



**The First Meeting of ICAO Asia/Pacific Performance based Navigation
Implementation Coordination Group (PBNICG/1)**

Beijing, China, 10-12 March 2015

Agenda Item 3: Global and Regional PBN Updates

PBN IMPLEMENTATION IN SINGAPORE

(Presented by Singapore)

SUMMARY

This paper presents updates on the status of PBN Implementation in Singapore. The paper summarizes the progress made for PBN implementations at the terminal area in Singapore as well as for its en-route airspace. The paper also proposes the continuation of the PBN Implementation Progress Report process which was previously undertaken by the PBN/TF. This ensures that progress can be monitored closely.

1. INTRODUCTION

1.1 At the 37th session of the ICAO Assembly in its Resolution A37-11, States and Planning and Implementation Regional Groups (PIRGs) were requested to develop PBN implementation plans and implement PBN in accordance with the timelines established in those plans.

1.2 Singapore has adopted a phased approach for the implementation of PBN in line with the ICAO Asia-Pacific Regional PBN Implementation Plan. The phased approach allows both ANSPs and aircraft operators to progress in tandem taking into consideration the avionics capabilities and air navigation infrastructures in the Singapore Flight Information Region (FIR). Please see **Attachment A** for Singapore PBN phased approach implementation.

2. DISCUSSION

2.1 To date, Singapore has been progressing effectively with the established plan. Within the Singapore FIR, in the en-route airspace beyond the surveillance coverage, ATC is able to reduce the longitudinal separation from 80 Nautical Miles (NM) to 50 NM on 57% of the routes from implementing the RNP10 PBN navigation specifications. For the areas within surveillance coverage, PBN specification such as RNAV5 enables the routes to be spaced closer to one another to increase the capacity within the same finite of airspace especially in areas with high volume traffic.

2.2 In February 2012, ATS routes between Singapore and Jakarta FIR serving South East Asia and Australasia was restructured to allow the reduction of separation on two ATS routes, M635 and M774. With RNP10 PBN specifications, the reduced horizontal separation of 50NM lateral / 50NM longitudinal contributes to a higher opportunity for flights to operate at their optimum flight level.

2.3 Focusing on high density routes, two RNAV5 routes, M630 and Y339, were established in August 2012 to enhance air traffic management safety and efficiency for flights between Singapore and West Malaysia. The restructured routes allowed for better air traffic management segregating short haul and long haul flights. This contributes to enhanced flight profiles in that area.

2.4 In the terminal airspace surrounding Changi airport where the arriving and departing flights manoeuvre from the airport to the en-route airspace and vice-versa, PBN plays a critical role in enhancing safety and optimising the capacity in our terminal airspace. Since 2006, segregated RNAV Standard Instrument Departure (SIDs) and Standard Terminal Arrival (STARs) routes for Changi had been implemented to minimise routes criss-crossing one another and to optimise climb and descent profiles. Continuous Descent Operations (CDO) procedures were also implemented in March 2012 to enhance efficiency in the terminal airspace using RNAV1 PBN specifications.

2.5 In the approach segment, PBN procedures are also in place to serve as a back-up for the conventional ground-based instrument procedures since 2007. These procedures are currently available on two of the runway ends at Changi Runway 1 (Runway 20R and 02L) and they utilise GNSS for lateral guidance and rely on the on-board avionics to provide the vertical guidance.

Progress Reporting of PBN Implementation

2.6 Recognising the potential benefits that PBN implementation can bring about and to harmonise with the Asia Pacific Regional PBN Implementation Plan, new ATS routes and procedures were developed in close collaboration with neighbouring States. The areas of collaboration focus on the harmonisation of PBN implementation based on communication, surveillance and navigation capabilities in those areas. Furthermore, prioritisation on areas where high demand of air traffic would bring about the necessary capacity enhancement contributing to optimised flight operations on those areas.

2.7 In August 2014, Baro-VNAV approaches were introduced as backup procedures to supplement Changi Runway 2 (Runway 20C and 02C). This improvement is to provide vertical guidance as a safety enhancement over the traditional non-precision approaches. Please see **Attachment B** for PBN implementation progress report.

2.8 PBN implementation progress reporting by States was previously under the purview of the APAC PBN Implementation Task Force (PBN/TF). These progress reports have been useful to monitor the progress of PBN implementation in this region. With APANPIRG's Decision 24/40 to dissolve the PBN/TF in 2013, on-going tasks such as reporting of progress has been delegated to the Regional Sub-Office or the CNS Sub-Group of APANPIRG. The PBNICG may consider adopting the same format of reporting to facilitate monitoring of progress. The continuing process of this reporting would ensure that the progress PBN implementation can be closely monitored and that the output from the report on platforms such as the Regional Performance Dashboards can accurately reflect progress of States.

2.9 As the skies get busier with more airplanes, PBN will serve to increase airspace safety, capacity and efficiency. Flight times will also be reduced with optimal flight paths design using PBN specifications resulting in fuel saving and enhanced environmental protection.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

- a) note the current status of PBN Implementation in Singapore; and
- b) note the collaborative efforts between States for PBN implementation; and

- c) encourage States to continue in their efforts in PBN implementation to achieve seamless ATM within Asia Pacific Region; and
- d) adopt the PBN Implementation Progress Report format and process which was previously used by the PBN/TF to monitor the progress of PBN Implementation in the Asia/Pacific Region.

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Performance Based Navigation Implementation Schedule for En-route, Terminal and Approach In Singapore

	Near Term (2008 – 2012)	Medium Term (2013 – 2016)	Long Term (2016 onwards)
Enroute	<div style="background-color: #4caf50; color: white; padding: 5px; display: inline-block; transform: rotate(-15deg);"> RNAV 10 (up to 50%) RNP4 (up to 25%) </div>	<div style="background-color: #4caf50; color: white; padding: 5px; display: inline-block; transform: rotate(-15deg);"> RNAV10 (up to 75%) RNAV5 Explore RNP2 </div>	<div style="background-color: #4caf50; color: white; padding: 5px; display: inline-block; transform: rotate(-15deg);"> RNAV10 RNAV5/RNAV2/RNP2 wherever feasible </div>
Terminal Areas	<div style="background-color: #4caf50; color: white; padding: 5px; display: inline-block; transform: rotate(-15deg);"> RNAV1 SIDs STARs for Changi </div>	<div style="background-color: #4caf50; color: white; padding: 5px; display: inline-block; transform: rotate(-15deg);"> RNAV1 SIDs STARs for Secondary Airfields Basic-RNP 1 for Changi Departures </div>	<div style="background-color: #4caf50; color: white; padding: 5px; display: inline-block; transform: rotate(-15deg);"> Basic-RNP 1 for Seletar Departures </div>
Approach	<div style="background-color: #4caf50; color: white; padding: 5px; display: inline-block; transform: rotate(-15deg);"> RNP APCH APV for remaining Changi </div>	<div style="background-color: #4caf50; color: white; padding: 5px; display: inline-block; transform: rotate(-15deg);"> RNP APCH APV for Seletar together with ILS </div>	<div style="background-color: #4caf50; color: white; padding: 5px; display: inline-block; transform: rotate(-15deg);"> RNP AR APCH for Changi & Seletar GLS as backups </div>

PBN IMPLEMENTATION PROGRESS REPORT

State: SINGAPORE

Date: 01/03/2015

Designation of PBN Focal Point

Reference: APANPIRG Conclusion 18/55 –Designation of Contact Person for PBN Implementation
“That, by 31 December 2007, States designate a focal contact person responsible for performance based navigation implementation and provide details of the contact person to ICAO Asia/Pacific Regional Office accordingly”

Status: Nominated

Focal Point: Michael Shee
 Air Traffic Control Manager
 Singapore Changi Airport, P.O Box 1
 Singapore 918141
michael_shee@caas.gov.sg
 Phone – (65) 6541 2454
 Fax – (65) 6545 6516

State PBN Implementation Plan

Reference: APANPIRG Conclusion 21/32 – Development of State PBN Implementation Plan
“That, the States, which have not developed their State PBN Implementation Plans so far, be urged to develop the plan in accordance with the Asia/Pacific Regional PBN Implementation Plan at the earliest and advise the Regional Office of the impediments they are facing in the implementation of PBN.”

Status: Adopted by Civil Aviation Authority of Singapore and to be reviewed by ICAO APAC PBN TF

Approach Operations

Reference: ICAO 37th General Assembly Resolution A37/11 which supersedes Resolution A36-23

“...a) States complete a PBN implementation plan as a matter of urgency to achieve:

2) implementation of approach procedures with vertical guidance (APV) (Baro- VNAV and/or augmented GNSS), including LNAV only minima, for all instrument runway ends, either as the primary approach or as a back-up for precision approaches by 2016 with intermediate milestones as follows: 30 per cent by 2010, 70 per cent by 2014; and

3) implementation of straight-in LNAV only procedures, as an exception to 2) above, for instrument runways at aerodromes where there is no local altimeter setting available and where there are no aircraft suitably equipped for APV operations with a maximum certificated take-off mass of 5 700 kg or more;”

Status:

Implementation Targets (# of RWY Ends)			Completed (# of RWY Ends)		In Progress (# of RWY Ends)	
Y2010	Y2014	Y2016	LNAV	LNAV/VNAV	LNAV	LNAV/VNAV
-	-	2	-	4	-	2

Arrival and Departure Operations

Reference: 1) ICAO 37th General Assembly Resolution A37/11 which supersedes Resolution A36-23

“...a) States complete a PBN implementation plan as a matter of urgency to achieve:

implementation of RNAV and RNP operations (where required) for en route and terminal areas according to established timelines and intermediate milestones;” and

2) Asia/Pacific PBN Regional Implementation Plan v 2.0

“Short-term Implementation Targets: RNAV 1 SID/STAR for 50% of international airports by 2010 and 75% by 2012 and priority should be given to airports with RNP Approach.”

“Medium-term Implementation Targets: RNAV 1 or RNP 1 SID/STAR for 100% of international airports by 2016. RNAV 1 or RNP 1 SID/STAR for 70% of busy domestic airports where there are operational benefits.”

Implementation Targets (# of Int'l Airports)			Completed (# of Int'l Airports)		In Progress (# of Int'l Airports)	
Y2010	Y2015	Y2016	Arrival	Departure	Arrival	Departure
-	1	1	-	-	1	1

En-route Operations

Reference: Asia/Pacific PBN Regional Implementation Plan v 2.0

“Short-term Implementation Targets: Re-defining existing RNAV/RNP routes into PBN navigation specification by 2012, Implementation of additional RNAV/RNP routes.”

“Medium-term Implementation Targets: Implementation of additional RNAV/RNP routes”

Navigation Specification	Completed (# of routes)	In Progress (# of routes)
RNAV 10	9	-
RNAV 5	2	-
RNAV 2	-	-
RNP 4	-	-
RNP 2	-	-

Continuous Descent Operations

Reference: APAC PBN Task Force Action Item 6/1

“States are encouraged to consider implementing CDO in accordance with ICAO CDO Manual Doc 9331 on as many STARs as practicable to enhance fuel efficiency, ease pilot and ATC workloads, and reduce emission and noise.”

Singapore has implemented CDO on 8 STARs since March 2012.

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