



International Civil Aviation Organization

**The Eighth Meeting of the Performance Based Navigation Task Force
(PBN TF/8)**

New Delhi, India 12 – 13 May 2011

Agenda Item 5: State/Industry Updates

THAILAND PBN IMPLEMENTATION

(Presented by Thailand)

SUMMARY

This paper discusses the progress of PBN implementation within Thailand. The paper notes the completion of Thailand PBN Implementation plan and the publications of RNP APCH procedures for Phuket, Hat Yai and Samui Airports and successful flight validation for RNP APCH procedures for Chiang Mai Airport. The paper also summarizes the progress made for PBN implementations at Suvarnabhumi, Don Mueang, Krabi, Chiang Rai, Lampang, Udon Thani and Khon Kaen Airports.

This paper relates to –

Strategic Objectives:

A: Safety – Enhance global civil aviation safety

C: Environmental Protection and Sustainable Development of Air Transport – Foster harmonized and economically viable development of international 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 Challenges in aviation and needs for higher efficiency in aircraft fuel consumption call for new navigation technologies and operation procedures to be implemented. In response to this call for actions, ICAO has adopted several conclusions to promote the uses of Performance-Based Navigation (PBN) and Global Navigation Satellite System (GNSS) as the navigation elements of CNS/ATM systems. These navigation technologies and specifications have promising potentials to provide accurate, reliable and seamless position determination and navigation capabilities to airspace users. Implementations of PBN and GNSS facilitate more efficient use of airspace and more flexibility for procedure design. They cooperatively result in improved safety, access, capacity, predictability, operational efficiency, fuel economy, and environmental effects.

1.2 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 described in the *Performance Based Navigation Manual* (Doc 9613). The resolution calls on the States and Planning and Implementation Regional Groups (PIRGs) to develop PBN implementation plans by 2009 to ensure globally harmonized and coordinated implementation of PBN. In its 37th session in September 2010, ICAO Assembly once again reiterated the importance of PBN in its Resolution A37-11 requesting ICAO contracting States to implement PBN as a matter of urgency.

1.3 APANPIRG, through its Conclusion 18/52, established a Regional Performance Based Navigation Task Force (PBN/TF) to address PBN related regional implementation issues. In its Conclusion 18/53, APANPIRG stipulated development of State's PBN Implementation Plans in harmony with the Asia/Pacific Regional PBN Implementation Plan. Subsequently in September 2009, APANPIRG through its Conclusion 20/41 adopted the first version of the Asia/Pacific Regional PBN Implementation Plan. The document has been published and made publicly available on the ICAO Asia/Pacific office website: http://www.bangkok.icao.int/edocs/PBN_%20Plan_v2.pdf

1.4 During the 6th APEC Transportation Ministerial Meeting in Manila, the Philippines in April 2009, Transportation Ministers of Asia/Pacific Economic Cooperation (APEC) Economies, encouraged the continued implementation of PBN aiming to result in more efficient fuel utilization for aircraft.

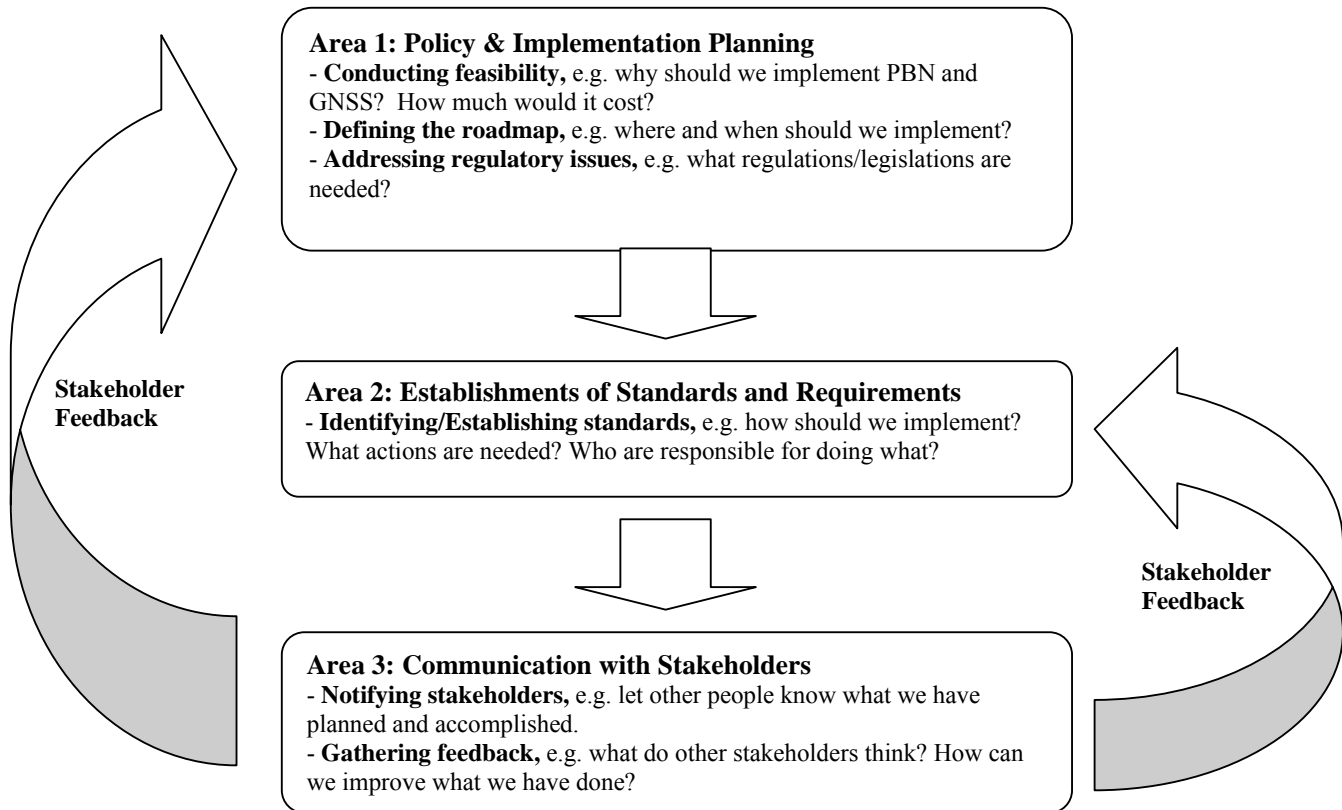
2. **Establishment of Thailand PBN & GNSS National Working Group & Thailand PBN Implementation Plan**

2.1 Recognizing the benefits of PBN and GNSS, in May 2007, Thailand has established a national Working Group to foster a cooperative approach among Thai aviation stakeholders in the implementations of PBN and GNSS over Thai airspaces. Planning and implementation activities involve participations from Department of Civil Aviation of Thailand (Thai DCA), representatives from Thai airline operators, Thai Pilot's Association (THAIPA), Airports of Thailand Public Company Limited, and Aeronautical Radio of Thailand Limited (AEROTHAI).

2.2 The Working Group is responsible for developing policies, implementation plans, and implementation standards for the deployment of PBN and GNSS procedures and operations in Thai airspace. The Working Group has three areas of responsibility in regards to the implementation of PBN and GNSS in Thai airspace. The three areas of responsibility are:

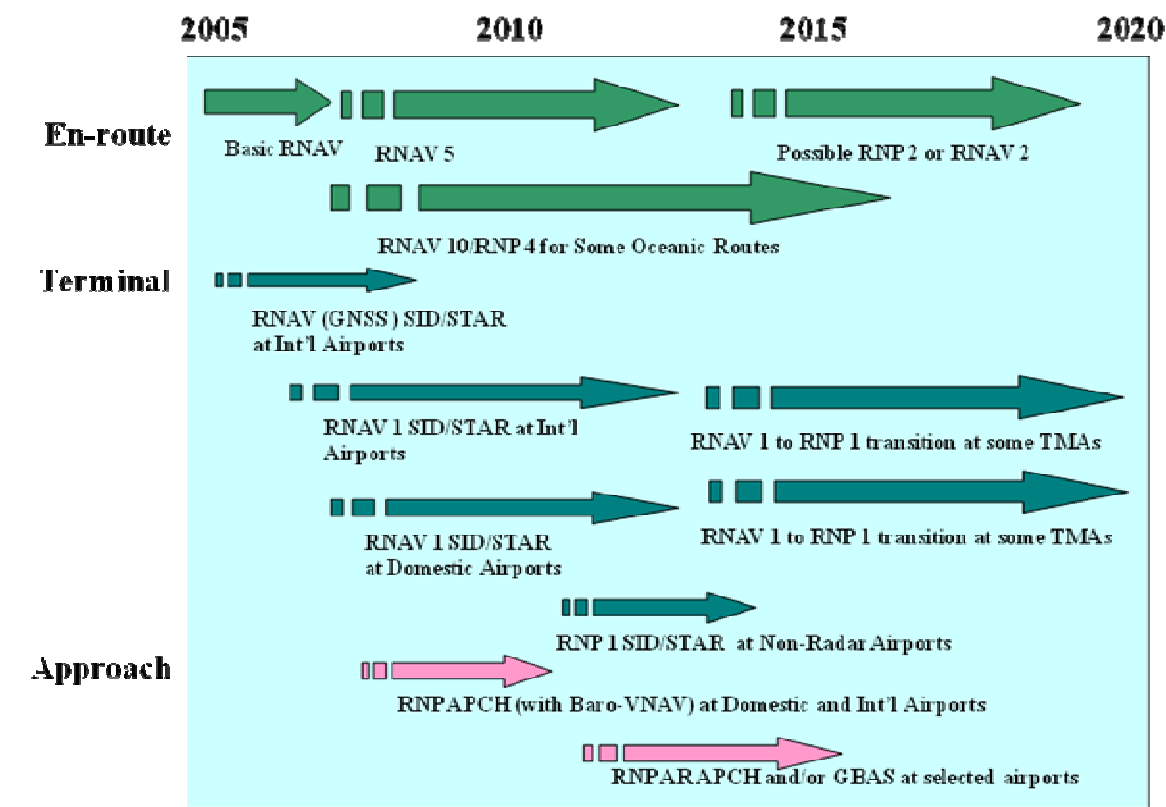
- Policy & Implementation Planning
- Establishments of Standards and Requirements in accordance to appropriate ICAO requirements
- Communication with Stakeholders

The following diagram depicts the roles and relationships of each area of responsibility:



2.3 In June 2009, the Working Group had approved Thailand PBN Implementation Plan. This Thailand PBN Implementation Plan aims to provide aviation stakeholders with appropriate implementation guidance and timelines to allow proper preparation for PBN implementation within the Bangkok Flight Information Region (FIR). The Plan is well aligned with the Asia/Pacific Regional PBN Implementation Plan developed by ICAO Asia/Pacific PBN Task Force and 2007 and 2010 ICAO Assembly Resolutions.

2.4 Thailand PBN Implementation Plan provides assessments of fleet readiness status and CNS infrastructure, which results in selection of appropriate PBN navigation specifications and implementation strategies for En-route and Terminal Area operations. It also explains some tangible operational benefits, derived from actual PBN implementations. The following diagram and table depict selected PBN navigation specifications and targeted TMA implementations as outlined in the Thailand PBN Implementation Plan, respectively.



Thailand PBN Implementation Plan: Selected Navigation Specifications

Terminal Areas	Progress
Phuket	Operation since January 2009
Hat Yai	Operation since December 2009
Samui	Operation since May 2010
Chiang Mai	Design Completed and Successfully Flight Validated
Krabi	Design Completed
Suvarnabhumi	2010-2012
Don Mueang	2010-2012
Lampang	Being Designed
Udon Thani	Being Designed
Chiang Rai	Being Designed
Khon Kaen	Being Designed

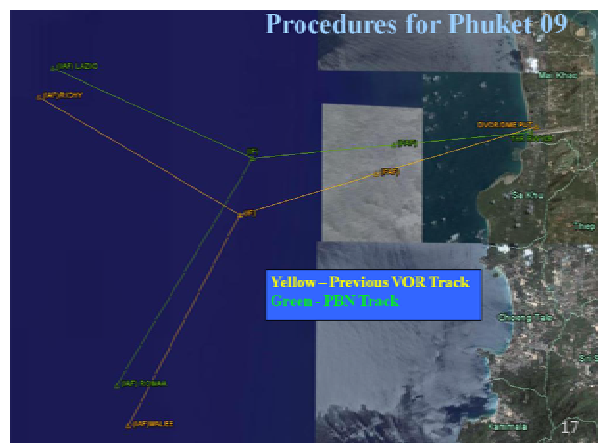
Thailand PBN Implementation Plan: Targeted TMA Implementation for 2009-2011

3. Progress of PBN Implementation in Thai Terminal Airspace

3.1 **Phuket:** Since February 2009, Thai DCA has approved full operation of RNP APCH procedures for Phuket International Airport. These procedures enhance safety and efficiency in the approach operation and also resolve the offset problems caused by the limitation of installation sites of conventional navigation aids.

3.2 The following safety benefits are the results of RNP Approach implementation for Phuket International Airport:

- Runway 27 - Providing a runway-aligned approach path as compared to the current ILS approach which has 1.4 degree offset.
- Runway 09 - Providing a runway-aligned approach path as compared to the current VOR approach which has 5 degree offset.

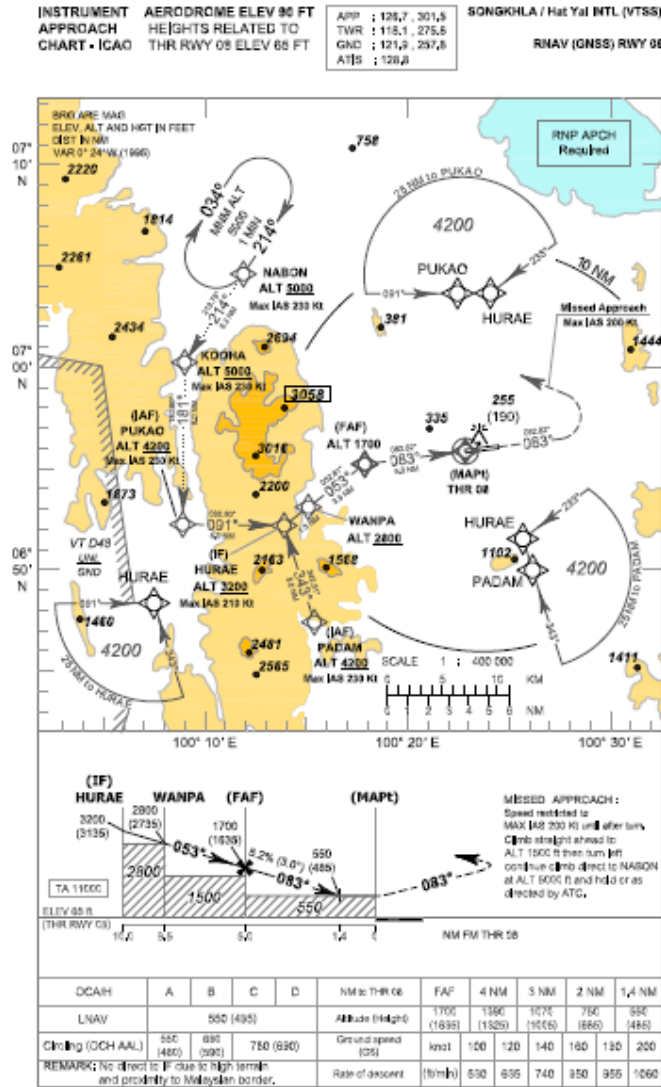


RNP APCH procedures for Phuket Runway 09



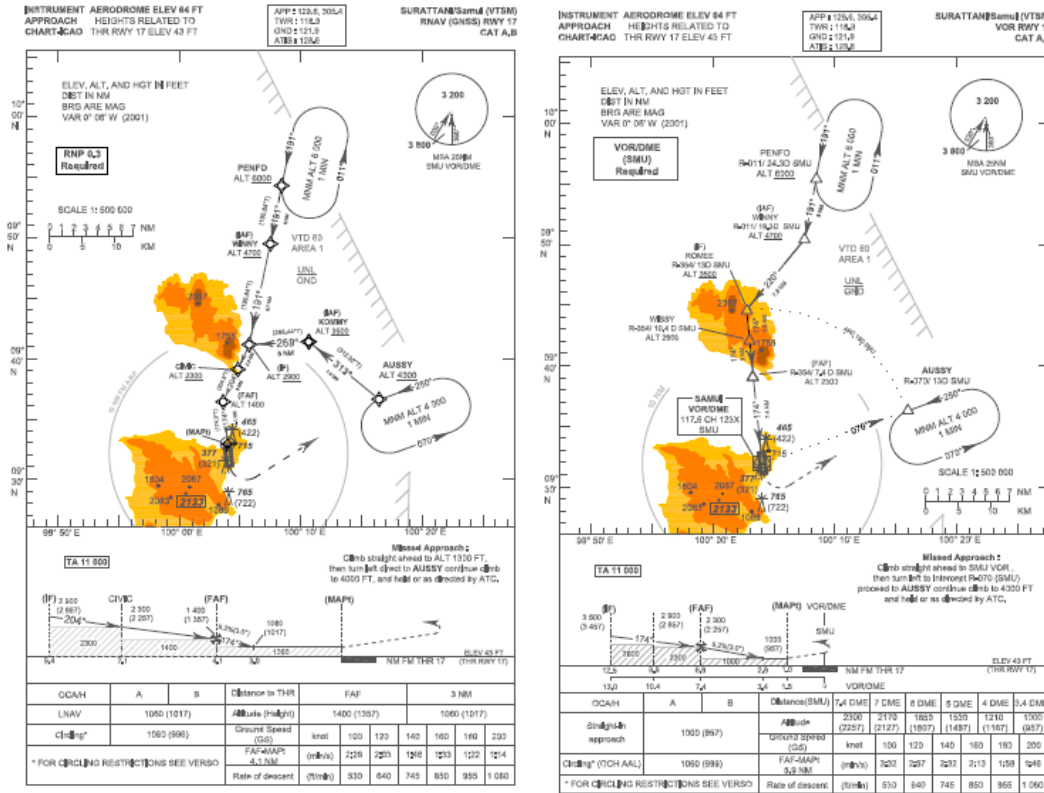
RNP APCH procedures for Phuket Runway 27

3.3 **Hat Yai:** RNP APCH procedures for Hat Yai International Airport have been designed and successfully flight validated by AEROTHAI. The procedures have been available for commercial operations since December 2009. These RNP APCH procedures help enhancing the level of safety and efficiency in approach and landing operations to Hat Yai International Airport, especially to Runway 08, of which no instrument approach procedure with conventional navigation aids was feasible. Moreover, RNP APCH procedures for Runway 26 also provide back-up approach procedures for the existing ILS procedures.



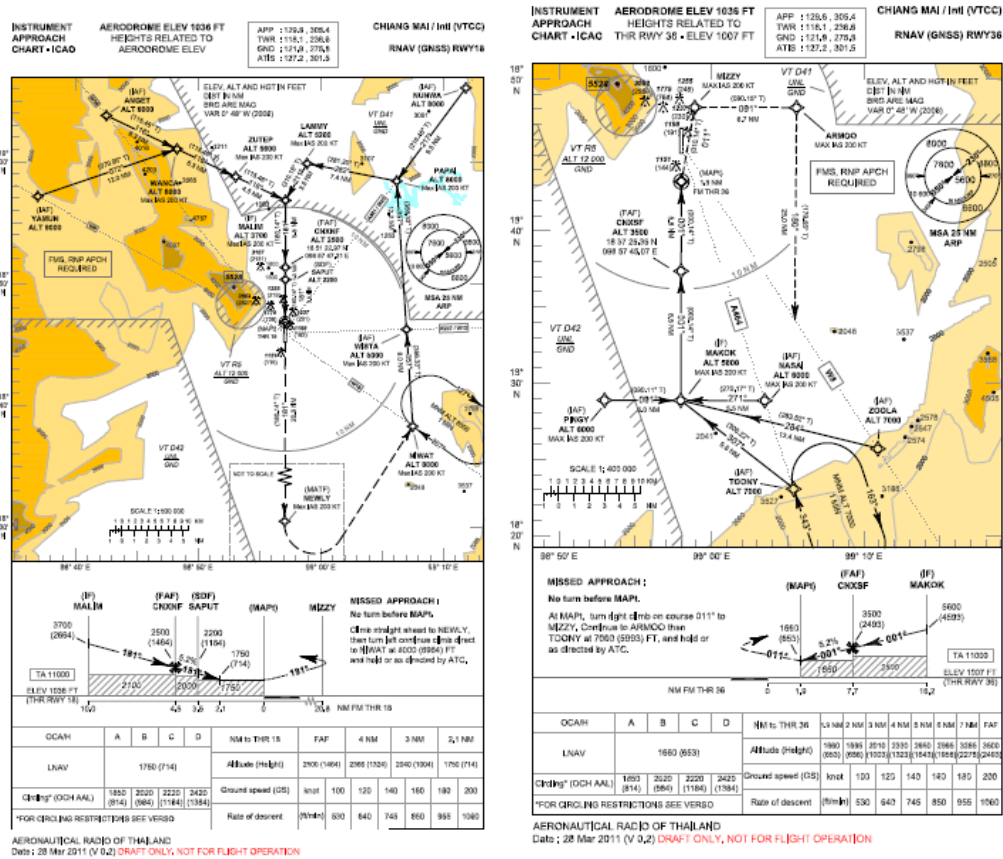
RNP APCH procedure for Hat Yai Runway 08

3.4 **Samui:** Two RNP APCH procedures for Samui Airport have been designed and successfully flight validated by AEROTHAI. The procedures have been authorized to be used in commercial operations by the Thai DCA since May 2010. These RNP APCH procedures help enhancing the level of safety and efficiency in approach and landing operations to Samui Airport, especially to Runway 17, since their flexible flight path can navigate the aircraft around mountainous areas while still providing the runway-aligned final segment.



RNP APCH procedure for Samui Runway 17 as compared to VOR Runway 17

3.5 **Chiang Mai:** AEROTHAI in coordination with Thailand’s National Working Group for PBN and GNSS implementation has completed the design for additional RNP APCH procedures for Chiang Mai International Airport. As of March 2011, AEROTHAI has successfully flight-validated the two RNP APCH procedures. Commercial operations for the procedures have been expected before the end of 2011. Once completed, these RNP APCH procedures will help enhancing the level of safety and efficiency in approach and landing operations to Chiang Mai International Airport, especially to Runway 18, of which no straight-in, runway-aligned approach procedure is feasible with the existing VOR.



RNP APCH procedures for Chiang Mai International Airport

3.6 The following tables summarize notable safety benefits derived from PBN implementation at Phuket, Hat Yai, Samui and Chiang Mai Airports:

Phuket	Conventional	PBN
Runway 27	1.4-degree ILS offset	Runway aligned approach
Runway 09	5-degree VOR offset	Runway aligned approach
	OCA at 850 feet	OCA at 750 feet

Samui	Conventional	PBN
Runway 17	Runway aligned, yet pass through unstable weather area	Runway aligned approach, side-step to avoid the unstable weather area

Hat Yai	Conventional	PBN
Runway 08	Unavailable due to mountainous terrain	Runway aligned approach

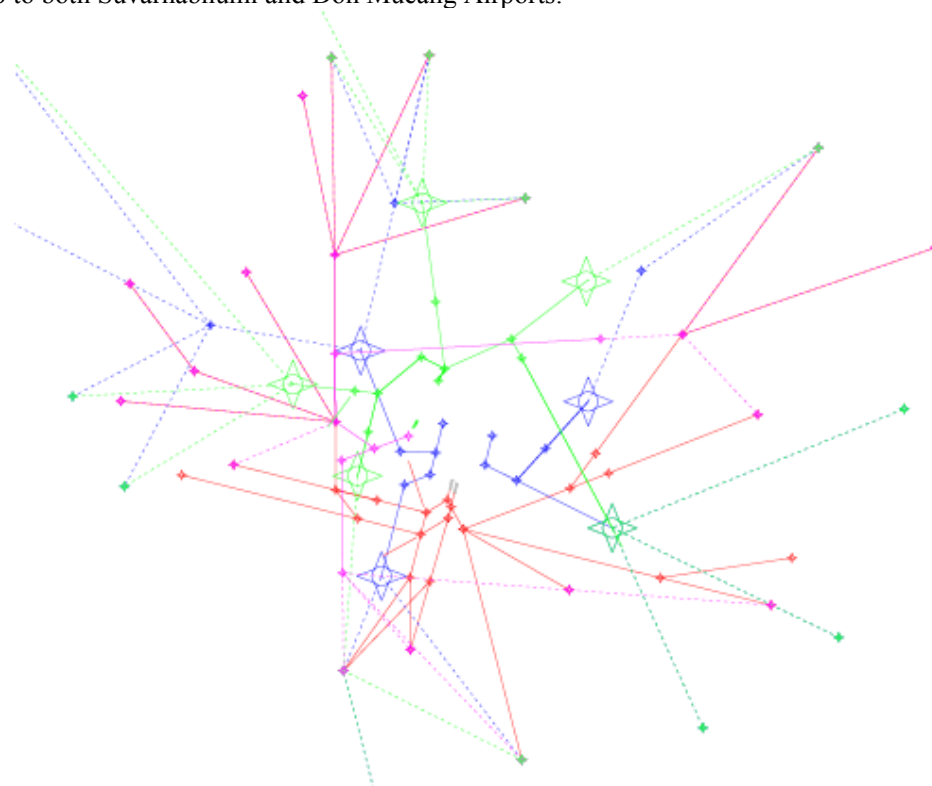
Chiang Mai	Conventional	PBN
Runway 18	VOR circling approach with high circling OCA/H	Runway aligned approach

3.7 AEROTHAI, in cooperation with THAIPA and airlines, are now in process of designing additional RNP APCH procedures for Krabi, Chiang Rai, Lampang, Udon Thani and Khon Kaen Airports. The design process for these procedures is expected to be completed in 2011. Following the completion of the design, the procedures will be submitted to the Thai DCA for its consideration, prior to the final flight validation by AEROTHAI.

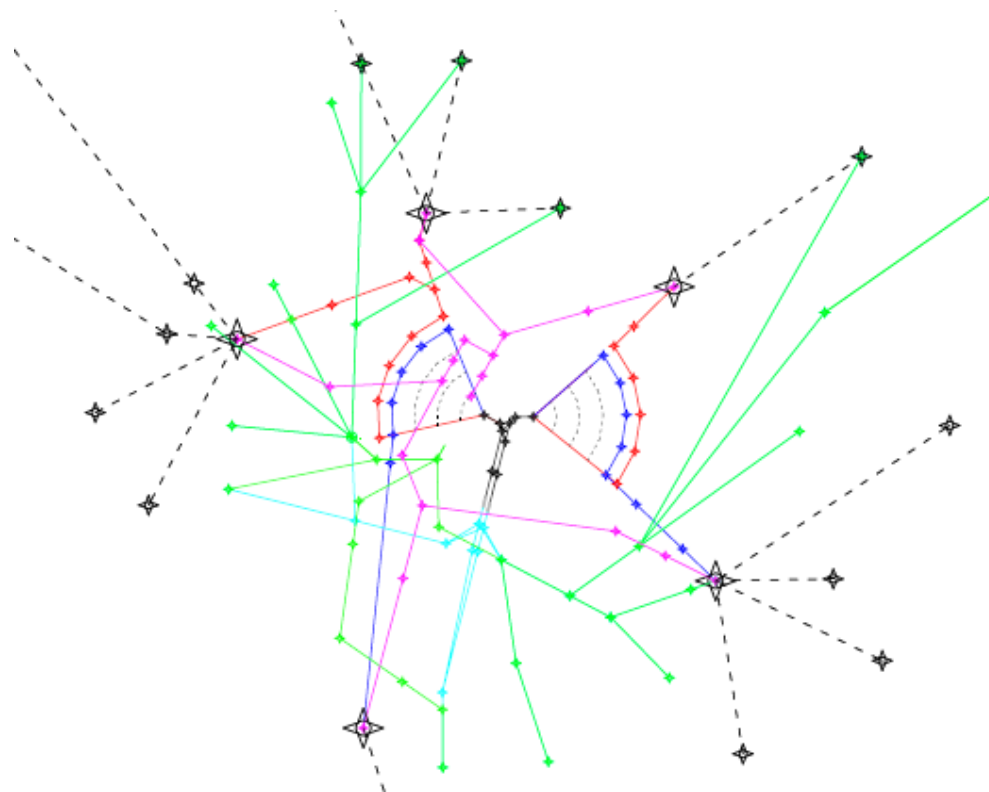
3.8 AEROTHAI is also re-designing Standard Instrument Arrivals (STARs) and Standard Instrument Departures (SIDs) for Suvarnabhumi and Don Mueang Airports based on RNAV 1 navigation specification using DME/DME/IRU and GNSS. The new design is expected to provide more efficient terminal area operations, while reducing needs for radar vectoring and supporting continuous descent and unimpeded climb operations. In 2010, the National Working Group at its 21st Meeting endorsed the following objective statement to provide policy guidance for this project: **“Enable the Maximum Use of Potential Runway Capacity subject to Maintain System Safety, Minimise System Delays, Optimise Controller Workload and Minimise Environmental Impact.”**

3.9 AEROTHAI is considering two alternative designs for this re-designing of SID/STAR for BKK TMA. One option is based on the existing Open-STAR concept; while the other is based on the Point-merge concept recently developed by EUROCONTROL. Independent consultant service has been acquired to perform fast-time simulation to compare delay/capacity performance and workload indications for each alternative design. Additionally, noise impact analysis has been conducted in this project. Initial fast-time simulation result indicates that Point-Merge design when uses in combination with independent parallel runway operation provide significant enhancement in safety, efficiency and capacity performance as compared to the current existing operations.

3.10 Beyond the fast-time simulation result, AEROTHAI also received supports from the ICAO/IATA Global PBN Go-Team to provide subject-matter-expert recommendations. In addition to revising SID/STAR, the company is designing RNP APCH with Baro-VNAV to provide back-ups to the ILS to both Suvarnabhumi and Don Mueang Airports.



PBN SID/STAR for BKK TMA based on the Open-STAR Concept



PBN SID/STAR for BKK TMA based on the Point-Merge Concept

4. Progress of PBN Implementation in En-route Airspace

4.1 During 2009-2012, Thailand has considered the use of RNAV 10, RNAV 5, and RNP 4 navigation specifications for PBN route implementations. Some existing domestic conventional ATS routes will be modified towards PBN navigation specifications, while additional domestic and international RNAV and RNP routes will also be introduced. Domestically, ideas for uni-directional parallel PBN routes connecting major domestic city pairs, such as Bangkok-Chiang Mai, are being considered. In the regional level, AEROTHAI in cooperation with the Thai DCA is engaging with ICAO task forces and working groups in the revision of route structures over South China Sea and the Bay of Bengal.

4.2 **Establishment of M752 Route:** Initiated by HRH Crown Prince of Thailand, M752 international route will connect Suvarnabhumi Airport with Australia. The air route is strategically developed to enhance interconnectivity between South East Asia and Australia. It also serves Thailand's strategic goal of becoming a regional air transport and logistics hub of South East Asia.

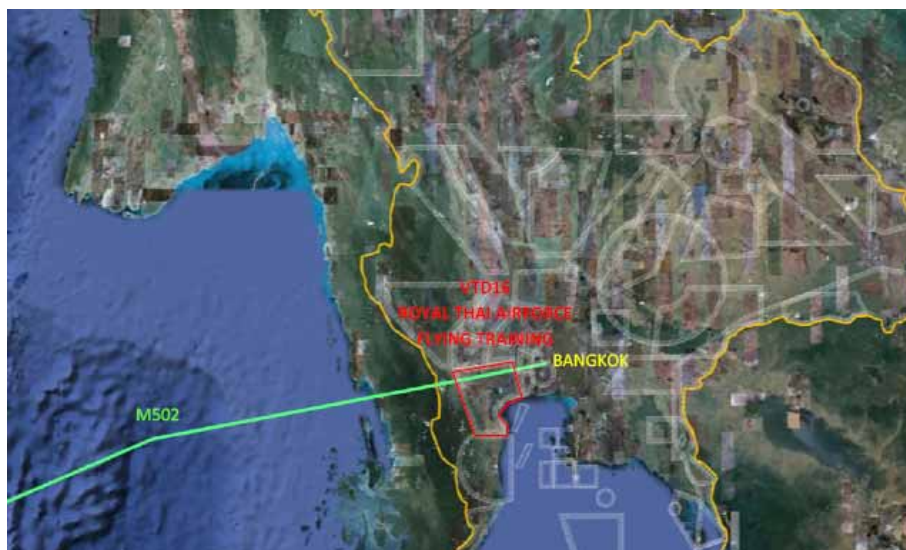
4.3 M752 will be established as an RNAV 5 route. Its efficient routing derives the tangible benefits of successful civil/military coordination among airspace users. The route establishment represents a cooperative effort among Thai aviation stakeholders, including the Royal Thai Air Force, the Royal Thai Navy, the Ministry of Transportation, the Thai DCA, Thai Airways International and AEROTHAI.



M752 connecting Suvarnabhumi with Australia

4.4 **Establishment of M502 Route:** M502 international route will connect Suvarnabhumi Airport with South Asia and Africa. The air route is strategically developed to enhance interconnectivity between South East Asia and South Asia. It also serves Thailand's strategic goal of becoming a regional air transport and logistics hub of South East Asia.

4.5 M502 will be established as a conditional RNAV 5 route, available for flight-planning during non-active military training period. Its efficient routing derives the tangible benefits of successful civil/military coordination among airspace users. Developed under the Flexible Use of Airspace Concept, the route establishment represents a cooperative effort among aviation stakeholders, including the Royal Thai Air Force, Thai DCA, Myanmar DCA and AEROTHAI.



M502 connecting Suvarnabhumi with South Asia and Africa

5. **Actions by the Meeting**

5.1 The Meeting is invited to note:

- the roles of Thailand's National Working Group on PBN & GNSS Implementation;
- that Thailand PBN Implementation Plan has been approved by the National Working Group;
- that Thailand PBN Implementation Plan is developed in consistent with the interim Asia/Pacific Regional PBN Implementation Plan;
- that actual PBN deployments at Phuket, Hat Yai and Samui Airports provide safety and operational benefits to airlines and air traffic controllers; and
- the progress made on PBN implementation for Suvarnabhumi, Don Mueang, Chiang Mai, Karbi, Chaing Rai, Udon Thani, Lampang and Khon Kaen Airports.

Attachment A**PBN IMPLEMENTATION PROGRESS REPORT****State: Thailand**

Date: May 2011 (PBN TF/8)

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.”

State Focal Point for PBN Implementation:

Mr. Noppadol Pringvanich, Acting Director Procedure Design for Air Navigation Service, AEROTHAI
 Email: npringvanich@gmail.com, noppadol@stanfordalumni.org
 Tel: + 66 (0) 812078822, Fax: + 66(0) 22878639

State PBN Implementation Plan

Reference: APANPIRG Conclusion 18/53 – Development of State PBN Implementation Plans

“That, the Regional Office encourages States to begin development of their State PBN implementation plans in harmony with the development of the Asia/Pacific Regional PBN implementation plan being coordinated by the Asia/Pacific PBN Task Force for submission to APANPIRG/19.”

State PBN Implementation Plan Version

Thailand PBN Implementation Version 1.0 was approved by the National Working Group on PBN and GNSS in June 2009. Thailand PBN Implementation Plan was then submitted to ICAO PBN TF/5 Meeting in July 2009. The National Working Group is now revising Thailand PBN Implementation Plan and the new version is expected in 2012.

Terminal Operations

Reference: ICAO Assembly Resolution A37-11

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

- (1) Implementation of RNAV and RNP operations (where required) for en-route and terminal areas according to established timelines and intermediate milestones; and*
- (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 back up for precision approaches by 2016 with intermediate milestones as follows: 30 percent by 2010, 70 percent by 2014¹; 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*

¹ Asia/Pacific Regional PBN Implementation Plan V2 states 50% by 2012

where there are no aircraft suitably equipped for APV operations with a maximum certificated take-off mass of 5 700 kg or more.”

State Approach PBN Progress

2010 Target (# of RWY Ends)	Completed (# of RWY Ends)		In Progress (# of RWY Ends)	
	LNAV	LNAV/VNAV	LNAV	LNAV/VNAV
18	7	-	20	4

Note(s):

1. Phuket International Airport - two RNP APCH procedures were published on 1 January 2009.
2. Hat Yai International Airport - two RNP APCH procedures were published on 17 December 2009.
3. Samui Airport - two RNP APCH procedures were published on 25 March 2010.
4. Chiang Mai International Airport - design and flight validation for RNP APCH procedure for AIRAC publication is expected in June 2011.

Arrival and Departure Operations

Reference: Asia/Pacific Regional PBN Implementation Plan

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

Target by 2010 (# of RWY Ends)	Completed (# of RWY Ends)	In Progress (# of RWY Ends)
13	-	16