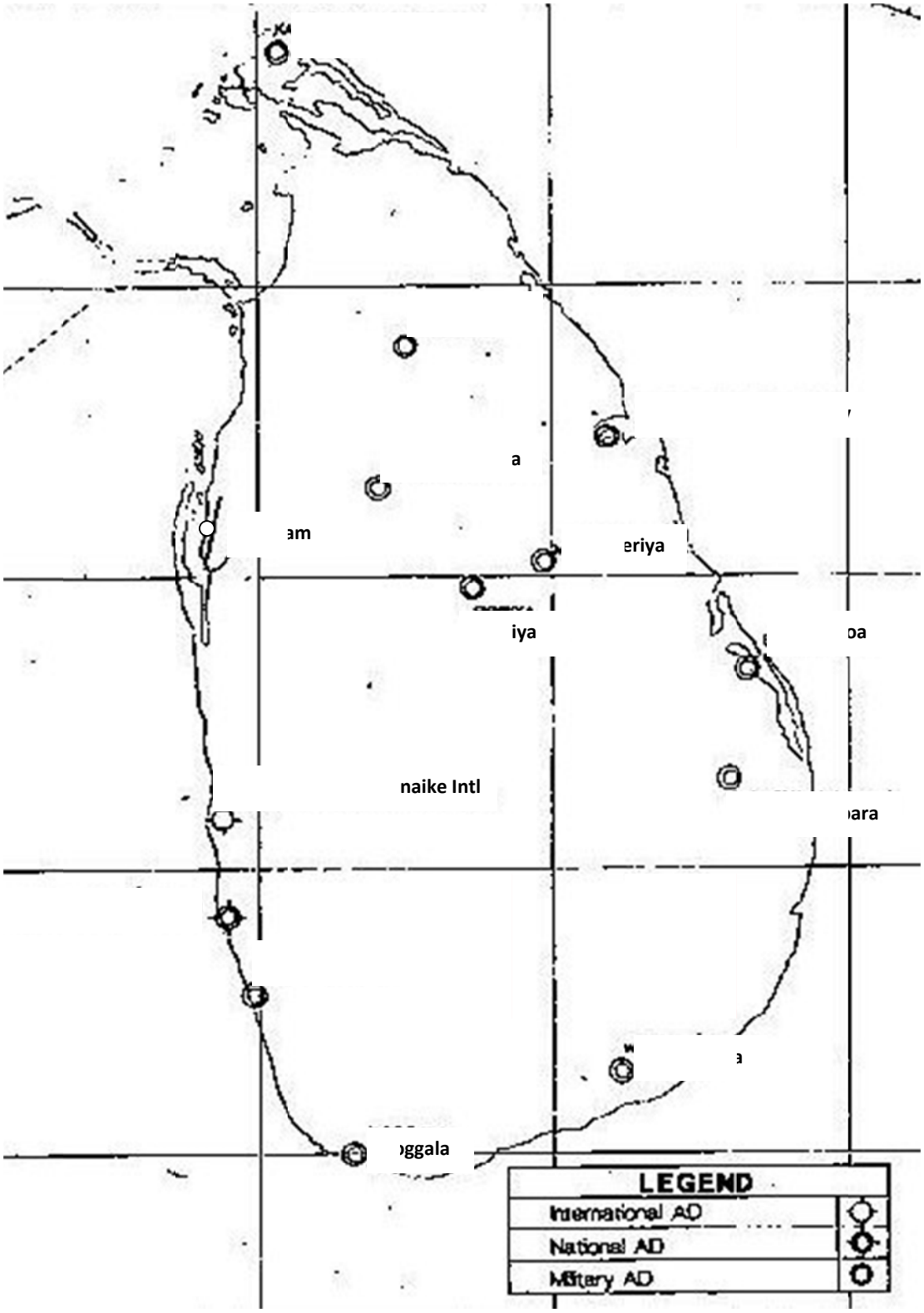
East by Jakarta FIR, South by Melbourne FIR, West Male FIR and North & North West by Chennai FIR

At present Sri Lanka has only one international Airport (Bandaranaike International Airport, Colombo, Katunayaka). The second International Airport is being constructed at present in the southern part of Sri Lanka and will be operational by end of 2012.

There are thirteen domestic airports in various parts of Sri Lanka, out of which only one airport is operated by a civil operator, Airport & Aviation Services (SL) Ltd. All other airports are military airports and operated by Sri Lanka Air Force. However the Government of Sri Lanka has planned to develop some of those Military Domestic Airports as Civil Domestic Airports.

The Diagram below shows the distribution of Airports within the island;

3.2 Airports in Sri Lanka



3.3 CNS Infrastructure within Colombo FIR

3.3.1 Navigational Aids

Navigational aids available within Sri Lanka;

1. ILS for Runway 22 and 04 at Bandaranaike International Airport (BIA)
2. Co-located VOR and DME at BIA
3. NDB at Civil Domestic Airport Ratmalana

3.3.2 Surveillance Aids

Surveillance Aids available for the provision of ATS;

1. Approach Radar Service - SSR for 60 NM from KAT
2. Area Radar Service – SSR which covers 250NM range from KAT VOR to the East
3. ADS – C, 24H Service within FIR
4. ADS – B, Expected to install in 2012

3.3.3 Communication Aids

Communication facilities used for ATS;

1. VHF – Extended Range 250NM from KAT
2. HF
3. CPDLC

3.4 Aircraft Fleet Equipage

Percentage of aircraft, registered in Sri Lanka equipped with GNSS avionics;

a) Domestic: C129 or equivalent 60%, C145/146 or equivalent 30%

b) International: C129 or equivalent 100%, C145/146 or equivalent 100%

A brief study conducted on the Equipage of Aircraft Fleets of the National Career Sri Lanka Airlines and “Mihin Lanka” Airlines and other major airlines operating scheduled and/or frequent non-scheduled flights into and/or across Sri Lankan airspace has shown favorable results that almost all aircraft are adequately RNAV/RNP Equipped meeting the minimum or even above minimum that is required for the intended PBN Applications. The discussions so far held with the Domestic Airline Operators and General Aviation has also indicated positive signs towards PBN transition as planned.

4 Challenges

4.1 Challenges during Pre-PBN Period;

The following challenges related to RNAV/RNP Operations are encountered by the aviation authorities of Sri Lanka.

4.1.1 Increasing Demands

With numerous airlines with modern aircraft fleet having a high RNAV/RNP capability commencing operations into and across Sri Lankan skies, a significant increase is witnessed in the demand of more flexible, user preferred, cost-effective airspace management in the following areas;

4.1.1.1 Oceanic - En-Route

Huge demand for Flex-tracks/User Preferred Routes (UPRs) with Reduced Horizontal Separation Minima (Lateral & Longitudinal) in addition to Reduced Vertical Separation Minima (RVSM) as against the Conventional ATS Routes which incur longer track miles/larger separation margins, restrict/denies optimum cruising levels, etc;

4.1.1.2 Terminal Areas (Departures & Arrivals)

Under Conventional SIDs and STARs and tactical Radar Vectoring by ATC aircraft are often subjected to 'level-off's on climbing/descending phase, holding over Navaids for sequencing, speed control etc; affecting the economical operations, Controllers workload and also with adverse impact on the environment through excessive emission of CO_2.

4.1.1.3 Approach

During IMC, approaches to land solely dependent on the operational status of VOR and ILS with higher probability of missed approaches and diversions even for RNAV/RNP capable aircraft due to non-availability of established/published RNP Approach Procedures.

4.1.2 Efficient Operations

Under this PBN Implementation Plan it is envisaged to ensure efficient aircraft operations across Sri Lanka airspace/Colombo FIR and at Aerodromes in Sri Lanka in the following manner;

4.1.2.1 Oceanic (En-route)

a) Introduction of RNP10 routes with applicable Lateral Separation Minima of 50 nm, introduction of 50/80nm , 50/50nm separation minima on En-route Oceanic airspace

b) Introduction of RNP4 routes with applicable Horizontal Separation Minima of 30/30 NM separation minima on En-route Oceanic airspace

4.1.2.2 Terminal Areas

By introducing Continuous Descend Operations (CDO) STARS and Continuous Climb Operations (CCO) SIDS under PBN Concept based on GNSS and reducing;

a) 'level-off's on climbing/descending phase, holding over Navaids for sequencing, speed control etc; affecting the economical operations
b) Controllers workload
c) adverse impact on the environment through excessive emission of CO_2

4.1.2.3 Approach

By introducing PBN APCH Approach procedures with AVP;

a) Reduce need to maintain sensor-specific approach procedures, and their associated costs.
b) Avoid need for development of sensor-specific approach procedures with each new evolution of navigation systems.
c) Increase safety by using approach operations with course guidance to the runway, which reduce the risk of controlled flight into terrain.
d) Improve airport access in all weather conditions, and the ability to meet environmental and obstacle clearance constraints.

4.2 Challenges During Implementation Period

4.2.1 Safety – Risks Associated with Major System Change

During the transition to a mature PBN environment the regulator and industry will face significant challenges. The regulator's challenges will include support of Civil Aviation Rule changes and associated preparatory work. The industry challenges will involve resourcing and managing a diverse range of navigation systems with equally diverse requirements. Some of the key identified challenges are:

- Adoption of supporting Civil Aviation Rules
- PBN capability register and aircraft minimum equipment lists (MEL)
- Integration of PBN capability into the ATM system (Flight Plan data fields)
- Mixed fleet/system operations
- Safety monitoring of ATM system
- Approach naming and charting conventions
- Navigation database integrity and control
- GNSS system performance and prediction of availability service
- Continued involvement in CNS/ATM and PBN development
- Resources of the CAASL, AASL and aircraft operators to implement PBN
- Education and training of personnel employed by the CAASL, AASL and aircraft operators

4.2.2 Infrastructure Development

Design and implementation of PBN routes and approach procedures is in progress. Procedure Designers have a significant workload in turning the design work into finished documents for publication by the CAASL.

The following issues need to be addressed by CAASL , AASL and the aviation industry:

a) Terrestrial navaids;
- Maintenance and upgrade where necessary of existing terrestrial navigation aid infrastructure
- Transition to GNSS based system
- Decommissioning of existing aids when so prescribed by ICAO

b) GNSS/RAIM prediction requirements including :
- Overall GNSS status monitoring, reporting and recording
- Prediction of availability for a particular operation and aircraft

c) Automatic Weather Station (AWS) for APV Baro-VNAV
- Implementation will require coordination with Department of Meteorology
- Responsibilities for funding of these initiatives will need to be determined

d) Approach design

e) Runway infrastructure
- Aerodrome obstacle survey

f) Use of GNSS
- A formal Safety Case will need to be developed to determine whether the performance of GNSS within Sri Lankan airspace is adequate to support the planned PBN implementation.

5 PBN Implementation in Sri Lanka

5.1 Short Term Plan - (2008 – 2012)

5.1.1 Oceanic Airspace

- IntroduceRNAV10 Routes in oceanic airspace
- Upgrade short distance continental routes to RNAV 5

5.1.2 TMA Arrival/Departure

- Introduction of RNAV-1 SIDS and STARS for BIA for Runway 22 in existing radar environment
- Introduction of RNAV-1 SIDS and STARS for BIA for Runway 04 in existing radar environment

5.1.3 Approaches

- Introduction of RNP APCH (APV) Procedures for runway 22 at BIA
- Introduction of RNP APCH (APV) Procedures for runway 04 at BIA
- Introduction RNP APCH (APV) Procedures for runway 22 at RMA
- Introduction RNP APCH (APV) Procedures for runway 04 at RMA

PBN approaches with vertical guidance will be based on Baro-VNAV specifications.

5.2 Medium and Long Term Plan (2013 – 2016 & beyond)

5.2.1 Oceanic Airspace

- Upgrade Airspace above FL225 to RNAV10 within entire FIR
- Introduce RNP4 routes in oceanic airspace under ADS-C/CPDLC environment

5.2.2 TMA Arrival/Departure

- RNAV-1 SIDS and STARS for Hambantota International Airport (Second International Airport)

5.2.3 Approaches

- Introduction of RNP APCH (APV)Procedures for runway 23 at HIA
- Introduction of RNP APCH (APV)Procedures for runway 05 at HIA
- Introduction of RNP APCH (APV) Procedures for Domestic Aerodromes

PBN approaches with vertical guidance will be based on Baro-VNAV specifications.

5.3 Long Term Plan (Beyond 2016)

Introduction of GNSS based precession approaches for Bandaranaike International Airport, Hambantota International Airport and Ratmalana airport with Space Based Augmentation System (SBAS).

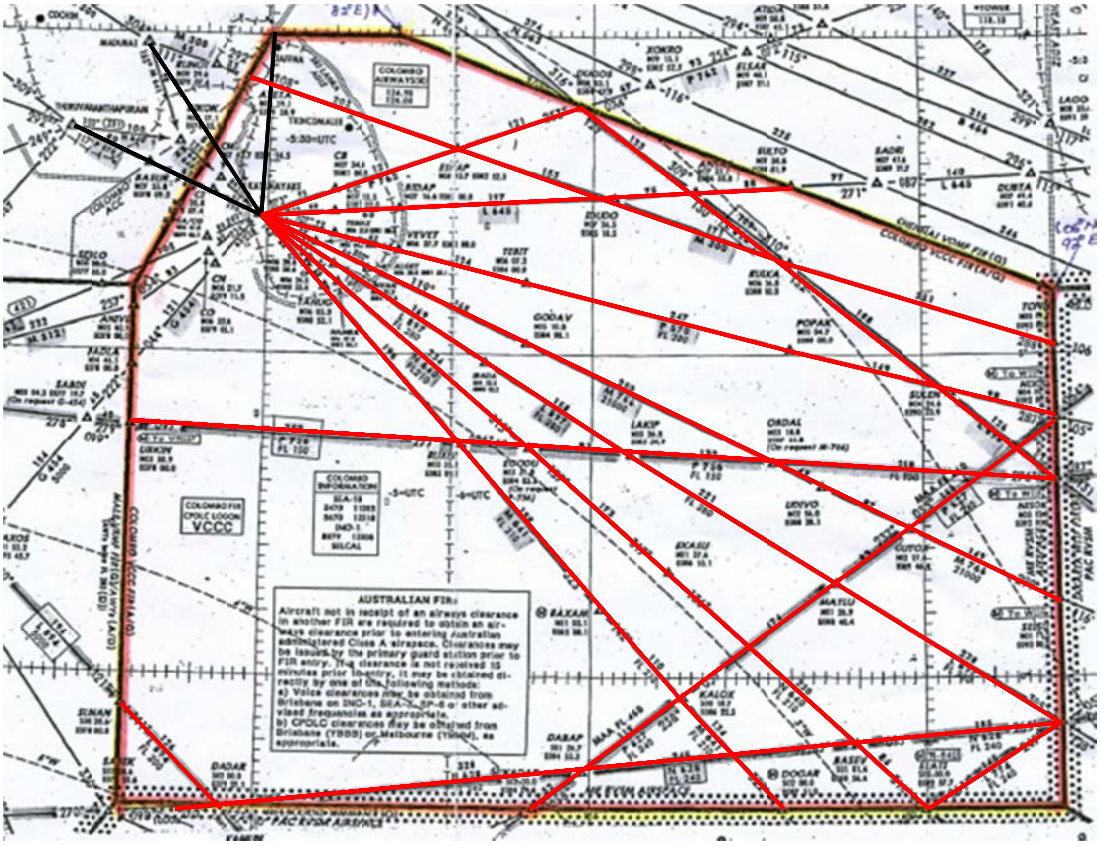
5.4 Current Status of Implementation

5.4.1 Oceanic Airspace

At present following Routes have been established as RNAV 10 routes in Colombo FIR;

P762, L645, P570, M766, L897, N640, M641, M300, L896, P576, P627, N628, L774, L894

The routes above have been marked in the diagram below in red color;



At present five conventional ATS Routes are available in the Colombo FIR which have not been upgraded to RNP or RNAV specifications. Those routes are A465, R461, G325, G465, M512, G454 which have been marked in the above diagram in black color. Out of above five routes A465, G325 and G465 can be considered as short distance continental routes and will be upgraded to RNAV 5 under short term plan before 2013.

5.4.2 TMA Arrival/Departure

- RNAV-1(GNSS-based) STARs for BIA Runway 22 designed and Charts drawn
- RNAV-1(GNSS-based) SIDs for BIA Runway 04 designed and Charts drawn
- Simulator Tested
- Sri Lankan Airlines is conducting trials at present

5.4.3 Approaches

Approach Procedures (RNP – APCH with APV) for Runway 22 and 04 ends at Bandaranaike International Airport, Colombo are being designed.

5.5 Sri Lanka's Implementation Strategy

The implementation of Performance Based Navigation (PBN) in Sri Lanka's controlled airspace will be delivered in three major phases with implementation targets of 2012, 2016 and beyond. Each phase will enable progressively greater dependence on PBN (concepts and enablers) and ensure that the corresponding improvements to safety, efficiency and environmental impact are delivered to industry stakeholders.

5.5.1 Operational Concept for Phase One and Two

During Phase One and Two the operational concept will be a **mixed-mode navigation environment** that allows continued use of conventional navigation applications while PBN application is progressively implemented in line with the equipage of aircraft fleets and the supporting infrastructure.

5.5.2 Operational Concept for Phase Three

During Phase Three the operational concept will move to a more exclusive PBN environment and will be dependent more on PBN (concept and enablers).

6 Stakeholders

Coordination is critical with the aviation community through collaborative forums. This will assist aviation stakeholders in understanding operational goals, determining requirements, and considering future investment strategies. This, in turn, enables the aviation stakeholders to focus on addressing future efficiency and capacity needs while maintaining or improving the safety of flight operations by leveraging advances in navigation capabilities on the flight deck. RNAV and RNP have reached a sufficient level of maturity and definition to be included in key plans and strategies, such as this PBN Implementation Plan - Sri Lanka.

The stakeholders who will benefit from the concepts in this "PBN Implementation Plan" include airspace operators, air traffic service providers, regulators, and standards organizations. As driven by business needs, airlines and operators can use the State PBN roadmap to plan future equipage and capability investments. Similarly, air traffic service providers can determine requirements for future automation systems, and more smoothly modernize ground infrastructure. Finally, the regulator can anticipate and develop the key enabling criteria needed for implementation.

This plan is a work in progress and will be amended through collaborative Asia Pacific Region States, industry efforts and consultations that establish a joint aviation community/government/industry strategy for implementing performance-based navigation.

The Sri Lankan PBN Implementation Plan has been developed in consultation with the stakeholders of the aviation community and provides for a staged transition to RNAV and RNP based procedures.

The following stakeholders have been consulted during the development of the National PBN Implementation Plan:

(a) Airline operators and users including Sri Lankan Airlines, Mihin Lanka Airlines and Domestic Operators

(b) Airport & Aviation Services (Sri Lanka) Limited (AASL –the Air Navigation Services Provider)

(c) CAASL and Regulating Authorities from adjacent ICAO States

The PBN Implementation Plan will enable stakeholders of the aviation community to plan for regulatory changes, industry training, operational transitions and the associated investment strategies.

The following principles were applied in the development of the PBN Implementation Plan:

(a) Continued availability of essential conventional air navigation procedures during the transition period, to ensure appropriate technology and procedures design support for users that are not RNAV and/or RNP compliant;

(b) Development of airspace concepts and use of airspace modeling tools that enable real-time and accelerated simulations that identify the navigation applications that best support PBN implementation in specific airspace;

(c) Conduct of cost-benefit analyses to justify the implementation of the RNAV and/or RNP concepts;

(e) Harmonization with the ICAO Asia/Pacific Regional PBN Implementation Plan.

END