International Civil Aviation Organization

The Twenty-First Meeting of the APANPIRG ATM/AIS/SAR Sub-Group (ATM/AIS/SAR/SG/21)

Bangkok, Thailand, 27 June – 01 July 2011

Agenda Item 3: Regional Performance Framework and Metrics

PBN IMPLEMENTATION IN INDIA

(Presented by India)

SUMMARY

This paper presents the current status of implementation in India. The paper highlights the operational flexibility and benefits achieved through PBN implementation.

This paper relates to–
A: Safety–Enhanced global civil aviation safety
C: Environmental Protection and Sustainable Development of Air Transport–Promote harmonized and economically viable development of civil aviation that does not unduly harm the environment

Global Plan Initiatives:
GPI-5 RNAV and RNP (Performance-based navigation)
GPI-7 Dynamic and flexible ATS route management
GPI-10 Terminal area design and management
GPI-11 RNP and RNAV SIDs and STARs
GPI-21 Navigation systems

1. Introduction

1.1. Sustained trend of rising aviation fuel cost, stringent regulation for environment protection, need for optimization of operations amidst steady growth in the number of aircraft, air traffic management and airspace complexity have prompted urgency in the need for implementation of PBN.

1.2. ICAO's adoption of GNSS as primary navigation sensor for air navigation purposes during all phases of flight has paved the way for availability of accurate, reliable and seamless position information globally. Capability of the aircraft to fly pre-defined path accurately, predictably and repeatedly provides assurance and flexibility in the design of 3D segments to efficiently overcome environmental, terrain and/or airspace constraints.

1.3. The 36th Session of ICAO Assembly held in Montreal in September 2007 adopted Resolution A36-23 urging all the States to implement RNAV and RNP air traffic services (ATS) routes and procedures in accordance with the ICAO PBN concept.In 37th session of ICAO Assembly in September 2010, in its Resolution A37-11; the importance of PBN has been reiterated and the States have been requested to implement PBN as a matter of urgency.

1.4. Recognizing the benefits of PBN, India commenced work on development of PBN procedures in 2006-07 with the strategy to achieve quantifiable benefits to stakeholders, terminal capacity enhancement, reduce arrival delay, efficient management of arrival & departure operations within TMA & enhanced all-weather access to runways.

2. PBN implementation status

2.1. PBN RNAV-1 SIDs and STARS at 6 international airports have been implemented. These 6 airports handle major traffic flows and during peak traffic times suffer from capacity constraint, communication congetion, bunching and delays. It has ben possible to overcome these dificulties and streamline traffic flows for efficient airspace management throught the implementation of RNAV-1 ARR/DEP procedures. The reduction in track miles achieved through these procedures have led to significant fuel savings and huge reduction in emissions. The track miles savings and number of procedures developed is given in Table 1 below.

Airport	**# SIDs**	**# STARs**	**Track Miles saved**
Delhi International Airport (2008)	20	10	20.0
Mumbai International Airport (2008)	16	12	14.1
Chennai International Airport (2009)	10	7	34.4
KolkataInternational Airport (2010)	13	10	21.0
AhmedabadInternational Airport (2008)	12	12	New procedure
Hyderabad International Airport (2010)	14	10	19.6

Table 1

2.2. Some of the benefits realized by the airspace users after PBN implementation were:

2.2.1 Structured flow of traffic in the TMA and vertically segregated arrival and departure flow at crossing and merging points have reduced the need for frequent communication between Pilot&ATC. It has been possible to obtain 30% reduction in communication during peak times. The safety benefits of this reduction in communication congestion cannot be overemphasized.

2.2.2 Reduced track-miles and predictable flight profile due to segregated arrival-departure flows have helped in reducing fuel burn and emissions. Predictability of flight profile and flight path has permitted aircraft to be managed for optimum efficiency.

2.3. In continued effort towards implementation of PBN across India, procedure developmentat the following airport is in progress:

Airport	# SIDs	# STARs	RNP APCH
Bangalore International Airport (2011)	√	√	√
Trivandrum International Airport (2011)	√	√	
Cochin International Airport (2011)		√	√
Calicut International Airport (2011)	√	√	√
Guwahati International Airport (2011)	√	√	
Mangalore International Airport (2011-12)	√	√	√
Coimbatore Airport (2011)	√	√	√
Mumbai International Airport (2011)			√

Airport	# SIDs	# STARs	RNP APCH
AhmedabadInternational Airport (2011)			√
Hyderabad International Airport (2011)			√

Table 2

2.4. Design flexibility offered by PBN concept is being fully utilized to plan optimum flight trajectory and profile even in terrain challengedairports where conventional procedures have been restrictive in providing economical flight profile. The requirement to honor sub-sector MSA, circumnavigate noise-sensitive areas and avoid danger areas has been fulfilled effectively and efficiently.

2.5. The ability to develop procedure segments connected by a sequence of waypoints defined by WGS-84 geographical coordinates has facilitated development of conditional arrival/departure routes through Special use airspace. This would promote civil/military cooperation through flexible use of airspace and provide significant reduction in track miles to the airspace users.

2.6. Recognizing RNP-1 navigation specification as an enabler for effective airspace management in non-radar environment, segregated ARR/DEP procedures is being developed to achieve optimization of airspace and airport capacity. Such procedure development is in progress at Calicut International, Cochin International and Coimbatore airports which also have difficult terrain as added challenge.

3. PBN Implementation Roadmap

3.1. For sustained effort in implementing PBN procedures at all airports and airspace in India, PBN Implementation Roadmap in harmony with APAC Regional PBN Implementation Plan has been developed. The roadmap has been approved by Director General of Civil Aviation, India in 2009 and has been reviewed by APAC PBN TF in 2010.

3.2. A brief on the objectives that are planned to be achieved in implementation roadmap

3.2.1. Short Term (2008-2012) –Enroute (ENR) - 12 RNAV-5 routes between major city-pairs.Existing RNP-10 routes redefined as PBN RNAV-10 routes.

- Terminal Area (TMA) - RNAV-1/RNP-1 SIDs and STARs at 12 out of 14 international airports.
- Approach (APP)–LNAV/VNAV procedure - 38 runways end at intl. airport.

3.2.2. Mid-term (2013-2016)

- Enroute (ENR) - 10 RNAV-5 routes will be created between major city-pairs.
- Terminal Area (TMA)- 2 international airports and 7 customs airport will have RNAV-1/RNP-1 SIDs and STARs.
- Approach (APP)–LNAV/VNAV procedure - 40 runway ends.

4. PBN Implementation progress report

4.1Approach Operations

Implementation Targets (# of RWY ends)			Completed (# of RWY ends)		In Progress (# of RWY ends)	
Y2010	Y2014	Y2016	LNAV	LNAV/VNAV	LNAV	LNAV/VNAV
28	42	38	-	-	10	10

4.2 Arrival/Departure Operations

Implementation Targets (# of Intl airport)			Completed (# of Intl airport)		In Progress (# of Intl airport)	
Y2010	Y2014	Y2016	Arrival	Departure	Arrival	Departure
6	15	-	6	6	6	6

4.3 En-route Operations

Navigation Specification	Completed (# of routes)	In progress (# of routes)
RNAV 10	-	34*
RNAV 5	-	8
RNAV 2	-	-
RNP 4	-	-
RNP 2	-	-

*Currently 34 RNP-10 routes established during EMAARSH implementation are in operation. These routes are to be redefined into PBN Navigation Specification.

5 Action by the meeting is invited to note:

a. PBN Implementation plan of India that has been reviewed by APAC PBN TF. India is willing to assist APAC states in PBN implementation.
b. The successful implementation of PBN implementation at international airport - Delhi, Mumbai, Chennai, Kolkata, Hyderabad, Bangalore and Ahmedabad.
c. On-going procedure development at airport - Bangalore, Trivandrum, Guwahati, Calicut, Cochin, and Coimbatore & Mangalore.