Asia-Pacific
Economic Cooperation

Performance-Based Navigation Regulatory Review and Evaluation Program (PBNRREVP)

Manila, The Philippines

Transportation Working Group (TPTWG)
Aviation Experts Group (AEG)

November 2012

APEC Project TPT 06/2011A

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1. Introduction

APEC, through the Transportation Working Group (**TPTWG**), is funding the Performance-Based Navigation Regulatory Review and Evaluation Program (**PBNRREVP**) which aims to assist developing APEC member economies with meeting the International Civil Aviation Organization (**ICAO**) requirements to file a Performance-Based Navigation (**PBN**) Implementation Plan, and actively engage in following through with all aspects of implementation, particularly establishing the proper regulatory safety oversight of related procedures.

To execute this program APEC has contracted the Ambidji Group to coordinate the work of a team of experts on Performance-based Navigation to share safety oversight training and best practices with Malaysia DCA staff and other local stakeholders.

This report documents the visit to Malaysia by the team of experts from 18 to 21 September 2012.

2. Background

PBN has provided enormous benefits to the aviation community, for conserving resources (i.e. saving fuel), reducing the environmental impact (i.e. reduced CO_2 emissions and noise in populated areas due to more efficient flight routing), and reducing accidents (i.e. stabilized instrument procedures and increased accurate flight positioning). However, many APEC member economies are proceeding slowly with implementation, primarily due to lack of information or misinformation regarding international and domestic requirements for implementing related technologies and procedures.

To date, the ICAO PBN Task Force has made significant progress in developing PBN implementation guidance and establishing broad regulatory requirements. It has set ambitious regional goals for procedural implementation and regulatory oversight of related activities to be carried out by individual APEC member economies. The task force set a 2010 deadline for submitting plans to ICAO in line with ICAO Assembly Resolutions, established a PBN flight procedural design office in Beijing as a resource to all Asian ICAO states, and acted as ICAO's review board for evaluating the quality and feasibility of each State's PBN Implementation Plans.

Despite this level of ICAO support, many developing APEC economies are still struggling with successful PBN implementation plans, specifically the components of safety regulatory oversight, development of PBN procedures that would fit their airspace needs and establishing required equipage for local fleets.

3. Project Objectives

The overall project objective is to address the primary impediments to developing and implementing a robust PBN Implementation Plan. These include: a lack of clear guidance for regulatory oversight needs, standards and best civil aviation authority practices; difficulty developing the PBN procedures; and safely implementing procedures once developed. Emphasis will be placed on providing additional guidance to assist in understanding the already-established international regulatory requirements and clarifying what domestic regulations and policy guidance needs to be developed for successful implementation.

There are three key objectives to this project:

1. Ensure that the Malaysia PBN Implementation Plan is mature, includes all necessary Basic Plan Elements (**BPE**) outlined in the Asia-Pacific Regional PBN Implementation Plan and meets the needs of local aviation stakeholders;

2. Create an action plan for participants to follow through with PBN implementation activities that includes further development of regulations and guidance material that may be needed; and

3. Training with respect to identifying common implementation challenges and how to overcome them with respect to developing PBN procedures, Flight Validation (**FV**), and the development of a common set of recommendations and strategies based on experience that can be used by the participants to ensure successful PBN implementation.

4. APEC Team

The APEC Team consists of PBN experts including:

- Mr Robert Kennedy (Ambidji Group) Project Coordinator;
- Mr Noppadol Pringvanich, Director, Procedure Design for Air Navigation Services, AEROTHAI and Manager, ICAO Asia Pacific Flight Procedures Programme, Beijing;
- Mr Kazuto Shiba, Manager Route Planning, All Nippon Airways Co., Ltd (**ANA**);
- Mr Tass Hudak, The Mitre Corporation.

5. Terms of Reference

Based on discussions with Malaysia Department of Civil Aviation (**DCA**) staff and taking into account the considerable amount of PBN development work already completed in Malaysia, the terms of reference were developed to include the following topics:

1. Review PBN regulatory requirements and recommend development strategies.

2. Provide PBN awareness training for all DCA staff and other stakeholders.

3. Work with DCA Flight Operations Safety Inspectors (**FOSI**) to build upon the Cooperative Development of Operational Safety and Continued Airworthiness Programme (**COSCAP**) PBN operational approval training and to develop PBN operational approval framework.

4. Provide technical assistance to DCA flight operations inspectors and other relevant staff in respect of current/pending Required Navigation Performance Approach (**RNP APCH**) and/or RNP Authorisation Required Approach (**RNP AR APCH**) applications for operational approval (e.g. Air Asia).

5. Provide training and technical advice to Malaysia DCA flight procedure design staff and flight operations inspectors with regard to the design and validation of RNP APCH Lateral Navigation/Vertical Navigation (**LNAV/VNAV**) and RNP AR APCH procedures in Malaysia, including the administration of a third party design organisation.

6. Review the Malaysia PBN Implementation Plan and provide assistance to ensure that the plan meets the needs of Malaysian airspace users and the recommendations of the ICAO Regional PBN Task Force.

A copy of the terms of reference is included at Appendix A.

6. Program

The following program of activity was completed:

<table>
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<tr><td>0900
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Work with Malaysia DCA FOSI inspectors to develop PBN regulatory framework
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Provide technical advice and training in respect of RNP APCH and RNP AR APCH design
(Agenda Item 5)</td><td rowspan="2">All Stakeholders
Review PBN Regulatory requirements for Air Navigation Service Providers (ANSPs) and Flight Operations
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(continued)</td><td rowspan="2">Flight Operations
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<tr><td>1430
1600</td><td>APEC Team Departs.</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
</table>

7. Attendance

The program was very well attended with 55 representatives from Malaysia DCA and all sectors of the Malaysian aviation industry, including military and general aviation.

Feedback from attendees was very positive indicating that respondents considered the program to be extremely useful. Notable amongst the comments received is the view that follow-up is required to maintain the Malaysian PBN Implementation Plan.

A list of attendees is included at Appendix B. In addition, a copy of the participant survey and summary of the feedback received is included at Appendix H.

8. Other PBN Activities

In the two weeks immediately prior to the APEC Team's visit ICAO/FPP and ICAO COSCAP-South East Asia (**SEA**) conducted PBN activities.

COSCAP-SEA conducted a PBN Operational Approval Course which was attended by Malaysia DCA staff and a number of airline personnel from 3 to 7 September.

ICAO APAC Flight Procedures Program (**FPP**) in association with COSCAP-SEA conducted a PBN Implementation Workshop from 11 to 13 September.

As a consequence, many attendees at the APEC PBNRREV Program were well informed and able to make a significant and informed contribution.

A copy of the PBN Implementation Workshop outcomes is included at Appendix C.

9. Day 1: PBN Awareness Training

Following team and attendee introductions, an overview of the agenda was completed.

Mr Tass Hudak presented a briefing on the Principles of Performance-Based Navigation which was attended by 49 persons.

The briefing included the following topics:

1. Compared and contrasted Conventional, Area Navigation (**RNAV**), RNP;
2. ICAO PBN concept;
3. ICAO airspace concept;
4. PBN benefits with case studies and implementation examples; and
5. Review of ICAO PBN Implementation Processes 1, 2 and 3.

The briefing was well received and feedback indicated that the level of detail was suitable.

A copy of the PowerPoint presentation is included at Appendix D.

10. Day 2: Flight Operations Regulatory Development

The second day of the program was allocated to assisting with the development of Malaysia DCA regulatory framework to support the implementation of PBN.

It was noted that no specific PBN regulations had been drafted and reliance to date has been on Civil Aviation Regulation (**CAR**) 59.

Regulation 59 – *Minimum Navigation Performance s*pecifies approval requirements for operators to conduct flights in airspace designated by the Director General (**DG**) under this regulation unless:

a) It is equipped with navigation systems which enable it to maintain the prescribed navigation performance capability;

b) The navigation systems required by paragraph (a) are approved by the DG and installed and maintained in a manner approved by the DG;

c) The operating procedures for the navigation systems required by (a) are approved by the DG; and

d) The equipment is operated in accordance with the approved procedures while the aircraft is flying in said airspace.

However, there currently exists no documentation to identify the requirements for PBN approval.

After some discussion it was agreed by the meeting that the most appropriate means available to initiate PBN operations was an Aeronautical Information Circular (**AIC**).

Under the guidance of the APEC Team, a draft AIC was developed during the session which, subject to legal review, would provide a basis for the implementation of PBN in Malaysia.

Provisions were included in the draft AIC to permit operators who currently hold PBN approvals to continue to operate for a period prior to being required to demonstrate continued compliance with ICAO PBN Manual compliance by 31 December 2013.

The draft AIC is to be completed by DCA FOSIs and will be subject to legal review, and submitted for approval by the DG.

A copy of the draft AIC is included at Appendix E.

In order to comply with the draft PBN AIC, applicants should submit an Operations Specifications and Operations Manual amendment for approval by the DCA. The information should include:

(a) Demonstration of aircraft capability;

(b) Operating procedures (operations manual);

(c) Flight crew and dispatcher (training manual); and

(d) Navigation database procedures.

The regulation of operators that do not hold an operating certificate (General Aviation (**GA**)) was discussed. Based on the low level of perceived risk it was recommended that Malaysia DCA focus on regulating airline operation and look at GA if/when it becomes a problem. It was noted that in many other countries, for GA operations, the onus is on the pilot to ensure that the equipment is capable and they are properly trained.

Malaysia DCA AIC 110/2005 – RNAV Approach for Global Navigation Satellite System (GNSS) was reviewed and it was recommended that the AIC be updated to reflect changes in terminology and clarify changes.

Recommendations:

- *Update the AIC to reflect the ICAO PBN Manual;*
- *Remove reference to Supplemental means; and*
- *Issue an AIC to inform operators of PBN transition plans.*

Inspector Training. Two Malaysian FOSIs have completed PBN Operational Approval Training although there is no framework to qualify inspectors. It was suggested that Malaysian FOSIs enlist help of personnel with prior experience in approving specific operations, such as COSCAP-SEA.

Recommendations:

- *DCA update the Flight Operations Safety Inspector (**FOSI**) Handbook to include the periodic oversight and surveillance of PBN operations and training; and*
- *DCA revise the requirements to authorize FOSIs to ensure they meet the PBN requirements i.e. FOSIs should have some authority to provide oversight for specific operations (RNP APCH).*

Procedure Design Validation. The process for the validation of instrument flight procedures was discussed. In Malaysia the primary responsibility resides with the Malaysian Flight Calibration Unit. One pilot has completed ICAO FV Pilot Training but Malaysian DCA has yet to develop policy on FV Pilot Qualifications in accordance with ICAO Doc 9906. On the job training for flight validation pilots is also required and assistance may be available from other States (e.g. Thailand) and COSCAP-SEA.

It was noted that no formal process exists for the validation of instrument flight procedures including RNP AR. Authorisation of third party consultants (e.g. GE Aviation) to conduct validation while DCA FOSIs gain experience is required. Although the flight calibration unit will be responsible for FV, flight operations should retain a general oversight role and be consulted where exceptions to ICAO procedure design criteria are applied.

Air Asia/GE Project. Air Asia has contracted GE Aviation to design RNP AR approach and departure procedures at all 15 airports serviced by Air Asia in Malaysia. It is proposed that Air Asia will own the procedures for five years after which the procedures will become public and the property of Malaysia DCA. It is not yet decided if the Air Asia procedures will be published in the Malaysia Aeronautical Information Publication (**AIP**).

Malaysia Airlines (MAS). MAS has commenced operations into Kathmandu and consequently intends to seek RNP AR operational approval for its B737-800NG fleet as a matter of priority. DCA approval is required as soon as possible in the interest of safe.

Mr Shiba Kazuto provided a short presentation on ANA RNP AR operations.

11. Day 3 Session 1: Procedure Design

DCA Procedure Design. The PBN Implementation Workshop conducted in the week prior to the APEC Team visit identified a serious lack of procedure design capability in Malaysia DCA. Actions were recommended by the PBN Implementation Workshop to increase permanent staffing and to provide additional training.

To date only two RNP APCH LNAV procedures have been published in Malaysia, and these procedures are in need of review.

Recommendation:

- *Malaysia DCA should update its process for the design of instrument flight procedures to comply with ICAO Doc 9906* The Quality Assurance Manual for Flight Procedure Design

Validation. The principles of flight procedure validation (including flight validation) in accordance with ICAO Doc 9906 were reviewed. It was noted that one Malaysia DCA pilot has completed Flight Validation pilot training.

Data. DCA acquires obstacle/terrain data from the mapping department however the tools to record and verify obstacles in the aerodrome environment are not available

Recommendations:

- *For DCA internal procedure designs, survey data must be obtained by a qualified surveyor;*
- *DCA establishes process to validate survey data; and*
- *DCA require third party designers to survey obstacle data.*

The requirement for periodic (five year) periodic reviews of instrument flight procedures was noted.

Design Staff. DCA procedure designers have recently completed the PBN Procedures for Air Navigation Services – Aircraft Operations (**PANS-OPS**) procedure design course, but have not yet completed On-the-Job training (**OJT**). Currently there are no qualified staff able to check PBN procedure design. Internal audit revealed this gap and directed the Procedure Design Group (**PDG**) to resolve the issue. It is planned to arrange for the ICAO FPP to assist with OJT. It is possible that the FPP may be able to provide OJT on site in Malaysia.

Third Party Designer Authorization. Malaysia has two projects in progress which will involve the use of third party procedure designers, Kuala Lumpur International Airport (**KLIA**) 2 redevelopment and Air Asia/GE Aviation RNP AR.

The KLIA 2 project, administered by Malaysia DCA, involves the redevelopment of airspace in Western Malaysia and includes the design of new instrument flight procedures throughout the Flight Information Region (**FIR**). It is understood the procedure design extent of work includes the design of PBN procedures.

The Air Asia project will provide RNP AR procedures at all 15 airports serviced by Air Asia within Malaysia and procedures design will be completed by GE Aviation.

It was explained that although third party designers may be contracted to undertake procedure design work, Malaysia remains responsible for the procedures, and third party designers need to be authorized by the State. However Malaysia DCA does not yet have a process or the resources to conduct the review or certification of third party designers. In the interim the APEC team has proposed that the responsibility for design and quality assurance be delegated to third party designers on the basis that the designer was able to provide to DCA evidence of competency accepted by other States such as Australia, Canada, New Zealand or the US.

Recommendations:

- *DCA required third party designers to provide evidence of qualifications accepted by another contracting State;*
- *DCA issue an interim authorisation to third party designers who provide acceptable evidence of qualification;*
- *The requirements for the authorization of third party designers is set out in an AIC (or other document);*
- *Third party designers must demonstrate compliance with ICAO Doc 9906;*
- *The PDG should not be responsible for authorization of third party designers. The PDG may draft the requirements and provide to them the Auditing department, but it should be the responsibility of the Auditing/Inspection department to authorize the third party;*

- *FV should be implicitly required by the process with supporting output and documentation of FV results. The FV pilot/department should provide some level of oversight or participation to ensure that the necessary steps are taken.*

Long term, Malaysia has plans to employ and train inspectors to certify third party designers.

In order to commence the process of authorization of third party designers, the APEC Team provided assistance to draft a suitable AIC to provide interim authorization of designers based on recognition of approval by another State.

The draft Third Party Procedure Design AIC is included at Appendix F.

12. Day 3 Session 2: Malaysia PBN Implementation Plan

The Malaysia PBN Implementation Plan was reviewed during the PBN Implementation Workshop conducted by FPP/COSCAP in the week prior to the APEC Team visit.

It had been identified that a number of Basic Plan Elements (**BPE**) needed to be addressed to enable the Malaysia PBN Implementation Plan to be assessed by the ICAO Regional Office as “robust”.

The purpose of this Session was to assist Malaysia in completing the Implementation Plan such that a revised plan addressing the outstanding BPEs should be submitted to ICAO one to two weeks prior to the next PBN Task Force meeting late in 2012.

A copy of the previously submitted PBN Implementation Plan is included at Appendix G.

The Basic Plan Elements were assessed as follows:

BPE 1 Policy and implementation planning

Formation of a key working group: Malaysia has a PBN Task Force and this is to be reconvened to progress the work of PBN Implementation.

The PBN Implementation Plan needs to identify:

- *Constitution of the PBN Task Force; and*
- *Tasks and roles allocated to the Task Force and individual members.*

BPE 2 Assessment of Communications, Navigation and Surveillance (CNS) Infrastructure

Adequately covered in last submission.

BPE 3 Assessment of fleet readiness

A fleet assessment has been included in the PBN Implementation Plan but needs to be updated to include both domestic and foreign carriers and present the information as statistics with relevance to other elements of the Plan, rather than raw data as previously provided.

BPE 4 Selection of appropriate PBN Navigation Specifications

The revised table detailing the Navigation Specifications and timelines developed during the PBN Implementation Workshop needs to be included.

BPE 5 Strategies for en route implementation

No changes required.

BPE 6 Strategies for terminal area implementation

Timeline requires revision.

DCA strategy and current activities need to be described, including KLIA 2 FIR redevelopment etc.

BPE 7 Strategies for Instrument Approach Procedure (IAP) implementation

The list of airports and the timeline for implementation developed during the PBN Implementation Workshop needs to be included.

BPE 8 Transition strategy

The ground-based navaid infrastructure plan needs to be clarified including:

- *Decommissioning of Non-Directional Beacons (**NDB**) based on a policy of non-replacement;*
- *Establishing a policy for not installing additional ground-based navaids;*
- *Maintenance of a basic Very High Frequency Omni-directional Radio Range/Distance Measuring Equipment (**VOR/DME**) structure located at strategic airports as a backup to PBN navigation; and*
- *Issue of an AIC to communicate to users what the transition plan is so that operators can understand the impact to their operations as the infrastructure evolves.*

BPE 9 Description of the tangible benefits

Specific benefits need to be identified such as:

- *Enabling certain operations because of PBN, providing an approach to a runway that previously could not support an Instrument Approach (**IAP**). De-conflicting airport, departure/arrival operations.*

13. Day 4: Air Traffic Management

Major projects involving Air Traffic Services (**ATS**) in Malaysia include:

- Air Asia implementation of RNP AR at 15 airports;
- KLIA 2; and
- Establishment of RNP 2 routes.

To date Malaysian Air Traffic Control (**ATC**) has received no PBN training, however general training is planned in October and November before Air Asia starts RNP AR operations. The contract between Air Asia and GE Aviation does not cover ATC training.

Malaysian ATC management advised that the KLIA FIR airspace concept development and Air Traffic Management (**ATM**) training has been contracted out. They are confident that this will be handled well.

Air Asia expressed concern that separation is conservative and that they will not be able to use their RNP approaches.

In response to the question “What happens with aircraft that are not PBN-equipped (and will not be equipped in the near future) and wish to file IFR flight plans?” DCA responded that operators will not be denied access to airspace.

The APEC Team advised that the impact upon ATC workload must also be considered. Malaysia would need to consider the long-term impact and whether or not to mandate equipage for airspace access.

Several operational issues for ATC were discussed including:

- Vectoring rules for RNP approaches; and
- Vertical intercept of procedures.

The following topics were recommended for inclusion in the ATC Training Syllabus:

- PBN phraseology;
- Vectoring rules;

- Separation requirements;
- Operational issues (e.g. availability prediction);
- Issuing runway transitions;
- Changing runway transitions; and
- Blunder mitigations.

Recommendations:

- *ATC develop methods of sequencing RNP approach traffic with Instrument Landing System (**ILS**) traffic. This is necessary to ensure that the Air Asia RNP AR Project achieves efficiency benefit. Experience gained in Brisbane, Australia should be considered;*
- *A phased implementation of RNP AR approaches is adopted with initial operations restricted to day Visual Meteorological Conditions (**VMC**) to provide controllers with the opportunity to become familiar with and with RNP AR operations before conducting Instrument Meteorological Conditions (**IMC**) operations;*
- *All ATC personnel complete a generic PBN training program; and*
- *DCA reviews and updates the ATS manual to include PBN provisions.*

14. Summary

The PBNRREVP Team visit to Malaysia has provided Malaysia with a sound foundation upon which to pursue the implementation of PBN. The program was very well supported and all sections of the industry contributed enthusiastically.

Building on ICAO FPP and COSCPAP-SEA programs the APEC PBNRREVP has provided Malaysia with the tools to proceed. Basic regulatory provisions were drafted to enable the authorization of PBN operations and procedure design, recommendations made to complete the Malaysia PBN Implementation Plan and participants shared in developing their knowledge of PBN and its application in the Malaysian environment.

The regulatory provisions drafted during the visit are the minimum necessary to proceed. As Malaysia DCA gains experience and additional staff are trained, further development of regulatory documentation will be required.

While the implementation of PBN in Malaysia has been limited to date, all stakeholders have expressed the intention to actively pursue their respective responsibilities. In order for Malaysia to meet the schedule for implementation in accordance with ICAO Resolution A37-11 prompt action is required to overcome some significant difficulties that exist.

It is expected that Malaysia DCA will require continued assistance from APEC and other agencies over the next one to two years in the following areas:

- Development of detailed regulatory documentation; and
- Procedure design training and documentation.

15. Key Action Items

Immediate action is required in the following key areas:

1. The AICs drafted during the APEC Team visit need to be completed and published to provide a regulatory framework for PBN implementation.

2. Further training is required to provide additional qualified DCA FOSIs. Although the current FOSIs are trained and competent, the anticipated workload can be expected to exceed capacity and cause delays in implementation.

3. The lack of sufficient PBN-trained procedure design staff is a significant risk to Malaysia achieving timely implementation.

4. Establishment of a process to ensure that procedure design, including internally by DCA and third party designers, is completed in accordance with ICAO Doc 9905 *The Quality Assurance Manual for Flight Procedure Design*.

5. The training of ATC staff must be completed as planned and in a timely manner to ensure that there is no delay to the implementation of PBN procedures.

6. The Malaysia PBN Implementation Plan should be revised in accordance with the recommendations made during the APEC visit and resubmitted to the Regional ICAO PBN Task Force.

7. Malaysia DCA should publish information to advise the Industry (domestic and foreign) of the Malaysia PBN implementation strategy and timeline.

APPENDIX A

MALAYSIA PBNRREVP TERMS of REFERENCE

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Performance-Based Navigation
Regulatory Review and Evaluation Program

Kuala Lumpur, Malaysia 18–21 September 2012

Asia-Pacific Economic Cooperation (APEC)
30 July, 2012

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Proposed Terms of Reference
APEC PBNRREVP in Malaysia

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To execute this program APEC has contracted with the Ambidji Group to coordinate the work of a team of experts on Performance Based Navigation to share safety oversight training and best practices with DCA Malaysia staff and other local stakeholders.

The project managers wish to invite the Department of Civil Aviation Malaysia to host a one week site visit by an APEC team of PBN experts from 18th to 21st September 2012.

This document represents the proposed program for the APEC Team site visit which has been developed to build upon the ICAO COSCAP/FPP PBN training and workshop activities that are proposed for Malaysia in September.

2. Background

Performance-Based Navigation has proven enormous benefits to the aviation community, both for conserving resources (i.e. saving fuel), reducing the environmental impact (i.e. reduced CO2 emissions and noise in populated areas due to more efficient flight routing), and reducing accidents (i.e. stabilized instrument procedures and increased accurate flight positioning). However, many APEC economies are proceeding very slowing with implementation, primarily due to lack of information or misinformation regarding international and domestic requirements for implementing related technologies and procedures. To date, the ICAO Performance Based Navigation (PBN) task force has made significant progress in developing PBN implementation guidance and establishing broad regulatory requirements. It has set ambitious regional goals for procedural implementation and regulatory oversight of related activities to be carried out by individual economies. The task force has set deadlines for submitting plans to ICAO by the end of 2010 in line with ICAO Assembly Resolutions, established a PBN flight procedural design office in Beijing as a resource to all Asian ICAO states, and acted as ICAO's review board for evaluating the quality and feasibility of each state's PBN implementation plans.

Despite this level of ICAO support, many developing APEC economies are still struggling with successful PBN implementation plans, specifically the components of safety regulatory oversight, development of PBN procedures that would fit their airspace needs, and establishing required equipage for local fleets.

3. Scope of Work

The site visit portion of this project will include a gap analysis on regulatory matters concerning proper PBN implementation and an evaluation of PBN implementation plans with respect to conforming to international standards, and best practices for managing and safely overseeing the PBN implementation process at the government level.

4. Project Objectives

The overall project objective is to address the primary impediments to developing and implementing a robust PBN implementation plan. These include: a lack of clear guidance for regulatory oversight needs, standards, and best civil aviation authority practices; difficulty developing the PBN procedures; and safely implementing procedures once developed. Emphasis will be placed on providing additional guidance to assist in understanding the already-established international regulatory requirements and clarifying what domestic regulations and policy guidance needs to be developed for successful implementation.

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iii) Training with respect to identifying common implementation challenges and how to overcome them with respect to developing PBN procedures, flight validation, and the development of a common set of recommendations and strategies, based on experience that can be used by the participants to ensure successful PBN implementation.

5. APEC Team

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- Mr Kazuto Shiba, Manager Route Planning, All Nippon Airways Co., Ltd (ANA)
- Captain Albert A. Hendon, The Mitre Corporation
- Mr Tass Hudak, The Mitre Corporation.

6. Proposed Topics

Based on discussions with DCA MALAYSIA staff and taking into account the considerable amount of PBN development work already completed in the Malaysia, the following topics are proposed.

1. Review PBN regulatory requirements and recommend strategies for regulatory development.
2. Provide PBN awareness training for all DCA staff and other stakeholders.
3. Work with DCA Flight Operations Inspectors to build upon the COSCAP PBN Operational Approval Training and to develop PBN operational approval framework.
4. Provide technical assistance to DCA Flight Operations Inspectors and other relevant staff in respect of current or pending RNP APCH and/or RNP AR APCH applications for operational approval (e.g. Air Asia).
5. Provide training and technical advice to Malaysia DCA Flight Procedure Design staff and Flight Operations Inspectors with regard to the design and validation of RNP APCH LNAV/VNAV and RNP AR APCH procedures in Malaysia, including the administration of third party design organisation.
6. Review the Malaysia PBN Implementation Plan and provide assistance to ensure that the Plan meets the needs of Malaysian airspace users and the recommendations of the ICAO Regional PBN Task Force.

7. Schedule

The proposed schedule is as follows. If required session times can be re-arranged to suit the availability of key staff.

Day I is intended to be a general session and an opportunity for stakeholders to provide input to the APEC team. The proposed activities will be briefed and any additional topics identified which may need to be included in the program.

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</table>

8. Delivery Method

Day 1 will be a general and open session with briefings provided by the APEC Team. The session will provide an opportunity for stakeholders to raise any additional issues that might also need to be addressed during the APEC Team visit.

Day 1 will include a briefing by APEC experts providing an overview of the PBN concept. The briefing is intended for all stakeholders including management and other personnel not directly involved with PBN implementation but who have a need to understand the terminology and general application of Performance Based Navigation. Time will be made available for participants to raise specific issues and for general discussion with regard to the implementation of PBN.

Days 2 and 3 will be round table working group sessions for specialist staff building upon the previous Operational Approval Training and Implementation Workshop. This format is intended to permit on-the-job style training and mentoring for the responsible personnel. Where necessary the APEC team will provide briefings and technical advice on specific subjects.

Day 4 is a general session to review the outcomes of the week. The APEC Team will provide a PBN Regulatory Review and Evaluation report and make recommendations for any further action required.

9. Attendance

The success of the APEC Team visit depends upon the attendance of DCA and stakeholder personnel with direct responsibility for the tasks to be reviewed.

The following key personnel should attend.

DAY 1:	All stakeholders including:
	ATS staff including ATC
	Flight Standards staff including flight safety inspectors
	Flight Procedure Design
	Airline operator senior pilots/training staff
	Management staff
DAY 2:	Flight Operations Inspectors
	Senior airline operational and training pilots
DAY 3:	Morning Session
	Flight Procedure design staff
	Flight operations inspectors
	Afternoon Session:
	All Stakeholders

DAY 4: Concluding Session: Open to all stakeholders.

10. Reference Documentation

Any relevant existing regulatory or guidance documentation should be forwarded to the APEC Team for review prior to the site visit.

11. Assistance to the Team Members by DCA

The APEC Team site visit will be fully funded by APEC. However it is requested that DCA MALAYSIA will contribute to the program by providing the venue for the site visit, transport to/from the APEC Team hotel, and lunch/refreshments daily for the APEC Team and DCA MALAYSIA/Stakeholder participants.

APPENDIX B

LIST OF ATTENDEES

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APEC PBN REGULATORY REVIEW AND EVALUATION PROGRAMME

Department of Civil Aviation Malaysia
A380 Meeting Room, DCA Putrajaya
18–21 September 2012
Attendance List

No.	Name	Agency	Email / Contact No.	Signature			
				18/9	19/9	20/9	21/9
Department of Civil Aviation (DCA)							
1.	Tay Siew Huang	BIT	taysh@dca.gov.my	√	√	√	√
2.	Dr. Noorlinah G Mohd	BIT	noorlinahgmohd@dca.gov.my	√		√	√
3.	Zainul Abidin bin Maslan	BIT	luniaz@dca.gov.my			√	
4.	Tajul Annwar Ismail	MAvA	tajul@dca.gov.my	√			
5.	Abdul Razak bin Abdul Malik	SAW	razak@dca.gov.my	√	√	√	
6.	Kamal Ibrahim	SAW	kamal@dca.gov.my	√			
7.	Dzul Ezwan bin Mad Yunus	SAW	dzulezwan@dca.gov.my	√			
8.	Mohd Naziran bin Mohammed	SAW	naziran@dca.gov.my	√			
9.	Zulfadhly bin zulkifli	SAW	zulfadhly@dca.gov.my	√			
10.	Mazlan bin Mat Jan	SAW	mazlanjan@dca.gov.my	√			
11.	Capt. Zainal Abidin Aidid bin Omar Azaddin	SOP	aidid@dca.gov.my	√	√	√	√
12.	Capt. Philip Joseph	SOP	philip@dca.gov.my	√	√	√	
13.	Capt. Tan Mong Loong	SOP	tanml@dca.gov.my	√	√	√	√
14.	Capt. Zulkifli bin Abdul Hadi	SOP	Zulkifli.hadi@dca.gov.my	√			
15.	Capt. Chow Weng Cheong	SOP	chowwe@dca.gov.my	√	√	√	√
16.	Nurul Khairiyah binti Samsudin	PUU	khairiyah@dca.gov.my	√	√	√	√
17.	Norahimah Fitri	PUU	norahimah@dca.gov.my	√	√		√
18.	Mior Adli Bin Mior Sallehhuddin	STU	mior.adli@dca.gov.my	√			√
19.	Nagayaindran S.Narayanan	STU	naga@dca.gov.my	√		√	√
20.	Nasuruddin bin Zainol Abidin	STU	nasuruddin@dca.gov.my	√			√

21.	Ahmad Shukri Shamsuddin	STU	shukri@dca.gov.my	√		√	
22.	Abdul Razak bin Ali	STU	razakali@dca.gov.my	√	√	√	√
23.	Chew Lam Leong	STU	chewll@dca.gov.my	√			
24.	V.P.R Nathan	STU	vprnathan@dca.gov.my	√			
25.	Hj. Zulkefli Harun	STU	zulkefliharun@dca.gov.my				√
26.	Nordian bin Ibrahim	STU	nordian@dca.gov.my	√	√	√	√
Others							
27.	Capt. Wong Jay Sheng	AirAsia X	wongjaysheng@airasia.com		√		√
28..	Faizal Bin Mohamad Azmie	AirAsia X	faizalmohamadazmie@airasia.com				
29.	Ahmad Amirul Bin Abdul Manaf	AirAsia	ahmadamirul@airasia.com	√	√	√	√
30.	Capt. Rajesh Gill	AirAsia	rajeshsinghgill@airasia.com	√	√	√	√
31.	Dhaneshvaran Baskaran	AirAsia	dhaneshvaranbaskaran@airasia.com	√	√	√	
32.	Capt Tan Poh Keat	MAS	tanpk@malaysiaairlines.com	√	√	√	√
33.	Ahmad Ilias Aziz	MAS	ilias@malaysiaairlines.com	√	√	√	√
34.	ACP Sathiya Seelan	PDRM	Sathiya101seelan@yahoo.com	√	√	√	√
35.	SUPT. Che Bokhari bin Mohamad	PDRM	bokhari@rmp.gov.my	√	√	√	√
36.	Capt. Idi Nabel	Transmile Air	idinabel@transmile.com	√	√	√	√
37.	Cheng Ling Perng	MAB	cheng@malaysiaairports.com.my		√		
38.	Capt. Mohd Ariffathillah bin Jamel	Firefly	mohdariffathillah.jamel@malaysiaairlines.com	√	√	√	√
39.	Saiful Anuar bin Mohd Sabrie	Firefly	epul@malaysiaairlines.com	√			
40.	Norsaadiah binti Nordin	Firefly	norsaadiah.nordin@malaysiaairlines.com	√			
41.	Muhammad Imran bin Ismail	Transmile	imran.ismail@transmile.com	√	√	√	√

		Air					
42.	Capt. Chomel	AMA	romainchomel@amaerospace.com	√			
43.	Capt. Shafrul Affendy bin Md Noor	MAS	shafrul@malaysuiaairlines.com	√	√	√	√
44.	Arimaran Arivananthas	MAS	ari@malaysiaairlines.com	√	√	√	
45.	Mir Amirul Shah bin Esa	MAS	amirul.esa@malaysiaairlines.com	√	√	√	√
46.	Ruben Sivanathan	MAS		√	√	√	
47.	Capt. Andrew Lim CK	MAS	limck@malaysiaairlines.com		√		
48.	Syaiful Alam	APFT	syaiful@apft.info.com	√			
49.	Mej. Abdul Halim bin Mohd	TUDM	atirah2001@yahoo.com	√	√	√	√
50.	Mej. Salam bin Shukor	TUDM	salam3590@rmafate.net	√	√	√	√
51.	Mej. Azhar bin Ismail	TUDM	azhar.ismail@dgta.gov.my	√	√	√	√
52.	Sandor Szegvari	MFA	sandor.szegvari@gmail.com	√			
53.	Capt. Syed Abdullah	IATAC	syedbsa@iatac.com	√			
54.	Zaidi bin Yusof @ Jusoh	KISTAA	zaidi@kist.edu.my	√			
55.	Mazlan bin Hussin	KISTAA	mazlan.kistaa@kist.edu.my	√			

BIT –Air Traffic Inspectorate Division
SAW – Airworthiness Sector
SOP- Flight Operations Sector
PUU – Legal Advisor
STU – Air Traffic Management Sector
PDRM – Royal Malaysia Police
TUDM – Malaysian Air Force
IATAC - International Aero Training Academy
KISTAA - KIST Aviation Academy

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APPENDIX C

MALAYSIA PBN IMPLEMENTATION WORKSHOP OUTCOMES

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PERFORMANCE-BASED NAVIGATION (PBN) IMPLEMENTATION WORKSHOP
Kuala Lumpur, Malaysia
11–13 September 2012

OUTCOMES AND RECOMMENDATIONS

On 11–13 September 2012, Department of Civil Aviation Malaysia hosted a Performance Based Navigation (PBN) implementation Workshop in Kuala Lumpur, Malaysia with supports from ICAO Asia-Pacific Flight Procedure Program (FPP) Office and ICAO COSCAP South East Asia. The Workshop was attended by 53 participants from various aviation stakeholders in Malaysia, including regulators, military, airline and helicopter operators and air navigation service providers.

The purposes of the Workshop were to identify actions required for successful and timely implementations of PBN for Malaysia recognizing safety and efficiency benefits which can be derived from PBN implementations in en-route, terminal area (SID/STAR) and approach operations and to support PBN goals as agreed in the ICAO Assembly's Resolution A37-11.

The Workshop collectively identified the following 31 action items in 9 areas that need to be accomplished in order to meet the goals of implementing PBN in Malaysia. Each action item is critical in ensuring successful implementation of PBN in Malaysia in accordance with the goals laid out in ICAO Assembly's Resolution A37-11. With leadership from DCA Malaysia, related organizations and agencies are expected to work cooperatively and in due diligence to accomplish the goals.

1. Malaysia PBN Task Force

a. The Workshop recommends DCA Malaysia to re-activate the Malaysia PBN Task Force, which includes invited representatives from all stakeholders, including regulators, air operators, military, airports and air navigation service providers. The Malaysia PBN Task Force should meet regularly every month. The Malaysia PBN Task Force should be chaired by the Director of ATM and should provide regular reports to the Director General.

2. Malaysian PBN Implementation Plan

Noting that State's PBN Implementation Plan is one of the requirements outlined in ICAO Assembly's Resolution A37-11, the Workshop urges the Malaysia PBN Task Force to consider revising the existing PBN Implementation Plan as followings:

a. The *Malaysian PBN Implementation plan* should include all 11 Basic Plan Elements as required by the ICAO Asia-Pacific Regional PBN Implementation Plan. Substantial amount of planning material has already been developed noting the presentations that have been presented at this Workshop. The Malaysia PBN Task Force should utilize this material and incorporate into the Malaysian PBN Implementation Plan which should be resubmitted to ICAO before the next PBN Task Force Meeting in December 2012.
b. The revision of the *Malaysian PBN Implementation Plan* should include transitional plan for decommissioning of conventional navigation aids. The transitional plan should indicate maintenance of ILSs and selected critical VORs and decommissioning plan for NDBs.

c. The revision of the *Malaysia PBN Implementation Plan* should include appropriate Navigation Specifications for each phase of flight as followed:

	2012	2016	2020
En Route	RNAV5	RNP2	RNP2 or ADV RNP
	RNP10 or RNP4	RNP4	RNP2 or ADV RNP
Terminal	RNP1		ADV RNP
Approach	RNP APCH LNAV/VNAV		ADV RNP
	RNP AR APCH if beneficial		
	RNP0.3 for helicopter		

3. PBN Implementations

Noting that ICAO Assembly Resolution A37-11 urges States to implement PBN procedures into all airports by 2016, the Workshop collectively develops a prioritized list for airports which should have PBN procedures implemented. The prioritized list, shown in Appendix A, divides airports into three levels of priority for PBN implementation, namely A (2013-2014), B (2015-2016) and C (2017-2018).

a. The Workshop urges the Malaysia PBN Task Force to consider including the Appendix A as a part of the Basic Plan Element 6 and 7 (BPE 6, 7) of the *Malaysia PBN Implementation* Plan which shall be resubmitted to ICAO prior to the next ICAO PBN Task Force meeting in December 2012.
b. The Workshop participants are committed to work in due diligence to achieve the outcomes as detailed in the Appendix A in order to meet Malaysian obligation to complete the PBN implementation target as part of ICAO Assembly Resolution A37-11

4. Regulations

The Workshop recognized the needs for enhancing regulations to enable safe PBN operations. DCA Malaysia was encouraged to commence these activities during the APEC Visit in September 2012.

a. DCA Malaysia will update the direction under its relevant regulations to serve as an enabling regulation authorizing PBN operation with appropriate operational approval process.
b. DCA Malaysia will also publish information regarding PBN plan and implementation to aviation industry. This process should be completed by the end of 2012.
c. Airworthiness Section of DCA Malaysia will update its Airworthiness Notice to include PBN by the end of 2012.
d. Flight Operation Section of DCA Malaysia will extend the current Operational Guidance Approval Procedures and associated application forms to cover all PBN navigation specifications.
e. The Workshop identified that the current manning level of inspectors in the Flight Operation Section was inadequate for meeting the considerable demands from the operators to obtain PBN OPSPECs.

f. DCA Malaysia should request ICAO COSCAP-SEA to provide in-country support in Malaysia on PBN operational approval in 2013.

5. Obtaining Operational Approval

a. Air Asia will submit application to revise their OPSECS to include all applicable PBN specifications for each fleet in accordance to ICAO PBN Manual by the following schedule
   - RNP APCH , RNP AR APCH -- November 2012
   - RNP 4 -- September 2013

b. Air Asia X will submit application to revise their OPSECS to include all applicable PBN specifications for each fleet in accordance to ICAO PBN Manual by the following schedule
   - RNP 1 -- November 2012
   - RNP 4 -- September 2013

c. Firefly will submit application to revise their OPSECS to include all applicable PBN specifications for each fleet in accordance to ICAO PBN Manual by the following schedule:
   - RNAV 5, RNAV 1, RNP 1 -- June 2013
   - RNP APCH -- December 2013

d. Transmile will submit application to revise their OPSECS to include all applicable PBN specifications for each fleet in accordance to ICAO PBN Manual by the following schedule:
   - RNAV 1, RNP 1 -- December 2012
   - RNP 4 -- September 2013
   - RNP APCH -- December 2013

e. Malaysia Airline will submit application to revise their OPSECS to include all applicable PBN specifications for each fleet in accordance to ICAO PBN Manual by the following schedule:
   - RNP 4 -- November 2012
   - RNP AR APCH (B738) -- December 2012

f. Helicopter operators expressed strong interest and commitments to submit application to revise their OPSECS to include all applicable PBN specifications for each fleet in accordance to ICAO PBN Manual within the 2014. Helicopter operators will form a sub-working group to establish a concrete plan.

6. Additionally, the Workshop anticipated that additional PBN applications will be received from other air operators, such as MASWings.

7. Procedure Design

After considering the procedure design workload for the next few years and the need for Malaysia to have sufficient number of procedure designers who are qualified in accordance with ICAO requirements as detailed in ICAO Doc 9906, the Workshop recognized that the existing lacking of procedure design resources is the major road block for PBN implementation for Malaysia. The Workshop thus recommends that:

a. DCA Malaysia commits sufficient resources to strengthen procedure design section within DCA Malaysia in order to meet PBN implementation obligation of Malaysia.

b. The current procedure design section of DCA Malaysia has three designers officially on staff, two of which have been trained on PBN procedure design. The Workshop strongly recommends DCA Malaysia to support the other procedure designer to attend PBN Procedure Design training which takes place two times a year at the ICAO FPP Office in Beijing. The next PBN PD training at the FPP is scheduled for October 2012.
c. DCA Malaysia should send three PBN-trained procedure designers for a PBN OJT at FPP Beijing during the first half of 2013. The OJT period will focus on updating existing RNAV approach procedure at KLIA to be complied ICAO PBN guidance and the training aims to provide hand-on experience of the trainees under the supervisory of the FPP.
d. DCA Malaysia should recruit two additional full-time procedure designers, noting substantial amount of procedure design requirement and its quality assurance obligation.
e. Under the CNS/ATM project, it was expected that the SID/STAR and airspace structure and organization within Kuala Lumpur FIR, including airports, will be revised in accordance with ICAO PBN guidance. In the short term, the airspace associated with KLIA2 and Subang needed to be re-organized.
f. The Workshop encourages Malaysian Airport to assist with necessary resource to enhance procedure design aiming to increase safety and capacity of the airports themselves.
g. Helicopter operators expressed your willingness to provide necessary resources to assist DCA Malaysia in developing PBN procedures for helicopters.

8. Ground/Flight Validation and Quality Assurance

a. DCA Malaysia should establish appropriate regulations and procedures for the management of third party procedure design organizations.
b. DCA Malaysia should establish Quality Assurance process, including ground and flight validations, for its procedure design obligations. The process should be complied with ICAO requirements as detailed in ICAO Doc 9906.

9. PBN ATC and PBN Familiarization Training

a. DCA Malaysia should conduct necessary ATC trainings to prepare for initial operation of RNP-AR at Penang and Kuching scheduled November 2012.

10. State and Military Aircrafts

a. Malaysian Air Force is invited to be actively involved in PBN planning and implementation for Malaysia and be part of the Malaysia PBN Task Force.
b. Malaysian military is invited to send appropriate officers to attend future ICAO PBN courses.

International and Domestic Airports

	Airport	ICAO	IATA	RWY	ILS	RNP APCH LNAV/VNAV	RNP AR APCH	RWY	NPA	RNP APCH LNAV/VNAV	RNP AR APCH	Priority
1	Langkawi	WMKL	LGK	03	Yes	Yes	Yes*	21	No	Yes	Yes*	A
2	Alor Setar	WMKA	AOR	04	Yes	Yes	Yes	22	No	Yes	Yes	B
3	Penang	WMKP	PEN	04	Yes	Yes	Yes*	22	Yes	Yes	Yes*	A
4	Ipoh	WMKI	IPH	04	Yes	Yes		22	No	Yes		B
5	Subang	WMSA	SZB	15	Yes	Yes		15	ILS	Yes		A
6	KLIA	WMKK	KUL	All	Yes	Yes	Yes	All	ILS	Yes	Yes	A
7	Melaka	WMKM	MKZ	03	Yes	Yes		21	Yes	Yes		B
8	Johor Baru	WMKJ	JHB	16	Yes	Yes	Yes	34	Yes	Yes	Yes	B
9	Kota Baru	WMKC	KBR	10	Yes	Yes	Yes	28	Yes	Yes	Yes	B
10	K.Trengganu	WMKN	TGG	04	Yes	Yes	Yes	22	Yes	Yes	Yes	B
11	Kerteh	WMKE	KTE	34	Yes	Yes		16	Yes	Yes		B
12	Kuantan	WMKD	KUA	36	Yes	Yes		18	Yes	Yes		B
13	Kuching	WBGG	KCH	25	Yes	Yes	Yes*	07	Yes	Yes	Yes*	A
14	Sibu	WBGS	SBW	13	Yes	Yes	Yes	31	Yes	Yes	Yes	A
15	Bintulu	WBGB	BTU	17	Yes	Yes	Yes	35	Yes	Yes	Yes	B
16	Miri	WBGR	MYY	02	Yes	Yes	Yes	20	Yes	Yes	Yes	A
17	Mulu	WBMU	N/A	03	No	Yes		21	No	Yes		A
18	Limbang	WBGJ	N/A	04	No	Yes		22	Yes	Yes		A
19	Labuan	WBKL	LBU	14	Yes	Yes	Yes	32	Yes	Yes	Yes	B
20	K.Kinabalu	WBKK	BKI	02	Yes	Yes	Yes*	20	Yes	Yes	Yes*	A
21	Sandakan	WBKS	SDK	08	Yes	Yes	Yes	26	Yes	Yes	Yes	B
22	Lahad Datu	WBKD	LDU	29	No	Yes		11	No	Yes		A
23	Tawau	WBKW	TWU	24	Yes	Yes	Yes	06	Yes	Yes	Yes	B

Rural Airports

	Airport	ICAO	IATA	RWY	RNP APCH LNAV/VNAV	RNPAR APCH	RWY	RNP APCH LNAV/VNAV	RNPAR APCH	Priority
1	Bario									B
2	Bakalalan									B
3	Long Banga									B
4	Long Seridan									C
5	Long Lellang									C
6	Long Pasia									C
7	Marudi									B
8	Kapit									C
9	Belaga									C
10	Kudat									B
11	Pamol									C
12	Tomanggong									C
13	Semporna									C
14	Sahabat									C
15	Mukah									B
16	Lawas									B
17	Tg Manis									C
18	Long Akah									B
19	Long Semadoh									C
20	Long Sukang									C
21	Tioman									B
22	Redang									C
23	Sg Tiang									C
24	Pangkor									B

APPENDIX D

POWERPOINT PRESENTATION: PRINCIPLES OF PBN

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Principles of Performance Based Navigation

Kuala Lumpur, Malaysia

18th-21st September 2012

CAASD

MITRE

1

Agenda

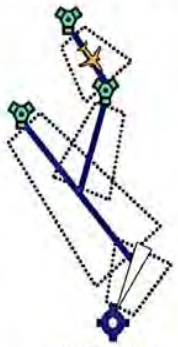
10:30	Introduction to PBN
12:00	Lunch
13:00	Implementation
14:15	Break
14:30	PBN Approvals
16:00	Adjourn

MITRE

2

Conventional Navigation

Current Ground NAVAIDs



Limited Design Flexibility

Source: FAA

System Constraints

- Aircraft must navigate either to or from a ground-based navaid. No "free flight."
- Large obstacle protection areas limit design options or prohibit flight
- Cost to maintain infrastructure
- Precision and repeatability to support advanced concepts does not exist

Typical Navigation Aids

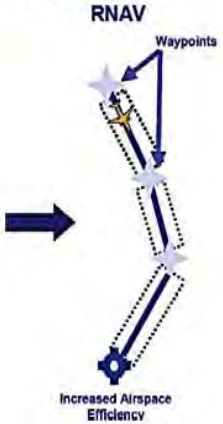
- VHF Omni Directional Range (VOR)
- Distance Measuring Equipment (DME)
- Instrument Landing System (ILS)
  - Localizer (LOC)
  - Glideslope (GS)

MITRE

3

An Evolution. . .
Area Navigation (RNAV)

- **Modern avionics use a combination of navigation sensors to derive a position solution**
  - **Space-based**
    - GPS, GLONASS, Galileo, et al
  - **Ground-based**
    - DME/DME, VOR/DME
  - **Aircraft-based**
    - Inertial Reference System (IRU) with DME/DME updating
- **This position-in-space enables Area Navigation (RNAV)**



Source: FAA

MITRE

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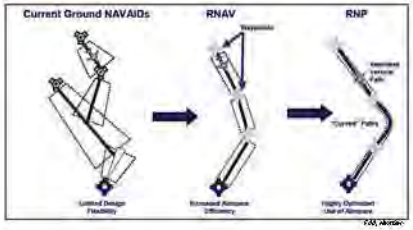
PBN Definition:
International Civil Aviation Organization (ICAO)

"Area navigation (RNAV) based on performance requirements for aircraft navigating on an air traffic service (ATS) route, terminal procedure or in a designated airspace.

"Performance requirements are expressed in navigation specifications in terms of accuracy, integrity, continuity, availability and functionality needed for the proposed operation in the context of a particular airspace concept."

Source: ICAO MID/RGCP/ASG, PBN Seminar

Evolution to PBN



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PBN History

- Until PBN, aircraft navigation specifications were specified directly in terms of sensors such as ground-based navigation aids (NAVAID) and/or a space-based global navigation satellite system (GNSS).
- This created dependencies for sensor-specific routes and sensor-specific operations
- It became evident that there existed:
  - No clear guidance for:
    - Aircraft requirements
    - Operating procedures
    - Training requirements
  - No clear understanding for a match between onboard avionics and navaids
  - Problems with interoperability

MITRE

6

The Need for Harmonization

- No clear requirements results in:
  - Difficulty to implement
    - Navigation centric only, no CNS requirements
    - No functionality requirements
    - No operating procedures

    . . . And leads to:
  - Potentially unsafe operations

NEED FOR REGULATORY FRAMEWORK

MITRE

7

What Does PBN Offer?

- PBN augments legacy RNAV by framing:
  - Performance requirements
    - "What capability do I need?"
    - Specification Based
  - Functionality requirements
    - Cockpit displays, alerts, and monitoring
  - Operating requirements
    - Flight crew training and procedures

MITRE

8

ICAO DOC 9613 (Vol I) The PBN Concept

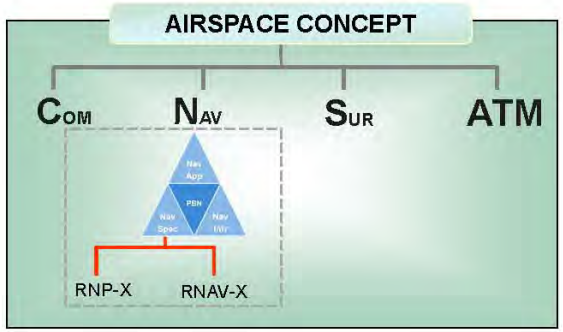
PART A : The PBN Concept

PART B: Implementation Guidance

MITRE

9

ICAO Generalized Airspace Concept



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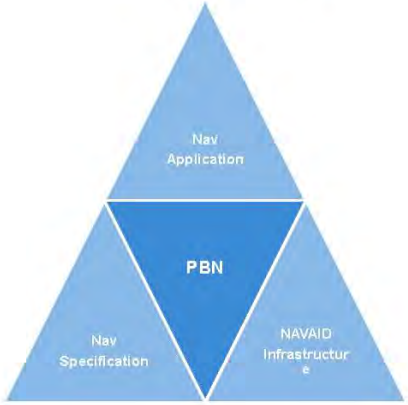
10

ICAO PBN Concept



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11

Navigation Application

Area of Application	Navigation Accuracy (NM)	Navigation Specification	Requires onboard monitoring and alerting	Navaid Sensors
Oceanic/Remote	10	RNAV 10 / (RNP 10)	No	GNSS / INS-IRU
	4	RNP 4	Yes	GNSS
En route – Continental	5	RNAV 5	No	GNSS / INS-IRU / DME-DME / DME-DME-IRU / DME-VOR
En route – Continental and Terminal	2	RNAV 2	No	GNSS / DME-DME / DME-DME-IRU
	2	*RNP 2 (TBD)*	Yes	GNSS
Terminal	1	RNAV 1	No	GNSS / DME-DME / DME-DME-IRU
	1	Basic RNP 1	Yes	GNSS
Approach	0.3	RNP APCH	Yes	GNSS
	0.3-0.1	RNP AR	Yes	GNSS

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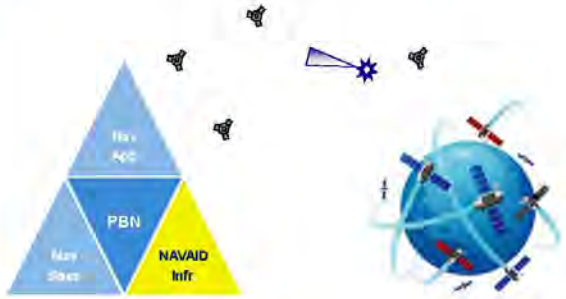
12

NAVAID Infrastructure



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PBN Fundamentals

1. PBN requires the use of an on-board RNAV system;
2. PBN creates requirements for airworthiness certification and operational approval to use RNAV systems in airspace implementations;
3. The RNAV system's functionality as well as its navigation accuracy in the navigation aid environment of the subject airspace must conform to the requirements stipulated in the relevant ICAO navigation specification.
4. PBN will eliminate the regional differences of various Required Navigation Performance (RNP) and Area Navigation (RNAV) specifications that exist today.

Simply put, for PBN, both the aircraft and air crew have to be qualified against the particular Navigation Specifications required for operation in the airspace.

MITRE

PBN Goals

1. Ensure safe and efficient performance of the global air navigation system.
2. Improve performance of the air navigation system.
3. Implement RNAV and RNP ATS routes and approach procedures worldwide.
4. Develop RNP procedures providing high track and velocity-keeping accuracy to maintain separation.

MITRE

Idealized Evolution: Gate-to-Gate PBN

MITRE

PBN Benefits

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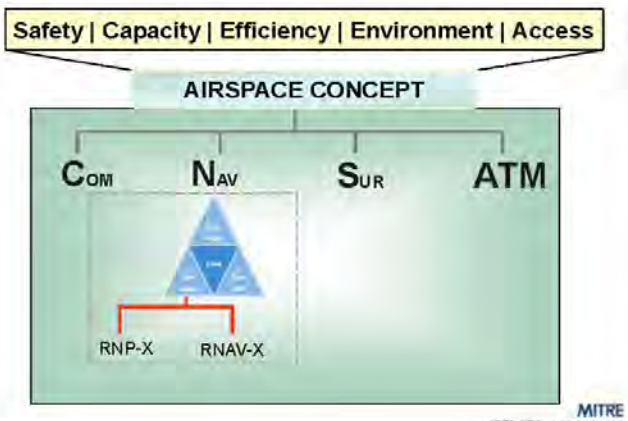
PBN is an Enabler

- RNAV and RNP can be used in all phases of flight and may result in:
  - Improved access to airspace
  - Reduction in the lateral separation between aircraft tracks due to increased track predictability and repeatability
  - Reduced environmental impact from improved route/procedure designs
  - Reduced fuel consumption from shorter, more direct routes
  - Improved situational awareness for the pilot
  - Reduced workload for both controllers and pilots

MITRE

Strategic Objectives

Safety | Capacity | Efficiency | Environment | Access



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Strategic Objectives

- **Safety** – Implementation of RNP Instrument Approaches to reduce unstabilized approaches that lead to runway excursions
- **Capacity** – Planning additional runways at an airport to improve capacity requires changes to the existing airspace concept
- **Efficiency** – Use of PBN procedures to optimize arrival and departure paths
- **Environment** – Satisfy noise abatement restrictions using PBN procedures to precisely route air traffic away from noise sensitive areas
- **Access** – Improve access to airports with conventional procedures by leveraging lower PBN minima

MITRE

Examples of PBN-Enabled Benefits and Applications

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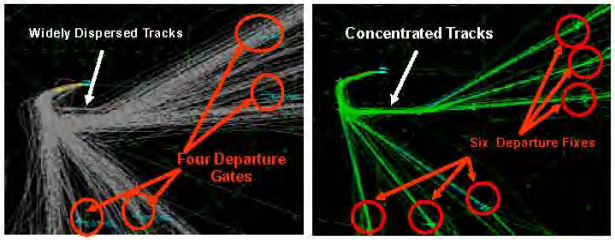
Hartsfield-Jackson Atlanta International Airport (KATL) Departures 2005

Pre-RNAV | **Post-RNAV**



Source: The MITRE Corporation

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Hartsfield-Jackson Atlanta International Airport (KATL) Departures 2007

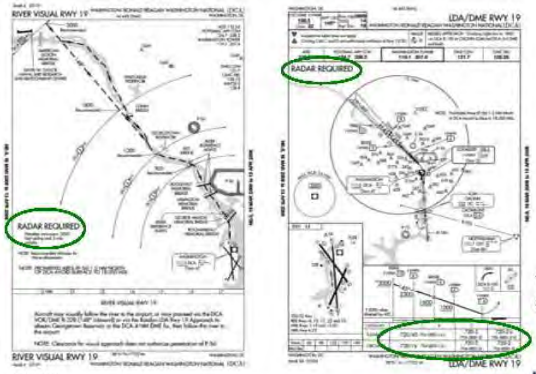
Source: The MITRE Corporation

- **KATL Evolved to include 16 departure gates**
- Approximately 94% of daily departures are RNAV-capable
- More departure lanes and exit points to the en route airspace
  - Capacity gain of 9-12 departures per hour
- Repeatable and predictable paths
- Benefits
  - Increased throughput
  - Reduced departure delays
  - USD $30M annual benefit (at 2007 demand levels)

MITRE

Example: Access DCA Visual and LDA Approaches

3,500 ft Ceiling



720 ft Ceiling

Source: FAA

MITRE

DCA RNAV (RNP) AR Approach

Source: FAA

Source: The MITRE Corporation

- 3D guidance to the runway improves safety
- RNP corridor avoids prohibited airspace
- Increased access to RWY 19
  - **475 ft ceiling**

MITRE

25

New York JFK Problem

New York airspace is among the busiest in the world with four major airports located within 10 miles of each other. Runway use is dependent at all four airports.

Preliminary Activities

MITRE

26

Parkway Visual

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27

The IFR Problem

- **A frequently used configuration at JFK includes use of the VOR or GPS approach with a visual transition to runways 13L/R.**
- **JFK may only use this procedure when ceiling is 800' or higher and visibility is 2.5 miles or better.**
- **If weather conditions require JFK to change runways, runway use at LGA, TEB, and EWR is impacted.**

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28

The Solution

- Design a new curved RNP IFR precision approach that follows the VOR/GPS flight track to DMYHL *and* the visual track to the runway.
- Provide lateral and vertical guidance to the runway.

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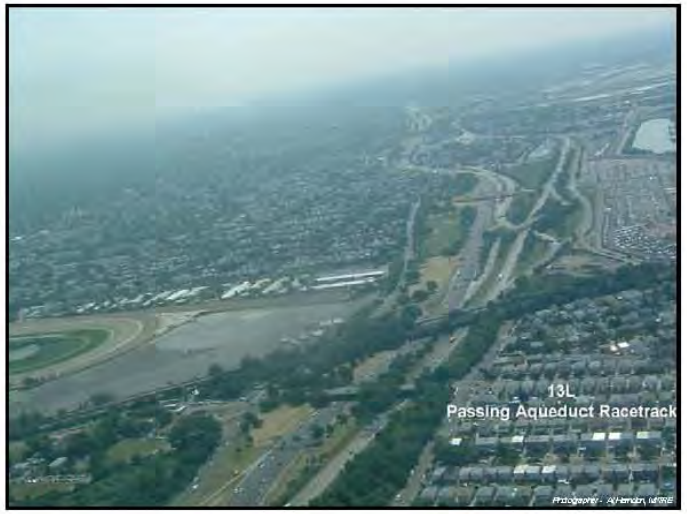
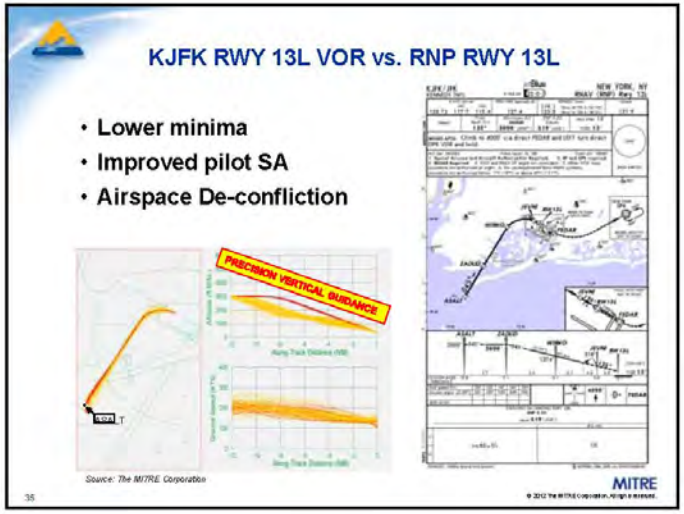
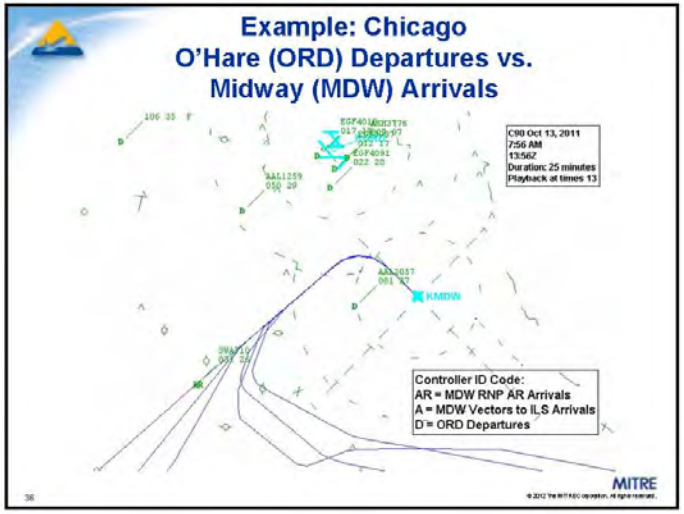


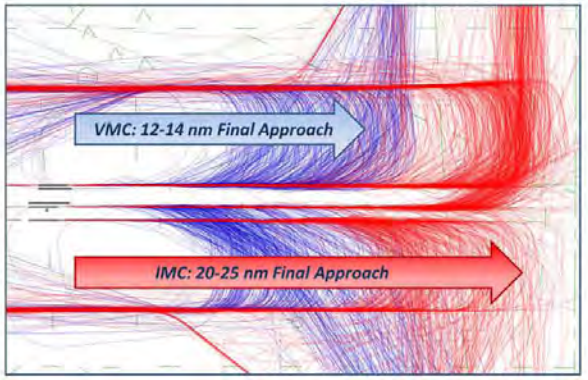

13L
Approaching minimums of 482'


13L
400', rolling wings level
Ramada Hotel (108')


KJFK RWY 13L VOR vs. RNP RWY 13L
• Lower minima
• Improved pilot SA
• Airspace De-confliction
PRECISION VERTICAL GUIDANCE
Source: The MITRE Corporation
MITRE


Example: Chicago
O'Hare (ORD) Departures vs.
Midway (MDW) Arrivals
C90 Oct 13, 2011
7:56 AM
13:56Z
Duration: 25 minutes
Playback at times 13
KMDW
Controller ID Code:
AR = MDW RNP AR Arrivals
A = MDW Vectors to IL,S Arrivals
D = ORD Departures
MITRE

Example: New Separation Standards



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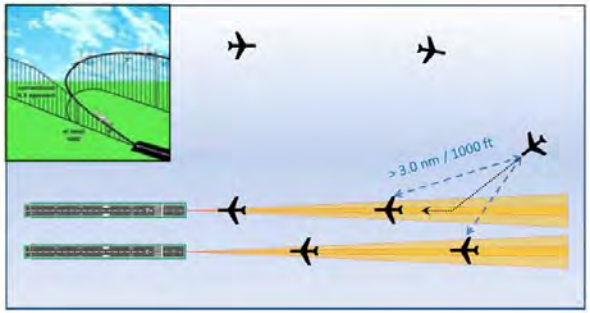
Terminal Radar Separation



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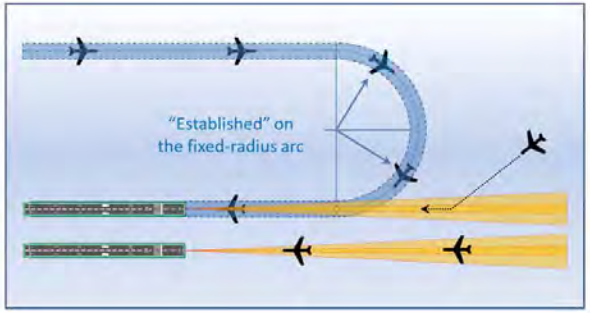
RNP-Established



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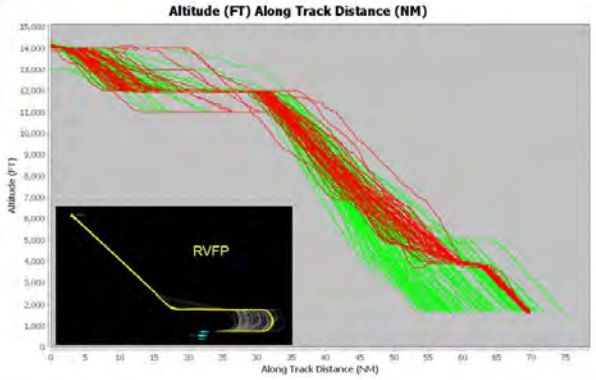
KATL Flight Trials (RW26R)



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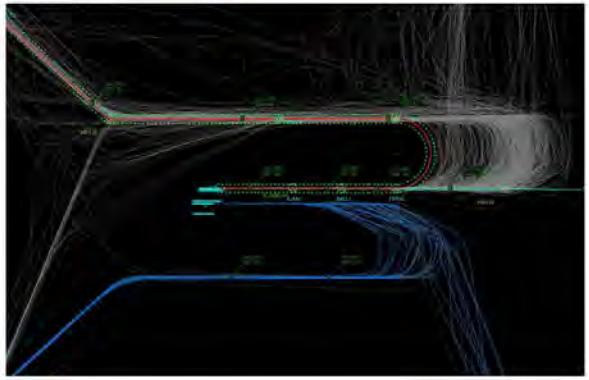
RNP Established



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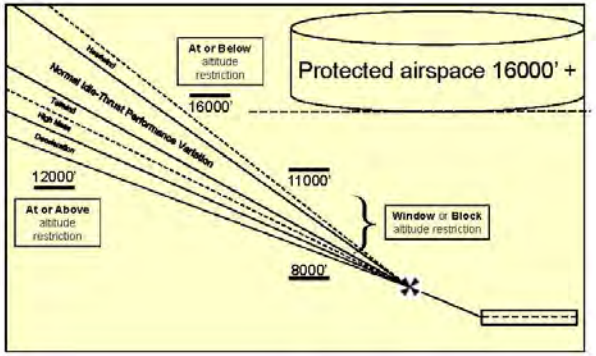
41

Continuous Descent Operations



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42

KPHX: EAGUL FIVE

- Extensive use of speed and altitude restrictions
- PHX RNAV STAR OPDs have been an iterative exercise with several "tweaks" to speeds and altitudes
- Greater reliance on modeling and simulation tools may reduce the need for an iterative approach

- Vertical profiles specific to landing direction (East vs West)
- ARTCC must issue landing direction prior to HOMRR
- This required special agreements with ZAB and ZLA since runway assignment is normally a TRACON function

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43

CDO Benefits

May 2008 Demos:

- North Arrival STAR at Atlanta (ATL)
  - 144 Liters of fuel savings and 360kg reduction in CO2 emissions per flight
- North Arrival STAR at Miami (MIA)
  - 182-197 liters of fuel savings and 460-500kg reduction in CO2 emissions per flight

600 CDO night demos at ATL from August – November 2008

- Two North Arrival STARs
- 151-227 liters of fuel savings and 380kg reduction in CO2 emissions per flight

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44

ICAO PBN Implementation Process

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ICAO DOC 9613 (Vol I) Implementation Guidance

PART A : The PBN Concept

PART B: Implementation Guidance

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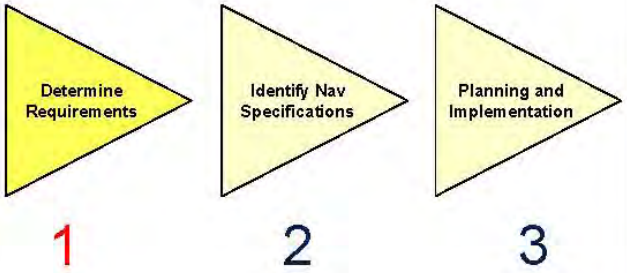
ICAO Implementation Guidance Processes



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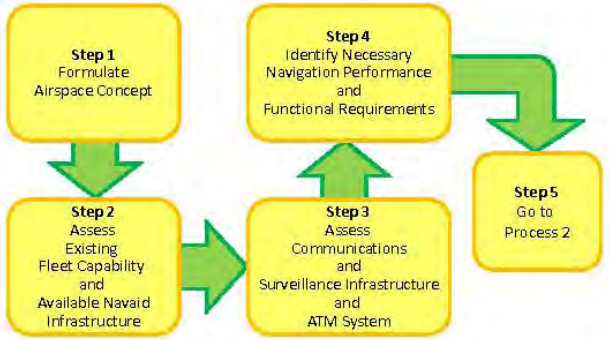
Process 1: Determine Requirements



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Step 1: Formulate an Airspace Concept

- An Airspace Concept is developed as a *general vision* or *master plan* which will meet the strategic objectives and operational requirements of the PBN implementation.

Safety | Capacity | Efficiency | Environment | Access

AIRSPACE CONCEPT

COM | NAV | SUR | ATM

* Performance-based Navigation (PBN) Manual – ICAO Doc 9613, Chapter 2, Section 2.2.2

MITRE

Step 1 Airspace Concept Definition and Components

- Must be defined in sufficient detail so that supporting navigation functions can be identified.
- Relevant factors:
  - Airspace organization and management (e.g., ATS route placement, SIDs/STARs, and ATC sectorization)
  - Separation minima and route spacing
  - Instrument approach procedure options
  - ATC operations
  - Flight crew operations
  - Airworthiness and operational approvals

MITRE

Step 1: Airspace Concept Inputs

Input 1: User Requirements

- IFR, VFR, Military, Civil, Domestic, International
- Balance strategic objectives
  - Trade studies may be needed for competing requirements
  - Alternate means of meeting requirements

Input 2: Airspace Requirements

- Traffic growth, volume and composition
- Available CNS-ATM infrastructure
- Route and procedure design criteria
- Assess minimum navigation functions needed to support the operational requirement against the aircraft fleet mix
- Define the required ATS route spacing

Input 3: Approach Requirements

- Leverage existing capabilities to reduce cost
- Determine approach types that will meet the airspace needs:
  - Straight or curved paths
  - Runway configuration
    - Parallel or converging multiple runways
    - Independent or dependent runway approaches
  - Approach redundancy

Input 4: Other Considerations

- Arrivals
- Departures
- Environmental factors requiring consideration and accommodation
- Any expected impacts to flight plan submission or processing
- Pilot and controller workload

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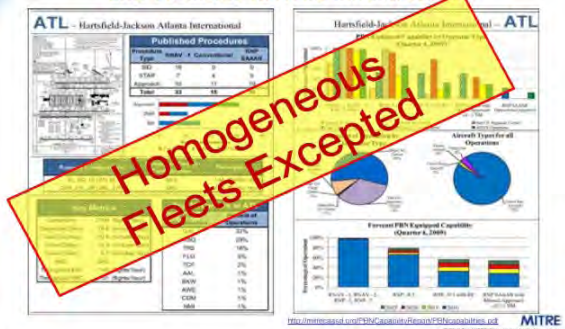
Step 2 Assessment of Existing Fleet Capability and Available NAVAID Infrastructure



http://mmecasd.com/PBN/Capability/Report/PBNcapabilities.pdf

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Step 2
1. Assessing Aircraft Fleet Capability

- Must accommodate varying levels of navigation equipage.
- Many states will need to support a mixed-equipage traffic environment for a significant time period.
  - Are sufficient aircraft equipped with GNSS capability?
  - Can failures of GNSS be mitigated by other means of navigation (e.g., DME-based RNAV, conventional navigation, or ATS surveillance service)?
  - On-going provision for maintenance of a minimal ground-based navigation system

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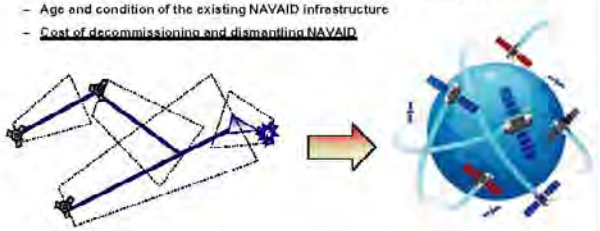
Step 2
2. Assessing NAVAID Infrastructure

- States currently provide a network of ground-based NAVAIDs to support en route, terminal, and approach operations.
- Full transition to satellite-based RNAV may take years and depend on:
  - Fleet attrition or operator retro-fit (upgrade)
  - Need to maintain ground infrastructure as a backup to non-GNSS equipped aircraft
  - Age and condition of the existing NAVAID infrastructure
  - Cost of decommissioning and dismantling NAVAID



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Step 3
Assessment of the Existing CNS/ATM Infrastructure

- ATS surveillance
  - Other than primary and/or secondary surveillance radars, newer ATS surveillance systems, such ADS-B, can be expected to play an increasing role
- Communication
  - States currently provide voice communication services through VHF and HF radio. VHF service, in particular, is widely available and is expected to be maintained (with or without augmentation by data link communications)
- ATM
  - The evolution of a state's ATM system to meet the needs of PBN implementation must be considered:
    - Reduced separation minima affects conflict detection tools
    - If required time of arrival is included in an Airspace Concept, the automation system will need to be designed accordingly
    - Other considerations...

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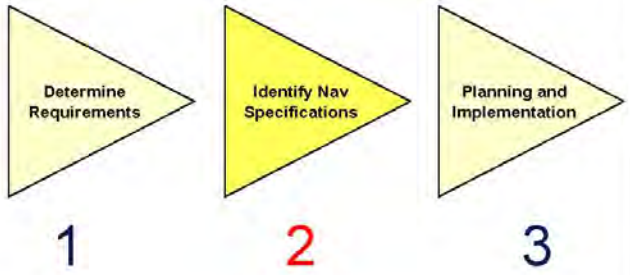
Step 5
Go to PBN Process 2

Step 4
Identify Necessary Navigation Performance and Functional Requirements

- The decision on the choice of an ICAO RNAV or RNP navigation specification is not only determined by aircraft performance requirements (e.g., accuracy, integrity, continuity, and availability).
  - Also may also be determined by the need for specific functional requirements (e.g., leg transitions/path terminators, parallel offset capabilities, holding patterns, and navigation databases).
- The proposed navigation functional requirements also need to consider:
  - The complexity of RNAV procedures envisaged
  - Domain

MITRE

ICAO Implementation Guidance Processes



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Input to Process 2

- Process 1 Results
  - Navigation functional requirements
  - ~~Fleet capability~~
  - CNS/ATM capabilities
- Can the requirements of a particular Navigation Specification be met?

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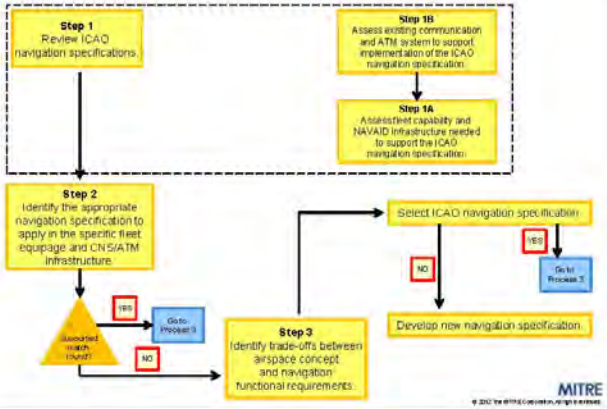
ICAO Process 2



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Process 2

- Step 1: Find a potential Nav Spec match
  - Doc 9613, Vol II, Part B
  - Requirements identified in Process 1
    - Fleet, NAVAID Infrastructure, CNS/ATM readiness
- Step 2 → Process3:

else. . .

- Step 3 : Explore the trade space
  - Airspace concept vs functional requirements

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PBN Process 2
Step 3: Trade-offs

- Reasons which could explain the lack of a match:
  - Incorrect identification of functions required for the airspace concept from PBN process 1
  - Omission of leg types required for RNAV in terminal airspace (i.e. Fixed-radius transitions for en route closely-spaced parallel tracks)
- Goal is to find an exact Nav Spec match
  - Something has to give!
    - Functional requirements (based on fleet mix)
    - Airspace concept

POTENTIAL FOR DILUTED BENEFIT

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Example: Trade-Off (1 of 2)

- Functionality: Parallel offset
  - Might be possible to adjust the functional navigation specification requirement
    - Alternative to parallel offset capability in a continental airspace could be the creation of radar vectoring areas
      - Off track vectoring to facilitate climb and descent of overtaking traffic

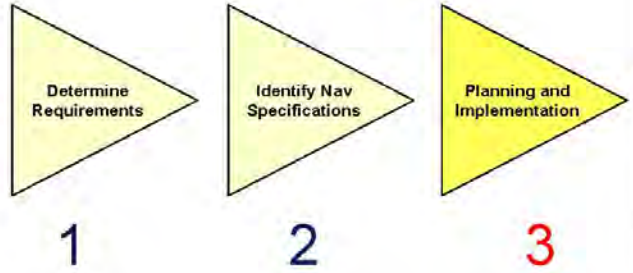
MITRE

No Compromise?

- If trade-offs are acceptable, a nav spec can be chosen
  - Not very likely, but. . .
- Otherwise a <u>new navigation specification must be developed</u>
  - Expensive
  - Time consuming
  - Subject to global review

MITRE

ICAO Implementation Guidance Processes



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Process 3: Planning and Implementation

- Before you get started consider that
  - Implementing Nav Specs in non-terminal areas often requires coordination with your neighbors
  - Continuity of operations is needed to maximize benefits

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Implementation Considerations

- The decision to mandate a requirement for one or more ICAO RNAV or RNP specifications should only be considered after several factors have been considered:
  - Operational requirements of the airspace users (civil/military and IFR operations) and those of ANSPs
  - Regulatory requirements at both international and national levels
  - Proportion of the aircraft population currently capable of meeting the specified requirements and the cost to operators that will need to equip aircraft to meet the navigation specification
  - Benefits in terms of safety, capacity, improved access to airspace/airports, and environment to be derived from implementing the Airspace Concept
  - Impact on operators in terms of additional flight crew training
  - Impact on flight crews in terms of workload
  - Impact on controller workload and facilities (automation and flight plan processing), particularly in a mixed navigation environment

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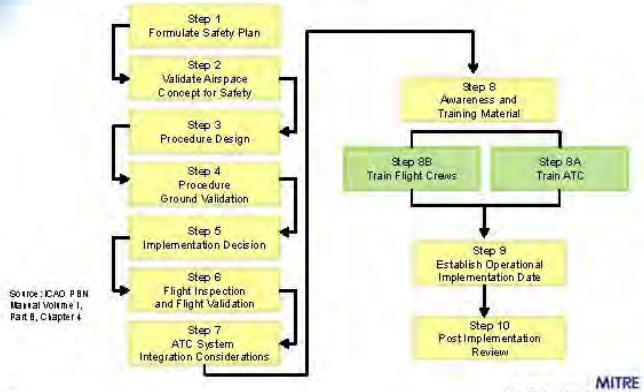
ICAO PBN Process 3



Source: ICAO PBN Manual Volume I, Part B, Chapter 4

MITRE

Process 3. Step 1 of 10 Formulate a Safety Plan

- The SMM (Doc 9859) assists states in fulfilling the requirements of Annexes 6, 11, and 14 with implementation of SMS by operators and service providers
- The Safety *Plan* details how the safety assessment is accomplished

MITRE

Process 3. Step 3 of 10
Procedure Design

- A total system approach to the implementation of the Airspace Concept means that the procedure design process is an integral element
- The procedure designer is a key member of the Airspace Concept development team

Process 3. Step 3 of 10
Procedure Design

- Procedure designers need to ensure that the procedures can be coded in ARINC 424 format
- Training and experience are the major challenges facing procedure designers:
  - Many are not familiar with either the path or terminators used to code RNAV systems or the functional capabilities of different RNAV systems
  - Close cooperation between procedure designers and the data suppliers can help to mitigate experience issues

Process 3. Step 4 of 10
Procedure Ground Validation

- The development of an RNAV or RNP instrument flight procedure or ATS route follows a series of steps:
  - Origination of data through user survey
  - Preliminary design and test
  - Final publication of the procedure in the AIP
  - Coding of the procedure for use in an airborne navigation database
- Each step of the procedure design process requires a quality control process to ensure accuracy and integrity are achieved and maintained :
  - Quality control procedures are detailed in PANS-OPS (Doc 8168), Volume II

Process 3. Step 4 of 10
Procedure Validation

- **PANS OPS, Volume II, *Construction of Visual and Instrument Flight Procedures*, provides design and quality assurance guidance**
- **ICAO Document 9906, Volume 1, outlines the requirements for flight procedure design quality assurance**

Process 3. Step 4 of 10
Procedure Ground Validation

- PANS-OPS (Doc 8168) requires that each procedure undergo a validation process before an RNAV or RNP route or procedure is published
- The objective of validation is to:
  - Provide assurance that adequate obstacle clearance has been provided
  - Verify that the navigation data to be published, as well as that used in the design of the procedure, are correct
  - Verify that all required infrastructure, such as runway markings, lighting, and communications and navigation sources are operative
  - Conduct an assessment of flyability to determine that the procedure can be safely flown
  - Evaluate the charting, required infrastructure, visibility, and other operational factors

MITRE

Process 3. Step 4 of 10
Procedure Validation Tools

- US FAA Order 8900.1, Volume 11, Chapter 12, specifies the requirements for "INSTRUMENT FLIGHT PROCEDURE VALIDATION"
- Several procedure validation tools are available which add confidence in the design prior to publication

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Process 3. Step 5 of 10
Implementation Decision

- The decision of whether to proceed with implementation will be based on certain deciding factors. These include:
  - Whether the ATS route/procedure design meets air traffic and flight operations needs
  - Whether safety and navigation performance requirements have been satisfied
  - Pilot and controller training requirements
  - Whether changes to flight plan processing, automation, or AIP publications are needed to support the implementation
- Flight validation may be needed to make a decision

MITRE

Process 3. Step 6 of 10
Flight Inspection and Flight Validation *(1 of 2)*

- Flight inspection of NAVAIDs involves use of specially equipped test aircraft to gauge the actual coverage of the NAVAID infrastructure
  - Ensures that the respective NAVAID supports the procedure's arrival and departure routes as designed by the design specialist
- Flight validation continues the procedure validation process noted in Step 4
  - Confirms the validity of the terrain and obstruction data used to construct the procedure
  - Ensures the track definition takes the aircraft to the intended aiming point

MITRE

Process 3. Step 6 of 10
Flight Inspection and Flight Validation *(2 of 2)*

- Flight validation results may reveal the need to refine and improve the draft procedures
- The *Manual on Testing of Radio Navigation Aids (Doc 8071)* provides general guidance on test and inspection of NAVAIDS
  - Ensures that radio navigation systems meet the SARPs in Annex 10, *Aeronautical Telecommunications, Volume I*
- *PANS-OPS (Doc 8168), Volume II, Part 1, Section 2, Chapter 4, Quality Assurance*, provides additional guidance on instrument flight procedure validation

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Process 3. Step 7 of 10
ATC System Integration Considerations *(1 of 5)*

- The new Airspace Concept may require changes to the ATC system interfaces and displays to ensure controllers have the necessary information on aircraft capabilities

  Note: Considerations arising from mixed equipage scenarios are discussed in the following slides.
- Such changes could include:
  - Modifying the air traffic automation's Flight Data Processor (FDP)
  - Making changes, if necessary, to the Radar Data Processor (RDP)
  - Requiring changes to the ATC situation display
  - Requiring changes to ATC support tools
- There may be a requirement for changes to ANSP methods for issuing NOTAMS

MITRE

Process 3. Step 7 of 10
Mixed Navigation Environments *(2 of 5)*

- **ATC system must provide the capability of identifying different navigation specifications from the ATC flight plan**
- **Different separation minima and route spacing are applied to different navigation specifications**
  - Varied separation minima introduce complexity and increase ATC workload

MITRE

Process 3. Step 7 of 10
Mixed Navigation Environments *(3 of 4)*

- **Mixed navigation environments can potentially have a negative impact on ATC workload, particularly in dense en-route or terminal area operations**
- **Also dependent on the complexity of the ATS route**
  - SID and STAR route structure
- **ATC capability in a mixed mode environment may vary**
  - Experience shows that ATC has only been able to accept a mixed environment where 90 per cent of the traffic is approved to the required navigation specification
  - ATC Decision Support Tools can ease this burden
- **Mixed navigation must be properly assessed**

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Process 3. Step 8 of 10
Awareness and Training Material

- PBN implementation will involve considerable investment in terms of training, education, and awareness material for both flight crews and controllers
- In many states, training packages and computer-based training have been effectively used
  - ICAO provides additional training material and seminars
- Each navigation specification should address the appropriate education and training for flight crews and controllers

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Process 3. Step 9 of 10
Establishing Operational Implementation Date

- The state should establish an "effective" start date in accordance with the requirements in the data processes
- Experience has shown that an additional time period (e.g., one to two weeks) should be allocated prior to the operational implementation date
  - Additional time is to ensure ground and airborne system data are properly loaded and validated in the respective databases

MITRE

Process 3. Step 10 of 10
Post-Implementation Review

- Following implementation, the system must be monitored to ensure that safety is maintained and strategic objectives are being achieved
- If unforeseen events occur after implementation, the project team should initiate mitigation measures as soon as possible
  - In exceptional circumstances, withdrawal of RNAV or RNP operations may be required pending resolution of the specific problems
- A system safety assessment should be conducted after implementation and evidence collected to verify that the safety of the system is ensured
  - *Reference the SMM (Doc 9859)*

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Questions?

Source : Tess Hedek

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APPENDIX E

DRAFT PBN AIC

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MALAYSIA

XX / 2012
DD MMM

Performance Based Navigation (PBN) – FLIGHT OPERATIONS

1. Introduction.

1.1

2. Definitions.

2.1 Performance Based Navigation (PBN) means

2.2 Navigation Specifications means

2.3 Operational Approval means

2.4 AOC means

2.5 OPSPEC means

3. Regulatory Requirements.

3.1 An aircraft operating within PBN-designated routes/procedures/airspace shall obtain an approval for the relevant appropriate Navigation Specifications as follows:

- RNP 10
- RNP 4
- RNP 2
- RNP 1
- Advanced RNP
- RNP 0.3
- RNP APCH LNAV
- RNP APCH LNAV/VNAV
- RNP AR APCH
- RNAV 5
- RNAV 1 and RNAV 2

3.2 An Operator shall apply to the DCA for Operational Approvals in accordance with the guidance provided by ICAO in ICAO Doc 9613: PBN Manual as amended from time to time or directed otherwise by DCA Malaysia.

3.3 An application shall be submitted using the appropriate Application/Check Form.

3.4 For AOC holders, an operational approval will be granted by the DCA in the form of an OPSPEC to operators.

3.5 Operators who have an existing OPSPEC authorizing PBN approach operations are authorized to continue their operations (including RNAV IAP) until 31 December 2013. Such Operators shall demonstrate to the DCA their compliance for relevant PBN approach operations as required by the requirements in paragraph 3.2 prior to 31 December 2013.

3.6 Operators who have an existing approval for B-RNAV and/or P-RNAV are authorized to continue their operations for RNAV-5 and/or RNAV-1, respectively, until 31 December 2013. Such Operators shall apply to the DCA for the reissue of OPSPEC authoring RNAV-5 and RNAV-1 operations prior to 31 December 2013.

3.7 For non-AOC holders, to conduct PBN operations, aircraft must be appropriately equipped and pilots need to be appropriately trained.

4. Training.

4.1

5. Demonstration of Compliance

5.1 All operators must provide an Operations Specifications and Operations Manual amendment for approval by DGCA in order to provide information and instruction with PBN approval. This information should include:

a) Aircraft navigation/PBN capability, and

b) Operation Manual and operating procedures for PBN operations, and

c) Flight crew's and dispatcher training records, and

d) Management procedure of navigation database as necessary

6. This circular is issued for information, guidance and necessary actions.

DATO' IR KOK SOO CHON
Director General
Department of Civil Aviation
Malaysia

APPENDIX F

DRAFT THIRD PARTY PROCEDURE DESIGN AIC

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MALAYSIA

XX / 2012
DD MMM

Instrument Flight Procedure Design
Authorization of Third Party Design Organisations

1. Introduction.

1.1 In order to facilitate the development of Instrument Flight Procedures in Malaysia this circular provides a means for Malaysia DCA to authorize commercial design organisations to provide procedure design services within Malaysia.

1.2 This is an interim phase which will superceded by a certification process to be implemented by 31 December 2014.

2. Definition.

2.1 Instrument Flight Procedure is a:

- Standard Instrument Departure
- Standard Terminal Arrival Route
- Instrument Approach Procedure

3. Regulatory Requirements.

3.1 A person shall not design an Instrument Flight Procedure in Malaysia unless they hold an authorization in accordance with this AIC.

3.2 An authorization may be issued to a person who meets the following requirements:

a. Provides to the Director General evidence of authorization provided by another State,

Or

b. Demonstrates to the satisfaction of the Director General that the organization meets all the requirements of ICAO Doc 9906: Quality Assurance Manual for Flight Procedure Design.

4. Requirement to obtain a procedure design certificate.

4.1 After the 31 December 2014 a person may not design an instrument flight procedure in Malaysia unless they hold a procedure design certificate issued by Malaysia DCA.

4.2 Malaysia DCA will publish the requirements for applicants to be issued a procedure design certificate.

5. This circular is issued for information, guidance and necessary actions.

DATO' IR KOK SOO CHON
Director General
Department of Civil Aviation
Malaysia

APPENDIX G

MALAYSIA PBN IMPLEMENTATION PLAN

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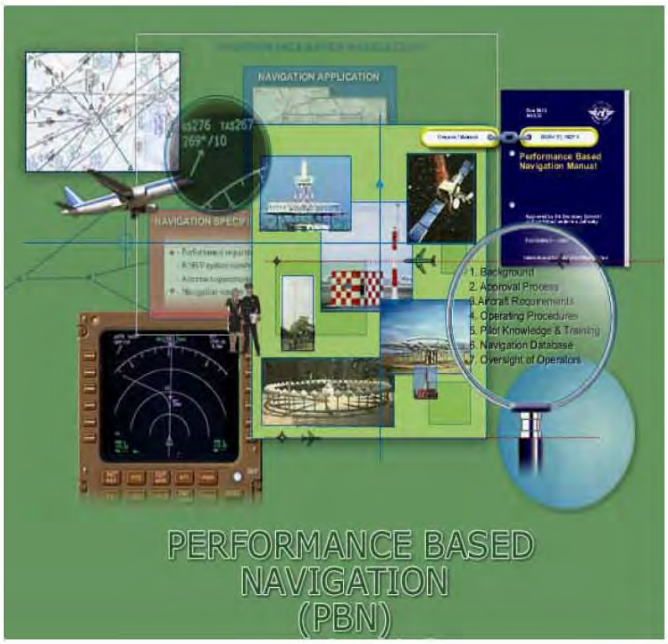
DEPARTMENT OF CIVIL AVIATION
MALAYSIA



MALAYSIA
PERFORMANCE-BASED NAVIGATION
IMPLEMENTATION PLAN

Edition
2010

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MALAYSIA PERFORMANCE-BASED NAVIGATION
IMPLEMENTATION PLAN

1. Executive Summary

1.1 This PBN Implementation Plan has been produced in line with APANPIRG Conclusion 19/25 adopted by APANPIRG/19. The PBN Plan addresses the strategic objectives for PBN implementation based on clearly established operational requirements, avoiding equipage of multiple on-board or ground based equipment, avoidance of multiple airworthiness and operational approvals and explains the contents relating to potential navigation applications. The Plan envisages the conduct of pre- and post-implementation safety assessments and continued availability of conventional air navigation procedures during transition. The Plan also discusses issues related to implementation which include traffic forecasts, aircraft fleet readiness, adequacy of ground-based CNS infrastructure etc. Implementation targets for various categories of airspace for the short term (2009 – 2012) and for the medium term (2013 – 2016) have been projected in tabular forms to facilitate easy reference. For the long term (2016 and beyond) it has been envisaged that GNSS will be the primary navigation infrastructure. It is also expected that precision approach capability using GNSS and its augmentation system will become available in the long term.

2. Explanation of Terms

2.1 The drafting and explanation of this document is based on the understanding of some particular terms and expressions that are described below:

2.1.1 **Malaysia PBN Implementation Plan.** A document offering appropriate guidance for air navigation service providers, airspace operators and users, regulating agencies, and international organizations, on the evolution of navigation capabilities as one of the key systems supporting air traffic management, and which describes the RNAV and RNP navigation applications that should be implemented in the short, medium and long term in Malaysian airspace.

2.1.2 **Performance Based Navigation** Performance based navigation specifies RNAV and RNP system performance requirements for aircraft operating along an ATS route, on an instrument approach procedure or in an airspace.

2.1.3 **Performance requirements.** 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. Performance requirements are identified in navigation specifications which also identify which navigation sensors and equipment may be used to meet the performance requirement.

3. Acronyms

3.1 The acronyms used in this document along with their expansions are given in the following list

ABAS	Aircraft-Based Augmentation System
AIS	Aeronautical Information Services

APAC	Asia and Pacific Regions
APANPIRG	Asia/Pacific Air Navigation Planning and Implementation Regional Group
APCH	Approach
APV	Approach Procedures with Vertical Guidance
ATC	Air Traffic Control
Baro VNAV	Barometric Vertical Navigation
CNS/ATM	Communication Navigation Surveillance/Air Traffic Management
CPDLC	Controller Pilot Data Link Communications
DME	Distance Measuring Equipment
EMA	En-route monitoring Agency
FASID	Facilities and Services Implementation Document
FIR	Flight Information Region
FMS	Flight Management System
GBAS	Ground-Based Augmentation System
GNSS	Global Navigation Satellite System
GRAS	Ground-based Regional Augmentation System
IATA	International Air Transport Association
IFALPA	International Federation of Air Line Pilots' Associations
KLIA	Kuala Lumpur International Airport
MAPA	Malaysia Airlines Pilots' Associations
INS	Inertial Navigation System
IRU	Inertial Reference Unit
PANS	Procedures for Air Navigation Services
PBN	Performance Based Navigation
PIRG	Planning and Implementation Regional Group
RASMAG	Regional Airspace Safety Monitoring Advisory Group
RCP	Required Communication Performance
RNAV	Area Navigation
RNP	Required Navigation Performance
SARP	Standards and Recommended Practices
SBAS	Satellite-Based Augmentation System
SID	Standard Instrument Departure
STAR	Standard Instrument Arrival
TMA	Terminal Control Area
VOR	VHF Omni-directional Radio-range
WGS	World Geodetic System

4. Introduction

Need for the PBN Implementation Plan

4.1 The Thirty-sixth Session of the ICAO Assembly held in Montreal in September 2007 adopted a Resolution to resolve that States to complete a PBN implementation plan by 2009.

4.2 Recognizing that the PBN concept is now established, Malaysia shall ensure that all RNAV and RNP operations and procedures are in accordance with the PBN concept as detailed in ICAO Doc 9613: PBN Manual for ensuring a globally harmonized and coordinated transition of PBN.

4.3 In view of the need for detailed navigation planning, Malaysia recognized the need to develop a PBN Implementation Plan to provide proper guidance to airspace operators and users on the RNAV and RNP navigation applications that should be implemented in the short and medium term in the Kuala Lumpur FIR and Kota Kinabalu FIR.

4.4 Furthermore, the development of Malaysia PBN Implementation Plan will be aligned with the Asia/Pacific PBN Implementation Plan in the implementation of air navigation infrastructure, such as ABAS, SBAS, GBAS, GRAS, etc.

Benefits of Performance-Based Navigation

4.5 The main benefits derived from the implementation of PBN are:

a) Increased airspace safety through the implementation of continuous and stabilized descent procedures using vertical guidance;
b) Reduced aircraft flight time due to the implementation of optimal flight paths, with the resulting savings in fuel, noise reduction, and enhanced environmental protection;
c) Use of the RNAV and/or RNP capabilities that already exist in a significant percentage of the aircraft fleet flying in Malaysian airspace;
d) Improved airport and airspace arrival paths in all weather conditions, and the possibility of meeting critical obstacle clearance and environmental requirements through the application of optimized RNAV or RNP paths;
e) Implementation of more precise approach, departure, and arrival paths that will reduce dispersion and will foster smoother traffic flows;
f) Reduced delays in high-density airspaces and airports through the implementation of additional parallel routes and additional arrival and departure points in terminal areas;
g) Reduction of lateral and longitudinal separation between aircraft to accommodate more traffic;
h) Decrease ATC and pilot workload by utilizing RNAV/RNP procedures and airborne capability and reduce the needs for ATC-Pilot communications and radar vectoring;
i) Increase of predictability of the flight path.

Goals & Objectives of PBN Implementation

4.6 The Malaysia PBN Implementation Plan has the following strategic objectives:

a) To ensure that the implementation of the navigation item of the CNS/ATM system is based on clearly established operational requirements.
b) To avoid undue equipage of multiple on board equipment and/or ground-based systems.
c) To avoid the need for multiple airworthiness and operational approvals for intra- and inter-regional operations.

4.7 Furthermore, the PBN Implementation Plan will provide a high-level strategy for the evolution of the navigation applications to be implemented in the Kuala Lumpur FIR and Kota Kinabalu FIR in the short term (2009-2012), medium term (2013-2016) and long term (2016 and beyond). This strategy is based on the concepts of Area Navigation (RNAV) and Required Navigation Performance (RNP) in accordance with ICAO Doc. 9613 and will be applied to aircraft operations involving instrument approaches, standard departure (SID) routes, standard arrival (STAR) routes, and ATS routes in continental and oceanic areas.

4.8 The Malaysia PBN Implementation Plan is developed by the National Working Group consisting of various unit in DCA Malaysia, Malaysia Airlines, Air Asia, Transmile Air and Malaysia Airlines Pilots' Associations (MAPA). It is intended to assist the main stakeholders of the aviation community plan a gradual transition to the RNAV and RNP concepts.

4.9 This Plan is intended to assist the main stakeholders of the aviation community plan the future transition and their investment strategies. For example, airlines and operators can use this Plan to derive future equipage and additional navigation capability investments; DCA Malaysia can plan a gradual transition for the evolving ground infrastructure.

Planning Principles

4.10 Planning for the implementation of PBN in Malaysia is based on the following principles:

a) Pre- and post-implementation safety assessments will be conducted to ensure the application and maintenance of the established target levels of safety.
b) Continued application of conventional air navigation procedures during the transition period, to guarantee the operations by users that are not RNAV- and/or RNP-equipped.
c) The Malaysia PBN implementation plan will address the short term (2009-2012) and medium term (2013-2016) and take into account long term regional and global planning issues.

5. PBN Operational Requirements & Implementation Strategy

5.1 Introduction of PBN will be consistent with the Regional and Global Air Navigation Plan. Moreover, PBN implementation will be in full compliance with ICAO SARPs and PANS and support relevant ICAO Global Plan Initiatives.

5.2 The introduction of PBN will be supported by an appropriate navigation infrastructure consisting of an appropriate combination of Global Navigation Satellite System (GNSS), self-contained navigation system (inertial navigation system) and conventional ground-based navigation aids.

5.3 The *Strategy for the Provision of Precision Approach, Landing & Departure Guidance Systems and the Strategy for Implementation of GNSS Navigation Capability* were reviewed and updated by the Eleventh meeting of CNS/MET Sub Group of APANPIRG in July 2007. The updated strategies were reviewed and adopted by APANPIRG as *Strategies for the Provision of Navigation Services* in its Eighteenth meeting held in September, 2007 under Conclusion 18/30.

Route Operations

5.4 Considering the traffic characteristics and CNS/ATM capability, en-route operations are classified as Oceanic and Domestic en-route.

5.5 In principle, classification of en-route operation will adopt, but not be limited to, a single RNAV or RNP navigation specification. This implementation strategy will be applied in coordination with airspace users, and the RNAV and RNP navigation applications will be coordinated between neighbouring states to ensure harmonization.

5.6 In areas where operational benefits can be achieved and appropriate CNS/ATM capability exists, a more accurate navigation specification than that specified in this plan, will be introduced on the basis of coordination with stakeholders and affected neighboring States.

TMA Operations

5.7 TMA operations have their own characteristics, taking into account the applicable separation minima between aircraft and between aircraft and obstacles. TMA operations also involve the diversity of aircraft, including low-performance aircraft flying in the lower airspace and conducting arrival and departure procedures on the same path or close to the paths of high-performance aircraft.

5.8 In this sense, a plan for the implementation of PBN in TMAs, will be based on the Asia/Pacific Regional PBN Implementation Plan, seek the harmonization of the application of PBN and avoid the need for multiple operational approvals for intra- and inter-regional operations. Applicable aircraft separation criteria will also be considered.

Instrument Approaches

5.9 PBN approaches that provide Vertical Guidance will be introduced to enhance safety. Conventional approach procedures and conventional navigation aids will be maintained to support non-equipped aircraft during the transitional period.

5.10 IFR Approaches based on PBN will be designed to accommodate mixed-equipage (PBN and non-PBN) environment. ATC workload will be taken into account while developing approach procedures. One possible way to accomplish this is to co-locate the Initial Approach Waypoint for both PBN and conventional approaches.

6. Current Status & Forecast

6.1 APAC traffic forecast

6.1.1 The GEN part of FASID (Doc9673 Vol. II) provides the information and data of the following traffic forecasts:

- **Forecasts of air traffic demand for air navigation systems planning**
- **Passenger forecasts**
- **Aircraft movement forecast**
- **Major city-pairs forecasts**

6.1.2 The forecast data as well as the figures contained in the FASID document are the results of the regular meetings of Asia/Pacific Area Traffic Forecasting Group (APA TFG).

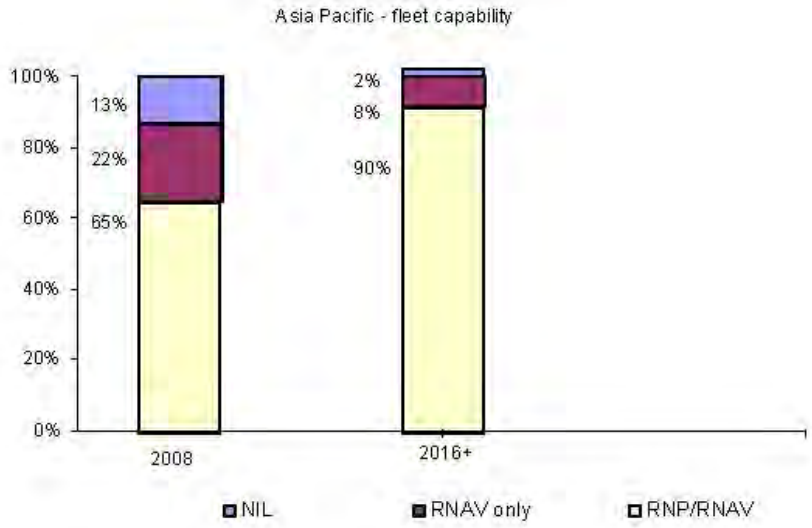
6.1.3 The forecast conducted by IATA on 27 February 2008 for Asia and Pacific traffic in respect of passenger, cargo, aircraft movements and new aircraft deliveries in all the Regions is also provided in the Appendix A to this plan as reference.

6.2 Aircraft fleet readiness status

6.2.1 All major commercial aircraft manufacturers since the 1980's have included RNAV capabilities. The commercial aircraft currently produced incorporate an RNP capability.

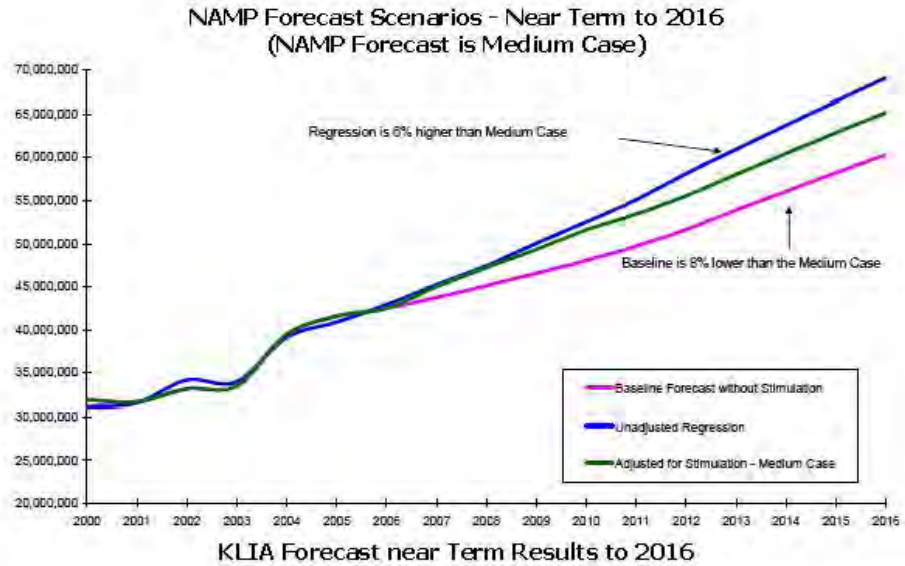
6.2.2 The diagram below displays a high level analysis based on fleet numbers from Ascend Online Fleets database March 2008 and RNAV/RNP classification by IATA.

6.2.5 National airlines i.e. Malaysia Airlines, Air Asia and Transmile fleet readiness status are attached in Appendix B, Appendix C and Appendix D respectively.

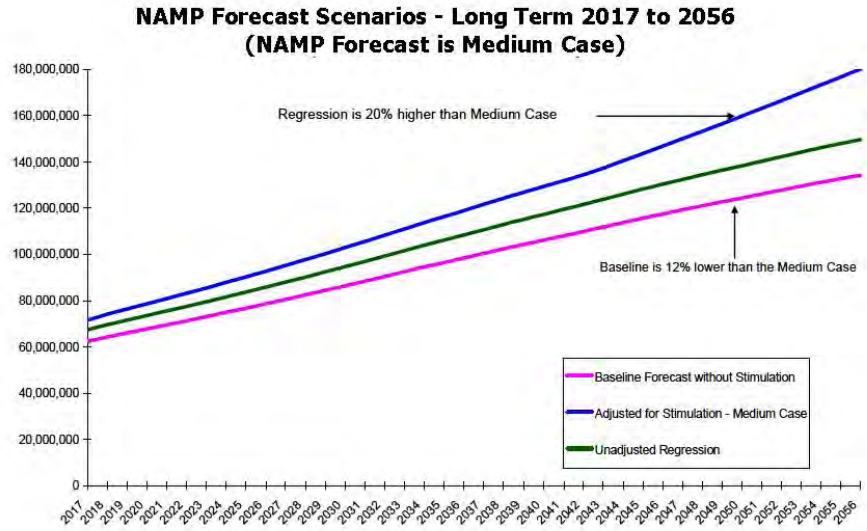


6.3 Domestic Traffic Forecast

6.3.1 Air passengers within Malaysia expect to see a growth triple in the next 50 years. It is believed that the fastest growth will occur in the next 20 years. A mere 42 million passengers in 2006 will exponentially leap to about 150 million in 2056. A study made by Malaysia Airport Holding Bhd. (MAHB) in the National Airport Master Plan (NAMP) predicts KLIA will grow to almost 70 million passengers by 2016, followed by Kota Kinabalu with 21 million passengers, then Kuching with 17 million passengers and Penang with 16 million passengers.



KLIA Forecast near Term Results to 2016



KLIA Forecast Long Term Results, 2017 to 2056

6.3.2. Six largest airports in Malaysia accounted for 87% of passenger traffic in 2006 and air cargo is even more intense. Abbreviated forecast medium case air passenger results for all NAMP in-scope the airports are displayed in Table below:-

Code	Airport	2006 Passengers	2011 Passengers	2016 Passengers	2031 Passengers	2056 Passengers
KUL	KLIA	24,129,748	31,380,328	37,362,886	51,450,094	69,538,768
PEN	Penang	3,103,772	3,901,954	5,016,097	8,551,416	15,691,911
LGK	Langkawi	934,024	1,410,918	1,854,295	3,329,919	6,549,587
KBR	Kota Bharu	678,306	846,345	998,461	1,333,736	1,690,268
TGG	Kuala Terengganu	398,252	465,422	548,989	733,119	929,341
AOR	Alor Star	292,549	323,495	382,037	512,110	653,895
KUA	Kuantan	273,005	289,246	341,290	456,615	583,149
SZB	Subang	83,502	104,748	126,640	212,545	334,601
IPH	Ipoh	64,711	72,929	86,126	115,415	147,132
MKZ	Malacca	18,509	32,189	37,981	50,815	64,897
BKI	Kota Kinabalu	4,015,221	5,154,641	6,643,376	11,402,413	21,283,890
TWU	Tawau	660,331	852,950	1,004,068	1,332,678	1,671,941
SDK	Sandakan	633,194	692,212	815,688	1,086,196	1,371,468
LBU	Labuan	575,684	598,914	706,456	943,998	1,201,380
LDU	Lahad Datu	108,697	76,855	90,683	121,326	154,947
KCH	Kuching	3,196,352	4,060,091	5,253,642	9,102,768	17,221,902
MYY	Miri	1,559,379	1,734,944	2,264,616	4,007,370	7,781,631
SBW	Sibu	898,923	899,431	1,060,375	1,414,101	1,790,182
BTU	Bintulu	449,673	417,537	491,760	653,885	823,967
LMN	Limbang	89,814	53,647	63,297	84,676	108,120
MZV	Mulu	48,826	38,403	45,313	60,622	77,418
		42,212,471	53,407,201	65,194,076	96,955,818	149,670,393

Actual 2006 and Forecast Passengers to 2056

6.3.3 Country-wide forecast approach underpinnings of the general airport forecast model comprise three key demand variables: (1) an organic forecast of local traffic based on Malaysian general economic indicators; (2) an adjustment to the local traffic forecast for passenger stimulation resulting from greater service levels and lower fares that will be driven in large part by the increase in LCC capacity and expected traffic shares at each airport, and;

(3) a forecast of transfer traffic at KLIA considering for hub and alliance development and competition from Bangkok and Singapore hubs.

6.3.4 The greatest driver to Malaysian air travel stimulation in the future will be greater LCC capacity and increasing shares of local traffic. LCCs are expected to grow to a steady state of about 40 percent of total local traffic in and around Asia. Greater LCC capacity will, then, work to increase service levels and lower fares – each of which will stimulate new passengers to the market.

6.3.5 Optimistic passenger under the optimistic forecast scenario, MAHB airports' traffic volumes will increase from a total 42 million passengers in 2006 to about 172 million in 2056. Forecast optimistic scenario annual results for select years are shown in Tables as below:

Optimistic Scenario - Forecast total Passenger Results

Code	Airport	2006 Passengers	2011 Passengers	2016 Passengers	2031 Passengers	2056 Passengers
KUL	KLIA	24,129,748	32,996,171	42,969,524	59,537,716	83,186,088
PEN	Penang	3,103,772	4,003,233	5,458,177	10,046,927	19,585,777
BKI	Kota Kinabalu	4,015,221	5,338,746	7,451,606	13,236,481	26,516,938
	All Others	10,963,730	12,970,277	16,171,716	25,551,895	43,155,825
		42,212,471	55,308,428	72,051,023	108,373,019	172,444,628

Optimistic Scenario - Forecast LCC Passenger Results

Code	Airport	2006 LCC Passengers	2011 LCC Passengers	2016 LCC Passengers	2031 LCC Passengers	2056 LCC Passengers
KUL	KLIA	5,646,314	15,129,287	21,824,480	30,863,411	45,705,627
PEN	Penang	510,766	1,532,157	2,431,187	5,651,971	13,112,864
BKI	Kota Kinabalu	794,851	2,492,070	3,866,039	7,511,133	16,736,990
	All Others	2,891,588	6,479,137	8,170,272	13,338,661	23,377,525
		9,843,519	25,632,651	36,291,978	57,365,175	98,933,007

A snapshot of forecast aircraft movements over the planning horizon is shown in Table below.

Forecast Aircraft Movements

Code	Airport	2006 AC Movements	2011 AC Movements	2016 AC Movements	2031 AC Movements	2056 AC Movements
KUL	KLIA	183,579	223,119	258,089	347,779	461,363
PEN	Penang	30,967	40,855	51,234	87,169	157,949
LGK	Langkawi	8,147	12,891	16,832	29,662	56,658
KBR	Kota Bharu	10,025	13,914	16,155	20,619	24,464
TGG	Kuala Terengganu	3,880	5,123	5,978	7,738	9,343
AOR	Alor Star	2,873	2,957	3,489	4,665	5,927
KUA	Kuantan	2,768	4,182	4,945	6,652	8,541
SZB	Subang	9,031	5,792	6,725	10,547	15,257
IPH	Ipoh	953	602	696	876	999
MKZ	Malacca	593	779	897	1,194	1,525
BKI	Kota Kinabalu	50,221	57,391	71,823	112,795	202,120
TWU	Tawau	8,024	8,201	9,412	12,352	15,452
SDK	Sandakan	9,740	8,863	10,180	12,554	15,562
LBU	Labuan	9,198	12,740	14,563	17,741	20,341
LDU	Lahad Datu	3,161	2,505	2,883	3,579	4,137
KCH	Kuching	36,991	41,312	53,217	90,953	168,135
MYY	Miri	39,334	40,902	51,831	86,481	164,678
SBW	Sibu	15,079	13,517	15,487	19,145	23,802
BTU	Bintulu	11,188	7,434	8,519	10,433	11,741
LMN	Limbang	4,216	2,559	2,946	3,656	4,225
MZV	Mulu	2,235	1,783	2,052	2,547	2,872
		442,204	507,422	607,953	889,137	1,375,090

6.4 CNS Infrastructure

6.4.1 Navigation infrastructure

6.4.1.1 Global Navigation Satellite System (GNSS)

6.4.1.1.1 Global Navigation Satellite System (GNSS) is a satellite-based navigation system utilizing satellite signals, such as Global Positioning System (GPS), for providing accurate and reliable position, navigation, and time services to airspace users. ICAO noted the increased flight safety, route flexibility and operational efficiencies that could be realized from the move to space-based navigation.

6.4.1.1.2 GNSS supports both RNAV and RNP operations. Through the use of GNSS augmentations, GNSS navigation provides sufficient accuracy, integrity, availability and continuity to support en-route, terminal area, and approach operations.

6.4.1.1.3 GNSS augmentations include Aircraft-Based Augmentation System (ABAS), Satellite-Based Augmentation System (SBAS), Ground-Based Augmentation System (GBAS), and Ground-based Regional Augmentation System (GRAS).

6.4.1.1.4 A Ground Based Augmentation System (GBAS) is planned to be installed at Kuala Lumpur International Airport (KLIA) in the medium term implementation plan to accommodate SIDs, STARs and RNP Approaches for the 3 runways.

6.4.1.2 Other PBN navigation infrastructure

7.1.2.1 Other navigation infrastructure includes INS, VOR/DME, DME/DME, and DME/DME/IRU. These navigation infrastructures will satisfy the requirements of RNAV navigation specifications, but not those of RNP.

6.4.1.2.2 INS may be used to support PBN en-route operations with RNAV-10 and RNAV-5 navigation specifications.

6.4.1.2.3 VOR/DME will be used to support PBN en-route and STAR operations based on the RNAV-5 navigation specification.

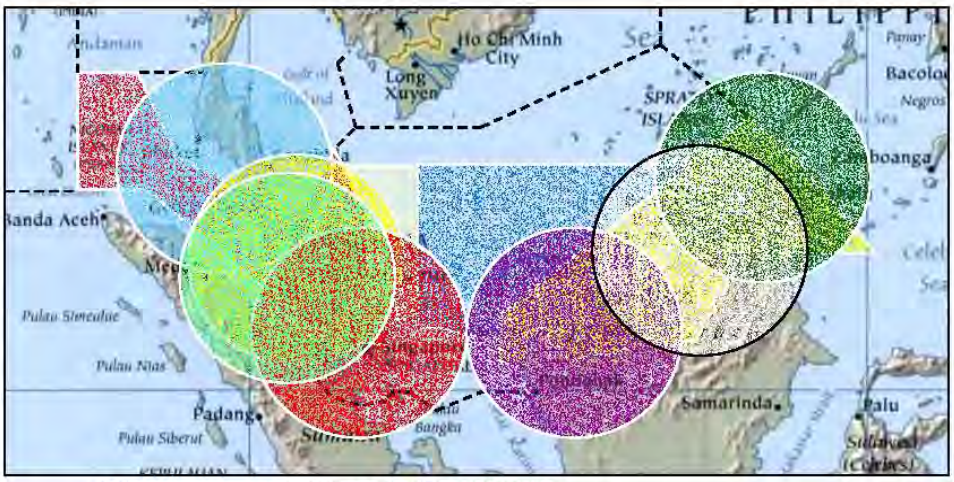
6.4.1.2.4 Uses of DME/DME and DME/DME/IRU will support PBN en-route and terminal area operations based on RNAV-5, RNAV-2 or RNAV-1 navigation specifications.

6.4.1.2.5 The list of VOR/DME currently available in Kuala Lumpur FIR and Kinabalu FIR is attached on Appendix Y.

6.4.2 Surveillance infrastructure

6.4.2.1 For RNAV operations, sufficient surveillance coverage will be provided to assure the safety of the operations. For RNP operations, surveillance coverage is not required.

6.4.2.2 Currently, Radar services are available covering over the land area and Automatic Dependant Surveillance (ADS) is available over Bay of Bengal in Kuala Lumpur FIR. (Surveillance infrastructure in Appendix H)



Radar coverage over land area in KL and KK FIRs

6.4.3 Communication infrastructure

6.4.3.1 Implementation of RNAV/RNP routes includes communication requirements.

6.4.3.2 Currently, VHF Air-Ground radio communication is covering over land route. HF services are available over Oceanic area beyond VHF coverage. CPDLC is available over Bay of Bengal. (Refer Appendix H)

7. Implementation Plan for Performance Based Navigation

7.1 ATM Operational Requirements

7.1.1 The Global ATM Operational Concept (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 CNS infrastructure that satisfies specific strategic objectives, including safety, access, capacity, efficiency, and environment.

7.1.2 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 ARINC-424 coding standard
g) Enhanced electronic data and processes to ensure appropriate level of AIS data accuracy, integrity and timeliness
h) WGS-84 implementation in accordance with ICAO Annex 15
i) uniform classification of adjacent and regional airspaces, where practicable
j) RNAV/RNP applications for SIDs and STARs
k) Coordinated RNAV/RNP routes implementation
l) RNP approach with vertical guidance

7.2 Short Term Implementation Plan

7.2.1 Route Operations

7.2.1.1 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.

7.2.1.2 The application of RNAV-10 navigation specifications has been implemented for Oceanic routes and RNP-4 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.

7.2.1.3 For other routes on key traffic flows and city pairs, the application of RNAV-5 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.

7.2.2 TMA Operations

7.2.2.1 In several TMAs i.e. Kuala Lumpur TMA, Johor TMA, Kuching TMA and Kota Kinabalu TMA, the application of RNAV-1 in a radar environment will be implemented with the support through the use of GNSS and/or ground navigation infrastructure, such as DME/DME and DME/DME/IRU. In this short term phase, mixed operations (equipped and non-equipped) will be permitted.

7.2.3 Instrument Approaches

7.2.3.1 The application of RNP APCH with Baro-VNAV procedures will not be implemented in the short term due to inadequate supporting navigation infrastructure. ILS currently available at all instrument airports is expected to be satisfactorily operational for the next 10 years (Refer Appendix F). Anyhow, Malaysia will promote the use of APV operations (Baro-VNAV or augmented GNSS) to enhance safety and accessibility of RNP approaches when the navigation infrastructure required are available.

Summary table & Implementation targets

<table>
<tr><th colspan="3">Short Term (2009-2012)</th></tr>
<tr><th>Airspace</th><th>Preferred Nav. Specifications</th><th>Acceptable Nav. Specifications</th></tr>
<tr><td>Route – Oceanic</td><td>RNP-4</td><td>RNAV-10</td></tr>
<tr><td>Route – Domestic en-route (City pair)</td><td colspan="2">RNAV-5</td></tr>
<tr><td>TMA – Arrival</td><td>RNAV-1 in radar environment and with adequate navigation infrastructure.</td><td></td></tr>
<tr><td>TMA – Departure</td><td>RNAV-1 in radar environment and with adequate navigation infrastructure.</td><td></td></tr>
<tr><td>Approach</td><td>Nil
(Conventional – ILS)</td><td></td></tr>
<tr><td colspan="3">Implementation Targets
• RNAV-1 SID/STAR for 50% of international airports by 2012
• Re-defining existing RNAV/RNP routes into PBN navigation specification by 2012
• Implementation of additional RNAV/RNP routes</td></tr>
</table>

7.3 Medium Term Implementation Plan

7.3.1 Route Operations

7.3.1.1 The implementations of all existing RNAV/RNP routes are consistent with PBN navigation specifications and separation standards. Implementations of additional RNAV/RNP routes will be considered.

7.3.1.2 With the utilization of ADS and 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 navigation specification. The fleet readiness status will be considered during the planning.

7.3.1.4 In this phase, the establishment of a backup system in case of GNSS failure or the development of contingency procedures is necessary.

7.3.2 TMA Operations

7.3.2.1 It is expected that the application of RNAV-1 or RNP-1 will be expanded in selected TMAs especially KL TMA. The application of RNAV-1/RNP-1 will also depend on DME/DME infrastructure, GNSS availability and aircraft navigation capability. In TMAs of high air traffic complexity and movement, the use of RNAV-1 or RNP-1 equipments will be mandatory. In TMAs of less air traffic complexity, mixed operations will be permitted (equipped or non-equipped).

7.3.3 Instrument Approaches

7.3.3.1 In this phase, the application of RNP APCH with Baro-VNAV or APV in major international airports 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.

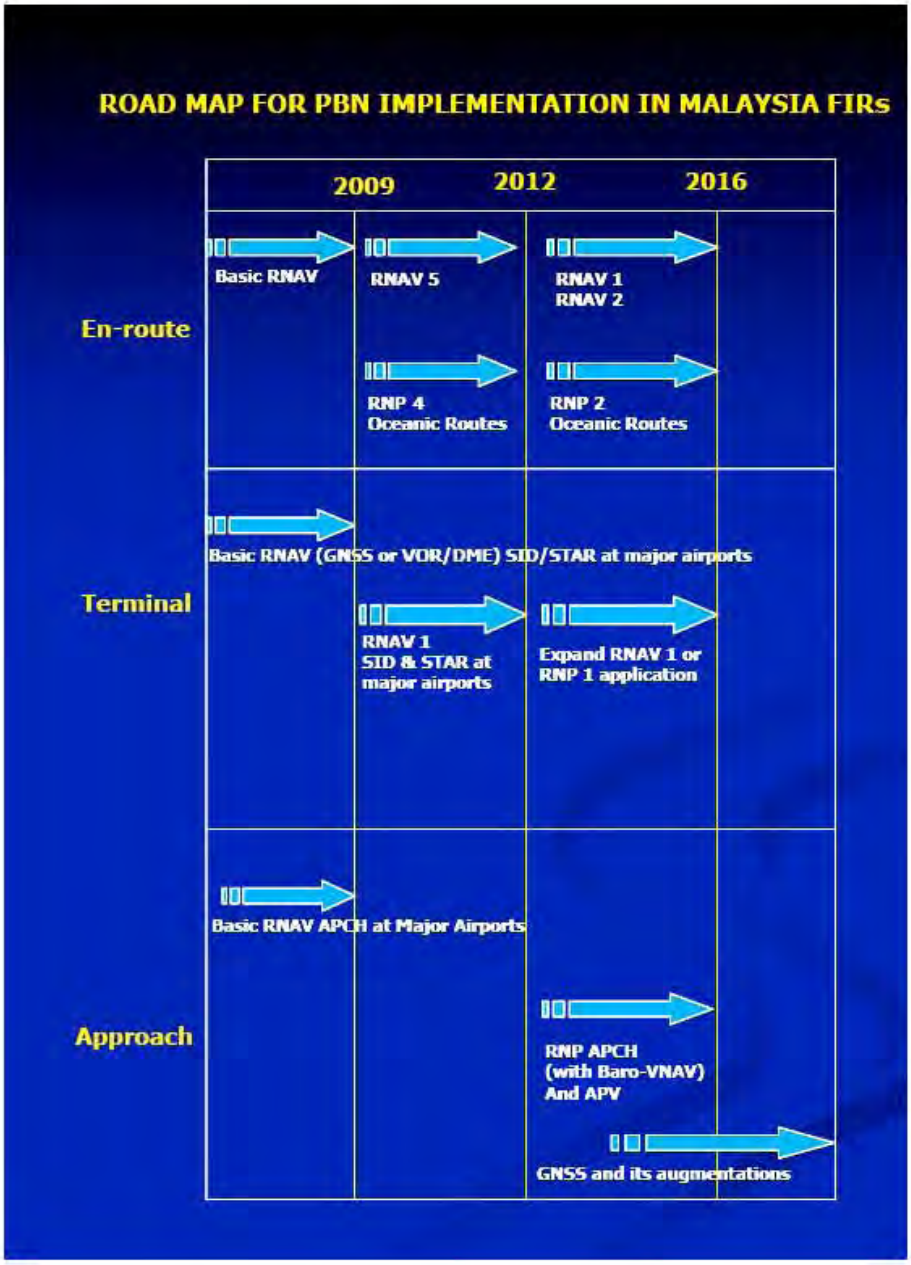
7.3.3.2 The extended application of RNP AR Approaches will be considered for airports where there are operational benefits.

Summary table & Implementation targets

Medium Term (2013-2016)		
Airspace	**Preferred Nav. Specification**	**Acceptable Nav. Specification**
Route – Oceanic	RNP-4	RNP-4, RNAV-10
Route – Domestic en-route	RNAV-2	RNAV-2, RNAV-5
TMA – Arrival	Expand RNAV-1 or RNP-1 application	
TMA – Departure	RNAV-1 application	
Approach	RNP APCH (with Baro-VNAV) and APV RNP AR APCH where there are operational benefits	

Implementation Targets

- RNP APCH with Baro-VNAV or APV in 50% of instrument runways by 2016
- RNAV-1 or RNP-1 SID/STAR for 70% of international airports by 2016
- RNAV-1 or RNP-1 SID/STAR for 70% of busy domestic airports where there are operational benefits
- Implementation of additional RNAV/RNP routes


ROAD MAP FOR PBN IMPLEMENTATION IN MALAYSIA FIRs
2009
2012
2016
En-route
Basic RNAV
RNAV 5
RNAV 1
RNAV 2
RNP 4
Oceanic Routes
RNP 2
Oceanic Routes
Terminal
Basic RNAV (GNSS or VOR/DME) SID/STAR at major airports
RNAV 1
SID & STAR at
major airports
Expand RNAV 1 or
RNP 1 application
Approach
Basic RNAV APCH at Major Airports
RNP APCH
(with Baro-VNAV)
And APV
GNSS and its augmentations

19

7.4 Long Term Implementation Strategies (2016 and beyond)

7.4.1 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 GNSS in order to facilitate seamless and inter-operable systems and undertake coordinated research and development programs on GNSS implementation and operation.

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

7.4.3 With the expectation that precision approach capability using GNSS and its augmentation systems will become available, Malaysia will explore the use of such capability where there are operational and financial benefits.

8. Transitional Strategies

8.1 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.

8.2 Malaysia will coordinate to ensure that harmonized separation standards and procedures are developed and introduced concurrently in all flight information regions along major traffic flows to allow for a seamless transition towards PBN.

8.3 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.

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

8.5 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.

9. Safety Assessment & Monitoring Requirements

9.1 Need for a safety assessment

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

9.2 Undertaking a safety assessment

9.2.1 DCA Malaysia will ensure that a safety assessment and, where required, ongoing monitoring of the PBN implementations are conducted. DCA Malaysia may seek assistance from other relevant body in the government agencies i.e. institutional department to undertake such activities.

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Appendix A

IATA Traffic Forecast

By 2010 Asia will be the largest single market for aviation - IATA 27th Feb 2008. Globally predicted passenger traffic will rise by 4.9 per cent per year between 2007 and 2026, almost trebling in two decades as jet planes got bigger and more people flew on them. Meanwhile airfreight will rise by 5.8 per cent annually in the same period. The greatest demand will come from the Asia-Pacific region, where airlines will take delivery of 31 per cent of new planes in the next 20 years, compared with 24% for Europe and 27% for North America.

Passenger

Asia Pacific airlines saw a marginal drop in demand growth from 6.2 per cent in December 2007 to 5.7 per cent in January 2008. Currently, airlines in the region benefited from increased competitiveness due to the strong Euro and the booming economies of both India and China.

Cargo

Steady year-on-year airfreight growth of 4.5 per cent was recorded in January 2008. In the larger freight markets there is continued strength. Asia Pacific airlines saw demand increase 6.5 per cent, up from 6 per cent in December 2007, boosted by the booming economies in China and India.

For the period 2002-2020 aircraft movements are expected to increase at an annual growth rate of 5.4 per cent, to reach almost 294 thousand aircraft movements by the year 2020. Average annual growth rates of 6.5, 5.7 and 5.2 per cent are forecast for the periods 2005 - 2010, 2010-2015 and 2015 - 2020, respectively.

TRANSPACIFIC PASSENGER FORECAST			
Average Annual Percentage Growth Rates			
Low	Medium	High	
2005-2010	5.3	6.5	7.8
2010-2015	4.5	5.7	7.0
2015-2020	4.0	5.2	6.5
2002-2020	4.1	5.4	6.7

The Intra-Asia/Pacific passenger aircraft movements are expected to increase at an average annual growth rate of 4.6 per cent to the year 2020. The growth rates for the intermediate periods of 2005-2010, 2010- 2015 and 2015-2020 are 5.0, 4.3 and 4.2 per cent, respectively.

INTRA ASIA /PACIFIC AIRCRAFT MOVEMENT FORECAST			
Average Annual Percentage Growth Rates			
Low	Medium	High	
2005-2010	3.6	5.0	5.5
2010-2015	3.1	4.3	5.2
2015-2020	3.1	4.2	5.2
2002-2020	3.3	4.6	5.6

New Aircraft Deliveries by Region

Record new aircraft orders were placed by the airline industry in 2005 – 2007. The large numbers of new orders represent strong confidence in the future prospects of the global airline industry. In its latest forecast of aviation growth, European aircraft maker Airbus said the world's fleet of large passenger jets (of more than 100 seats) would double in the next 20 years to nearly 33,000. The greatest demand will come from the Asia-Pacific region, where airlines will take delivery of 31 per cent of new planes in the next 20 years, compared with 24 per cent for Europe and 27 per cent for North America.

New Aircraft Deliveries by Region	2006	2007	2008	2009	2010	2011	2012+
	Existing						
Africa	665	26	15	20	16	13	28
Asia Pacific	3,578	329	428	407	344	267	440
Europe	5,301	292	348	364	251	153	297
Latin America/Caribbean	1,031	93	91	45	66	43	65
Middle East	626	41	57	44	36	27	164
North America	6,987	240	293	309	222	163	412
Total	18,188	1,026	1,237	1,208	944	679	1,551
Increase in Global aircraft fleet (%)	4.2	4.9	4.6	4.9	3.4	2.4	2.4

Appendix B
Malaysia Airlines – Aircraft Readiness 2009

Doc: Aircraft Readiness 09072009

No.	Aircraft Type	Quantity	Aircraft Registration	System Manufacturer Model	Mode	RNP 1	RNP 5	RNP 10
1	B747-400	15	9M-MPB	Honeywell	HG1050AD06	X	X	X
			9M-MPC			X	X	X
			9M-MPD			X	X	X
			9M-MPE			X	X	X
			9M-MPF			X	X	X
			9M-MPG			X	X	X
			9M-MPH			X	X	X
			9M-MPI			X	X	X
			9M-MPL			X	X	X
			9M-MPK			X	X	X
			9M-MPL			X	X	X
			9M-MPM			X	X	X
			9M-MPN			X	X	X
			9M-MPO			X	X	X
			9M-MPP			X	X	X
			9M-MPQ			X	X	X
2	B747-400F	2	9M-MPR	Honeywell	HG1050AD06	X	X	X
			9M-MPS			X	X	X
3	B777-200	17	9M-MRA	Honeywell	HG1060AD01	X	X	X
			9M-MRB			X	X	X
			9M-MRC			X	X	X
			9M-MRD			X	X	X
			9M-MRE			X	X	X
			9M-MRF			X	X	X
			9M-MRG			X	X	X
			9M-MRH			X	X	X
			9M-MRI			X	X	X
			9M-MRJ			X	X	X
			9M-MRK			X	X	X
			9M-MRL			X	X	X
			9M-MRM			X	X	X
			9M-MRN			X	X	X
			9M-MRO			X	X	X
			9M-MRP			X	X	X
			9M-MRQ			X	X	X
4	A330-300	11	9M-MKA	Honeywell	HG2030AC06	X	X	X
			9M-MKC			X	X	X
			9M-MKD			X	X	X
			9M-MKE			X	X	X
			9M-MKF			X	X	X
			9M-MKG			X	X	X
			9M-MKH			X	X	X
			9M-MKI			X	X	X
			9M-MKJ			X	X	X
			9M-MKR			X	X	X
			9M-MKS			X	X	X
5	A330-200	3	9M-MKV	Honeywell	HG2030AC06	X	X	X
			9M-MKW			X	X	X
			9M-MKX			X	X	X
6	B737-800	3	9M-MLA	Honeywell	HG2050AC07	X	X	X
			9M-MLB			X	X	X
			9M-MLC			X	X	X

No.	Aircraft Type	Quantity	Aircraft Registration	System Manufacturer Model	Mode		RNAV 5	
7	B737-400	37	9M-MMA,9M-MMB	Honeywell	HG1050AE09		X	
			9M-MMC,9M-MMD				X	
			9M-MME,9M-MMF				X	
			9M-MMG,9M-MMH				X	
			9M-MMI,9M-MMJ				X	
			9M-MMK,9M-MML				X	
			9M-MMM,9M-MMN				X	
			9M-MMQ,9M-MMR				X	
			9M-MMS,9M-MMT				X	
			9M-MMU,9M-MMV				X	
			9M-MMW,9M-MMX				X	
			9M-MMY,9M-MMZ				X	
			9M-MQA,9M-MQB				X	
			9M-MQC,9M-MQD				X	
			9M-MQE,9M-MQF				X	
			9M-MQG,9M-MQI				X	
			9M-MQK,9M-MQN				X	
			9M-MQO,9M-MQP				X	
			9M-MQQ				X	

Appendix C

AIR ASIA AIRCRAFT NAVIGATION EQUIPMENT 2009

AIR ASIA - Aircraft Navigation Equipment List

A/C TYPE	REGISTRATION	FM VENDOR	FM MODEL	RNP - 1	RNP - 5
A320-200	All AXM A320 Fleet	THALES	TOPFLIGHT	X	X
A330-301	9M-XAA	THALES	LEGACY		X
A330-343	9M-XXA	THALES	TOPFLIGHT	X	X
	9M-XXB	THALES	TOPFLIGHT		
A340-313	9M-XAB	HONEYWELL	PEGASUS	X	X
	9M-XAC	HONEYWELL	PEGASUS	X	X

Appendix D
Transmile Air Services Sdn. Bhd.

Attachment for
TAIR/TRG/ADMIN
Dated 28 Apr 2009

PBN IMPLEMENTATION
STATISTIC ON FLEET READINESS

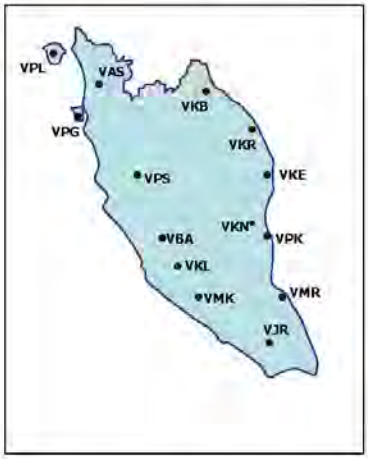
No	Acft Type	Qty	RNAV/RNP Equipage	RNAV 10	RNAV 5	RNAV 2	RNAV 1	RNP 4	RNP 1	RNP 0.3
1	MD-11	4	Honeywell GNSSU P/N HG2021MO1	Yes	Yes	No	No	No	No	No
2	B727-200	9	GPS Trimble Free Flight 2100	Yes	Yes	No	No	No	No	No
3	B737-200	3	GPS Trimble Free Flight 2100	Yes	Yes	No	No	No	No	No

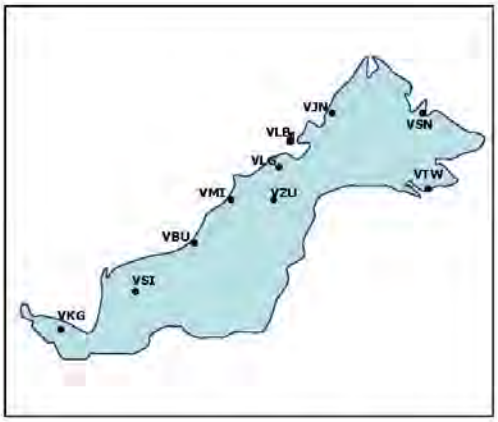
Note:

a. All Transmile MD-11 aircrafts are RNP-10 and BRNAV (RNAV 5) approved ONLY. Based on Boeing Service Letter MD11-SL-02-101 dated 4 June 03, Transmile MD-11 aircrafts are also PRNAV (RNP 1) compliance but Transmile never apply for MD-11 PRNAV approval from DCAM.

b. For B727 and B737, all aircrafts are RNAV approved using GPS Trimble Free Flight 2100. 06 X B727 (Ex-UPS aircrafts) are in process to get the RNP-10 approval. These aircrafts will be installed with Free Flight 2101 I/O Approach Plus GPS system (which coupled to HSI) for RNP-10 compliance. Please note that 2101 I/O Approach Plus GPS system is also comply for BRNAV (RNAV 5).

Appendix E
VOR/DME IN KUALA LUMPUR & KOTA KINABALU FIR (2010)





VHF OMNI DIRECTIONAL RADIO RANGE (VOR) & DME

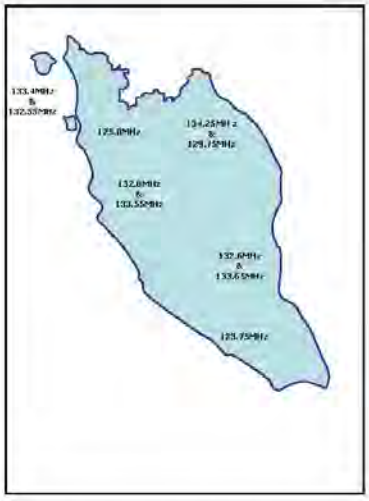
AIRPORT	IDENT	YEAR INSTALLED	AGE (Yr)	REMARKS
ALOR SETAR	VAS	2009	1	
BATU ARANG	VBA	1990	20	New replacement in 2011
BUTTERWORTH	VBT			
IPOH TERMINAL	VIH			
JOHOR BARU	VJR	1994	16	New replacement in 2011
KERTEH	VKE	2000	10	
KOTA BHARU	VKB	1996	14	
K. TERENGGANU	VKR	2009	1	
KUANTAN	VKN	2010	0	DVOR/TAC
PEKAN	VPK	2007	3	
MERSING	VMR	1996	14	
MELAKA	VMK	1996	14	
PENANG	VPG	1995	15	New replacement in 2011
P.LANGKAWI	VPL	1997	13	
PUSING (IPOH)	VPS	1994	16	
KLIA	VKL	2008	2	
TULAI (TIOMAN)	VPT	1996	14	
K.KINABALU	VJN	2009	1	
SANDAKAN	VSN	1998	12	
TAWAU	VTW	1998	12	
KUCHING	VKG	2009	1	
MIRI	VMI	1995	15	
SIBU	VSI	2005	5	
LABUAN	VLB	1994	16	
BINTULU	VBU	2003	7	
LIMBANG	VLG	2004	6	
MULU	VZU	2003	7	

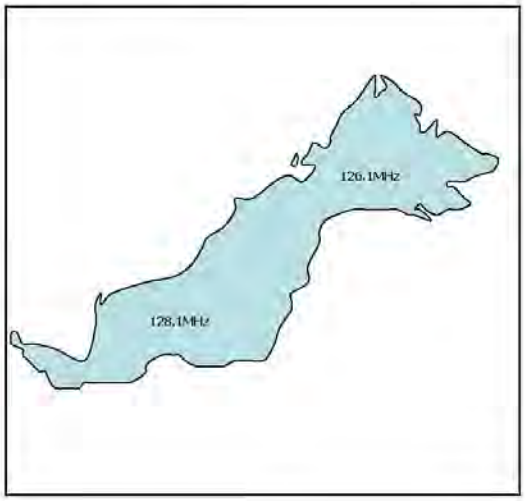
Appendix F
AERODROME WITH INSTRUMENT LANDING SYSTEM (2010)

INSTRUMENT LANDING SYSTEM (ILS)

NO.	AIRPORT	RWY	YEAR INSTALLED	AGE (Yr)
1	JOHOR BAHRU	16	1996	14
2	KLIA SEPANG	32L	1997	13
3	KLIA SEPANG	32R	1997	13
4	KLIA SEPANG	14L	1997	13
5	KLIA SEPANG	14R	1997	13
6	LANGKAWI	03	1995	15
7	PENANG	04	1996	14
8	KUCHING	25	2000	10
9	KOTA KINABALU	02	2010	1
10	ALOR STAR	04	2006	4
11	KOTA BHARU	10	2005	5
12	KUANTAN	36	1992	18
13	IPOH	04	1992	18
14	KERTEH	34	2002	8
15	MELAKA	03	2010	1
16	K. TERENGGANU	04	2008	2
17	SUBANG	15	2005	5
18	BINTULU	17	2003	7
19	MIRI	02	1994	16
20	SIBU	13	2005	5
21	LABUAN	14	2008	2
22	SANDAKAN	08	1994	16
23	TAWAU	24	2001	9
24	SUBANG	33	1996	14

Appendix G
VHF RADIO COMMUNICATION (ENROUTE) – 2010





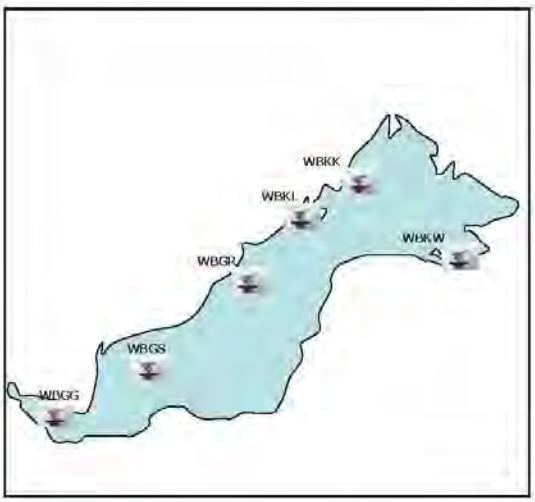
KUALA LUMPUR FIR

SECTOR	FREQUENCY	
	PRIMARY	SECONDARY
1	132.80	133.55
2	123.75	123.75
3	132.60	133.65
4	133.40	132.55
5	134.25	129.75
		134.25
		(Standby)

KINABALU FIR

SECTOR	FREQUENCY	
	PRIMARY	SECONDARY
1	126.1	128.3
2	134.5	125.35

Appendix H
SURVEILLANCE INFRASTRUCTURE – RADAR STATION (2010)



NO.	RADAR HEAD	YEAR INSTALLED	SSR/PSR	AGE (Yr)
1	SUBANG	1994	SSR/PSR	16
2	GENTING HIGHLAND	1995	SSR	15
3	KLIA	1996	SSR/PSR	14
4	TRAD (KLIA)	1996	SSR/PSR	14
5	BUTTERWORTH		SSR/PSR	
6	LANGKAWI	1995	SSR/PSR	15
7	KUANTAN		SSR/PSR	
8	JOHOR BAHRU	2007	SSR/PSR	3
9	KOTA BHARU	2007	SSR/PSR	3
10	KUCHING	1996	SSR/PSR	14
11	SIBU	2010	SSR/PSR	1
12	MIRI	2003	SSR/PSR	7
13	LABUAN		SSR/PSR	
14	KOTA KINABALU	1995	SSR/PSR	15
15	TAWAU	2010	SSR/PSR	0

AUTOMATIC DEPENDENT SURVEILLANCE (ADS)

NO.	AREA	YEAR INSTALLED
1	INDIAN OCEAN	2009
2	TERENGGANU	2010

APPENDIX H

Participant Survey and Summary of Responses

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PERFORMANCE-BASED NAVIGATION REGULATORY REVIEW and EVALUATION PROGRAM (PBNRREVP)

PARTICIPANT SURVEY REPORT

MALAYSIA

SEPTEMBER 2012

The following is a summary of the responses received to the Participant Survey distributed during the PBNRREVP Team visit to Malaysia from 18th to 21st September 2012.

Participants responded very favorably to a total of 29 questions with no negative comments received.

Relevant notable comments have been included in this report. Of particular note are several responses urging APEC/ICAO follow up.

It is clear from the survey that participants valued the program highly and are committed to pursuing the implementation of PBN in Malaysia.

Part I: Pre-Program Activities

All respondents agreed that reported that the registration and participation process was well-organized, and the event venue was suitable (one neutral).

Comments:

"It was about time".

"Ensure all airlines' participation"

"Not many GA operators attended but most of the major airlines attended"

"Short notice, not all operators invited."

Part II: Program Activities

All respondents agreed that the content was just right, not too detailed, and not lacking. No negative reports received.

All respondents agreed (1 neutral) that the PBN Regulatory Review and Evaluation Program is beneficial to my economy's aviation program.

All respondents agreed (50% strongly agreed) that the PBN Regulatory Review and Evaluation Program is beneficial to my economy's aviation program.

All respondents agreed (40% strongly) that the PBN Regulatory Review and Evaluation Program is personally beneficial.

Respondents indicated that the APEC Team Members were knowledgeable about the topics they discussed.

Comments:

"All the team members are knowledgeable and provide a useful info and feedback."

"Yes, of course! All topics were thoroughly covered".

Responses relating to individual sessions

Day 1 (PBN Familiarization)

All respondents agreed presentations were beneficial to their understanding of the ICAO PBN Concept.

Comments:

"Mr. Tass Hudak's presentation was a good brief overview of what PBN is all about."

"Practical example, pick an airport in the airline and simulate flight to a PBN equipped airport. Justify the requirement of the aircraft and airspace to comply."

Day 2 (Flight Operations)

All respondents agreed the discussions on PBN Regulatory development in Malaysia were beneficial.

Comments:

"The discussions shall also cover airworthiness".

"Emphasize steps in application, validation and approval of Nav Specs"

"Probably, if more examples/guidance of PBN regulatory development done by other States/Members are shared with DCAM, they would be more pro-active and efficient – manpower/resources issue!

"The country needs to move forward!"

Day 3 Session 1 (Procedure Design)

All respondents agreed the discussions were beneficial (one neutral).
Comments:

"Not much of flight procedure design info. More of resources issues were discussed due DCAM's manning constraints"

"Maybe military procedure designer can work together with DCA procedure designer".

Day 3 Session 2 (PBN Implementation Plan)

All respondents agreed the discussions were beneficial.

Comments:

"Clearly nominated PBN committee members, and justify the importance of the role to each member".

"A follow-up by APEC/ICAO is recommended to review team's progress."

Day 4 (Air Traffic Control/ANS)

All respondents agreed the discussions were beneficial (one neutral).

Nil comments.

PART III: Post-Workshop Activities

All respondents rated the overall PBN Regulatory Review and Evaluation Program contents and outcome as good or better (20% very great).

Comments:

How have you or your economy benefited from the program? What new skills, knowledge, or value have you gained?

"I represent the Royal Malaysian Air Force. Through this workshop, the Air Force is moving into new perspective regarding PBN. A lot of work is needed to be done. All the information gained (will) help us a lot for better operations".

"The program benefited operators from the presentations and explanation from the APEC team members and discussion, with regulatory and other operators".

"Beneficial knowledge on PBN adapted, good sharing of ideas on suggested implementation process. Understanding of A/C capability for PBN".

"Yes, of course! The workshop has certainly broadened our overall understanding about PBN – application, implementation, concept etc."

What needs to be done next? How should this program be built upon with future APEC activities?

"Strike while the iron is hot!! Continue working with all stakeholders to ensure program remains on track".

"DCA must commit to ensuring they bring their "marginal" depts. up to an acceptable level".

"A follow-up in future is necessary! Continuation … ".

"Continue to assist and monitor".

"Follow up of the PBN implementation, increase attention to airlines by defining urgent needs".

"There has to be a follow up programme to enhance PBN implementation".

"All parties to start playing their role".

Please provide any additional comments on the APEC PBN Regulatory Review and Evaluation Program:

"Good, should be ongoing".

"Practical sessions would be beneficial, simulation for example".

"The appropriate experts should/could be more specific with discussion topics. Its observed that most of the time during discussion, operators and regulatory are left wondering what should be discussed".

"This has been an excellent effort which has opened the eyes of DAM by making them realise their current capability and expected level of compliance".

All respondents said that they will share their experiences with your co-workers/management.

All respondents indicated that discussions will prompt further action.

Please provide any additional information on your planned post-APEC PBN Regulatory Review and Evaluation Program actions.

"Continue to engage all stakeholders ensuring the PBN Roadmap stays on track".

"Thank you very much for coming by and helping us and our country to evolve."

80% of respondents reported that they would attend future AAOEC Aviation Workshops.

Project Code: PBNRREVP

Project Title: Perfromance-Based Navigation Regulatory Review and Evaluation Program

Participant Survey

Thank you for participating in the APEC Performance Based Navigation Regulatory Review and Evaluation Program, hosted by the Department of Civil Aviation (DCA) Malaysia. In order for APEC to ensure that the event met the needs of Participants, we must determine whether you have noted any concrete benefits from participating in this workshop. As such, please take a moment to answer the following questions. Your answers will be treated as confidential and will only be shared with APEC and the DCA Malaysia. Under no circumstances will your responses be shared with anyone outside of APEC or DCA Malaysia.

PLEASE RETURN THIS FORM TO AN APEC TEAM MEMBER BEFORE YOU LEAVE.

Part 1: Pre-Program Activities

1. Did you hear about the workshop from your _____APEC Delegation, _____ Civil Aviation Authority, _____ Industry or Other (_____)?

2. The registration and participation process was well-organized, and the event venue was suitable.

___ **strongly agree** ___ **agree** ___ **neutral** ___ **disagree** ___ **strongly disagree**

Comments:

_____

_____

_____

Part II: Program Activities

Based on your overall participation during the program, please rank the following statements:

3. The content was just right, not too detailed, and not lacking.

___ **strongly agree** ___ **agree** ___ **neutral** ___ **disagree** ___ **strongly disagree**

4. The PBN Regulatory Review and Evaluation Program is beneficial to my economy's aviation program.

___ **strongly agree** ___ **agree** ___ **neutral** ___ **disagree** ___ **strongly disagree**

5. The PBN Regulatory Review and Evaluation Program is beneficial to my civil aviation authority's and/or industry's aviation PBN program.

___ **strongly agree** ___ **agree** ___ **neutral** ___ **disagree** ___ **strongly disagree**

6. The PBN Regulatory Review and Evaluation Program is personally beneficial.

___ **strongly agree** ___ **agree** ___ **neutral** ___ **disagree** ___ **strongly disagree**

7. Were the APEC Team Members knowledgeable about the topics they discussed? Were there speakers that you did you find particularly useful?

_____

_____

_____

_____

_____

*Based on your participation during **Day 1 (PBN Familiarization)** please rank and answer the following statements:*

8. The presentations were beneficial to my understanding of the ICAO PBN Concept.

___ **strongly agree** ___ **agree** ___ **neutral** ___ **disagree** ___ **strongly disagree**

or: ___ I did not attend this session.

9. What information, if any, concerning might have been added to the presentation materials to improve your understanding of PBN?

_____

_____

_____

*Based on your participation during **Day 2 (Flight Operations)** please rank and answer the following statements:*

10. The discussions on PBN Regulatory development in Malaysia were beneficial:

___ strongly agree ___ agree ___ neutral ___ disagree ___ strongly disagree

or: ___ I did not attend this session.

11. What information, if any, concerning PBN Regulatory development in Malaysia or other relevant issues might have been added to the agenda to provide further knowledge sharing in this area?

_____

_____

_____

*Based on your participation during **Day 3 Session 1(Procedure Design)**, please rank and answer the following statements*

12. The discussions were beneficial:

___ strongly agree ___ agree ___ neutral ___ disagree ___ strongly disagree

or: ___ I did not attend this session.

13. What information, if any, concerning the provisions for the regulation of PBN Instrument Flight Procedure Design and might have been added to the presentation materials to the discussion to provide further knowledge sharing in this area?

_____

_____

_____

*Based on your participation during **Day 3 Session 2 (PBN Implementation Plan)**, please rank and answer the following statements:*

14. The discussions were beneficial:

___ strongly agree ___ agree ___ neutral ___ disagree ___ strongly disagree

or: ___ I did not attend this session.

15. What information, if any, concerning the Malaysia PBN Implementation Plan might have been added to the discussion to provide further knowledge sharing in this area?

_____

_____

_____

*Based on your participation during **Day 4 (Air Traffic Control/ANS)** please rank and answer the following statements:*

16. The discussions were beneficial:

___ strongly agree ___ agree ___ neutral ___ disagree ___ strongly disagree

or: ___ I did not attend this session.

What information, if any, concerning the ANSP aspects of Malaysia PBN Implementation might have been added to the discussion to provide further knowledge sharing in this area?

_____

_____

_____

_____

_____

PART III: Post-Workshop Activities

17. Please rate the overall PBN Regulatory Review and Evaluation Program contents and outcome:

    ___ **very great** ____ **great** ____ **pretty good** ____ **fair** ____ **rather poor**

18. How have you or your economy benefited from the program? What new skills, knowledge, or value have you gained?

    _____
    _____
    _____
    _____

19. What needs to be done next? How should this program be built upon with future APEC activities?

    _____
    _____
    _____
    _____
    _____

20. Please provide any additional comments on the APEC PBN Regulatory Review and Evaluation Program:

    _____
    _____
    _____
    _____
    _____

21. Will you share your experiences with your co-workers/management? ___yes ___no

22. Do you anticipate your discussions to prompt further action? ___yes ___no

    Please provide any additional information on your planned post-APEC PBN Regulatory Review and Evaluation Program actions.

    _____
    _____
    _____

Part IV: General Information

23. What APEC Economy or ICAO State do you represent? _____

24. Are you a member of your economy's APEC delegation? ___ Yes ___ No

25. Are you a ____ government or an _____ industry representative?

26. If government, do you represent ___Flight Standards, ___Aircraft Certification ___Air Traffic Control, _____ Airports or ____Other (_____)?

27. If industry, do you represent a _____ manufacturer, _____ air carrier, _____ association or _____ Other (_____)?

28. Would you attend future APEC Aviation Workshops? ___ Yes ___ No

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(*Complete information below, or attach business card*)

Organization:

Name:

Title

Address:

Telephone:

Fax:

Email:

Thank you for taking the time to complete this survey. Your contribution is appreciated.

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