International Civil Aviation Organization

The First Meeting of the APANPIRG ATM Sub-Group (ATM /SG/1)

Bangkok, Thailand, 20 – 24 May 2013

Agenda Item 4: ATM Systems (Modernisation, Seamless ATM, CNS, ATFM)

GNSS LANDING SYSTEM SEMINAR AND 10th PBN TASK FORCE OUTCOMES

(Presented by the Secretariat)

SUMMARY

This paper presents the outcomes of the GLS Seminar, and PBN/TF/10 and Workshop.

This paper relates to –

Strategic Objectives:

A: ***Safety*** *– Enhance global civil aviation safety*

C: ***Environmental Protection and Sustainable Development of Air Transport*** *– Foster harmonized and economically viable development of international civil aviation that does not unduly harm the environment*

Global Plan Initiatives:

GPI-5 RNAV and RNP (Performance-based navigation)
GPI-7 Dynamic and flexible ATS route management
GPI-11 RNP and RNAV SIDs and STARs
GPI-21 Navigation systems

1. INTRODUCTION

1.1 The Ground-based Augmentation System (GBAS) Landing System (GLS) Seminar was held at Sydney, Australia from 6 to 7 December 2012. The Seminar was attended by 37 participants from Australia, Bangladesh, Fiji, Hong Kong China, India, Malaysia, New Zealand, Singapore, Thailand, Honeywell, IATA, ALPA (affiliated to IFALPA), and ICAO. The GLS Seminar was comprised of 16 technical presentations by experts from airlines, ATC, regulators, air navigation service providers and meteorological service providers.

1.2 The Tenth Meeting of the Performance Based Navigation Task Force (PBN/TF/10) was held in Nadi, Fiji from 11 to 13 December 2012 at Nadi, Fiji. The PBN Workshop was conducted prior to the PBN/TF/10 from 10-11 December 2012 at Nadi, and was attended by 63 participants from 21 administrations, including nine from small Pacific Island States.

1.3 The PBN/TF/10 meeting was attended by 62 participants from Australia, Bangladesh, Cambodia, Hong Kong, China, Fiji, French Polynesia, Indonesia, India, Japan, Kiribati, New Caledonia, New Zealand, Papua New Guinea, Philippines, Republic of Korea, Samoa, Singapore, Thailand, Tonga, Vanuatu, and IATA.

1.4 Four Draft Conclusions and one Draft Decision were developed by the PBN/TF/10.

2. DISCUSSION

GLS Seminar

2.1 The Twenty Third Meeting of APANPIRG/23 (Bangkok, Thailand, 10 – 14 September 2011) highlighted PBN and GNSS global developments. Australia had provided PBN/TF/9 an update on the Australian installation of GLS at Sydney. IATA supported GLS technology but preferred an aggressive timeline and implementation plan to meet airline requirements. The meeting adopted the following Conclusion:

Conclusion 23/26 - Asia/Pacific GLS Seminar

That, ICAO plans an Asia/Pacific GNSS Landing System (GLS) Seminar to provide information on emerging GLS technology, airport and airline GLS planning, and the development of applicable standards.

2.2 Australia stressed that GLS was a proven ICAO standardised precision approach service providing a quality and flexible solution for the approach phase of flight. It was noted that at the 12th Air Navigation Conference PBN based on GNSS was flagged as the key enabler and that augmented GNSS was identified as the technology to provide precision approach guidance. Moreover, GLS/GBAS was the only standardised and certified augmentation system available to replace Category I ILS and Microwave Landing System (MLS).

2.3 GLS passed GNSS corrections for each satellite in view and associated integrity information to the aircraft equipment using VHF broadcasts twice a second (MT1). Message Types 2 and 4 provided the site data and approach path definition and were sent at 10 second intervals. The messages included a 32 bit Cyclical Redundancy Check (CRC) to ensure integrity.

2.4 A critical improvement that GLS provided was that there was no requirement for critical areas that had to be sanitized around the navigation aids, unlike ILS. Aircraft operators stressed that the capability of the aircraft, and in particular the inertial coasting that allowed a continuity of flight path in the short term, meant that the risks associated with loss of GNSS acquisition were minimal. It was noted that GBAS improved accuracy of position in the taxi and rollout, as well as airborne phases.

2.5 The Seminar noted that flight validation was essential for GLS, although an ILS ‘overlay’ that had been previously checked, but did not necessarily need a flight inspection if the required VDB coverage and power were already confirmed.

2.6 Dmax was a parameter that was set to determine the maximum distance that a GBAS signal can be operationally utilised, due to the effects of oblique geometry through the ionosphere. This was currently set at 23NM in Australia. The RTCA was considering the merits of what this value might be globally and what consequence this would have on for aircraft receivers. Within the 23NM service volume, it was possible to provide services to more than one aerodrome if they were both within this area.

2.7 Currently GLS was approved for CAT I operations, although there was planning for CAT II and III capability through the ICAO Navigation Panel. Honeywell was expecting CAT III certification about 2016. GLS allowed up to 26 types of approaches for an aerodrome, potentially providing customized solutions for different wake turbulence or aircraft classifications and even providing different arrival and departure flight paths to the same runway. GLS also had the capability of defining a curved path to allow segregation of aircraft types or an overlay of visual procedures without using RNP Authorization Required (AR) procedures.

2.8 In conducting maintenance on a GBAS, there was no need to take it out of service, unlike ILS. GLS had low maintenance requirements compared to ILS. In addition, GBAS had a 'fail-soft' capability that allowed a slow degradation in redundancy. The siting of GLS was not as vulnerable as ILS to aircraft excursions, as there was no need to be sited immediately adjacent to the runway. The flexible siting options also a freeing up of sterilized land for airport development.

2.9 From 131 days of data at Sydney, the standard deviation from the GLS was 14cm laterally and 35cm vertically. Two very short term events (less than a second) had breached the limits due to insufficient constellation geometry being detected by the Remote Satellite Measurement Units (RSMU), although this was within the six second time to alert.

2.10 The Seminar recognised that the Asia/Pacific was leading the global implementation of GLS as part of the Aviation System Block Upgrade (ASBU) B0-65 module. In conclusion, the Seminar urged accelerated implementation programmes for ground and airborne components of GLS where there was an economic benefit.

PBN Workshop

2.11 There were three Group Sessions and 10 presentations made during the PBN Workshop, which included:

- Introduction to PBN – 'PBN 101';
- Introduction of New Navigation Specs / Functionalities;
- Procedure Design Criteria for the new navigation specs and GLS;
- Airspace Planning and Design;
- Instrument Flight Procedure Design;
- New Development – RNP to XLS;
- Navigation Aids;
- ATC Procedures and Training;
- Operator Training / Approvals;
- PBN Plan Requirements – the BPEs, etc.; and
- PBN Implementation Lessons Learned.

2.12 The value of this type of workshop was noted by the attendees with the recommendation that similar workshops on PBN and APV (Approach with Vertical Guidance) would be required to ensure the progress of implementation is maintained. A PBN Plan template was developed and States that had not yet developed a robust plan were urged to utilise the template.

PBN/TF/10

2.13 The PBN/TF meeting was apprised of the dialogue that had been on-going in Australia regarding the requirements of conventional procedure overlays. IATA stated that this was a complex area with possible legal implications for ATC. APANPIRG/23 noted the lack of guidance on this matter and discussed the draft Conclusion formulated by PBN/TF/9, asking ICAO to review and develop operational guidance materials for conventional instrument flight procedures flown using GNSS/RNP aircraft.

2.14 APANPIRG/23 did not adopt the draft PBN/TF Conclusion regarding conventional instrument flight procedures flown using GNSS/RNP aircraft, requesting further clarification of what was expected from the Draft Conclusion. During PBN/TF/10, Australia developed Flimsy 1, which provided more information on the issues that precipitated the overlay matter earlier.

2.15 In the United States, AC 90-108 allowed the substitution of approved RNAV aircraft to fly enroute, terminal and approach procedures based on conventional aids without the aids being either on the aircraft or in operation. However, the AC did not make any reference to either the flight planning requirements or the separation standards to be applied. The United States provided the ATS service the operator requested. Australia advised that they already used GNSS in lieu of conventional navigation aid information, as did other Asia/Pacific States. Moreover, most modern RNP capable aircraft had approval to conduct enroute, terminal and approach procedures based on using their RNP capabilities in their Aircraft Flight Manual (AFM).

2.16 Amendment 1 to Doc 4444 (Flight Plan 2012) still required that the flight plan contain the equipment that the aircraft carried rather than its capabilities. The outcome of this was that aircraft could not include capabilities to fly conventional enroute, terminal and approach procedures on the flight plan, and in turn, ATS could not technically apply conventional aid separation standards to these aircraft, imposing significant operational restrictions and costs on operators.

2.17 The issue of GNSS overlays of conventional navigation aids was considered by the ICAO Separation and Airspace Safety Panel (SASP), which had produced Draft Circular 322 in 2009. IATA accepted the use of GNSS overlays as an interim measure.

2.18 PBN/TF/10 agreed to the following Draft Conclusion, for consideration by the CNS Sub-Group and APANPIRG:

Draft Conclusion PBN/TF/10-1: RNAV Substitution for Conventional Instrument Flight Procedures

That, considering the intent of US AC 90-108 and issues concerning the application of GNSS capability for aircraft flying conventional instrument flight procedures:

a) Asia/Pacific States should publish material that–

(i) includes approval for authorised operators with the appropriate RNAV capability to include the listing of conventional navigation aids in flight plans, provided the operator has approval for navigation aid substitution and an appropriate, up-to-date database; and

(ii) includes acceptance of navigation substitution approvals of foreign States; and

(iii) supports ATC separation standards for navigation aid substitution; and

b) ICAO HQ should –

(i) expedite development of global navigation aid substitution provisions; and

(ii) review the current Flight Plan contents to consider the listing of aircraft navigation capabilities rather than the listing of specific equipment carried (revisions should include the addition of Item 18 PBN codes for navigation specifications not currently included).

2.19 The Task Force agreed that the new navigation specifications in the advance Fourth Edition (unedited) version of the PBN Manual, particularly Advanced RNP, were still a ‘work in progress’. However Advanced RNP elements could be applied where benefits could accrue. The limitation preventing early application was the lack of procedure design criteria in ICAO Doc 8168 PANS OPS, for the application of low RNP values for missed approach and departure applications.

2.20 Providing for low RNP values for departure and missed approach operations would, in many cases, remove the need to implement RNP-AR procedures with their high overhead costs for operators and regulators alike. Training material for Advanced RNP would be needed, particularly for the advanced ATM capabilities envisaged. However, the Advanced RNP applications needed more development before the training material could be produced.

2.21 The meeting considered that the most practical way to undertake these tasks and update the PBN Manual Doc 9613 was through the reconvening of the ICAO PBN Study Group. The meeting agreed to the following Draft Conclusion for consideration by the CNS Sub-Group and APANPIRG:

Draft Conclusion PBN/TF/10-2: New PBN Navigation Specifications

Considering that the RNP2, RNP0.3 and Advanced RNP Navigation Specifications were to be significantly valuable for future planning, ICAO HQ was urged to:

a) expedite standards and guidance associated with these navigation specifications; and

b) provide adequate training material and courses to enable effective implementation; and

c) expedite the development of procedure design standards in Doc 8168 for low RNP value missed approach and departure operations.

2.22 In accordance with APANPIRG Conclusion 21/32 – *Develop State PBN Implementation Plan* and DGCA Action Item 47/4, Asia/Pacific PBN State Plans had been categorized into three categories based on quality:

- Robust – when 8 to 10 basic plan elements (BPE) were satisfied;
- Marginal – when 5 to 7 BPE were satisfied; and
- Incomplete – when 4 or less BPE were satisfied.

2.23 **Table 1** indicates the results of the 2012 PBN State Plan assessments.

State	**# of BPEs Addressed (Robust/Needs Improvement / Non Existent)**	**Status**	**Submitted**
Tonga	8/2/1	Robust	26 June 2012
Bangladesh	9/2/0	Robust	30 July 2012
French Polynesia	6/1/4	Marginal	12 October 2012
Malaysia	9/1/0	Robust	20 November 2012
Maldives	9/2/0	Robust	10 December 2012

Table 1: 2012 PBN State Plan Assessments

2.24 There were 42 administrations which include New Caledonia and French Polynesia separately; or 43 if the US was included in regards to its territories (American Samoa, Guam, Johnston, Kingman, Midway, Mariana, Palmyra, and Wake Islands). **Table 2** provides an overall summary of the status of Asia/Pacific PBN Plans.

Asia/Pacific PBN Plan Status	**2011 (PBN/TF/8)**	**2012 (PBN/TF/9)**	**2012 (PBN/TF/10)**
Robust	9 (21%)	14 (33%)	18 (43%)
Marginal	4 (10%)	5 (12%)	3 (7%)
Incomplete	8 (19%)	5 (12%)	4 (10%)
Total Plans (of 42)	**21 (50%)**	**24 (57%)**	**25 (60%)**
Administrations with no plan	21 (50%)	18 (43%)	17 (40%)

Table 2: Asia/Pacific PBN Plan Overall Status

2.25 There had been a significant improvement in the number of administrations with a 'Robust' plan since PBN/TF/9. Bangladesh, Maldives, Malaysia and Tonga had successfully transitioned to 'Robust' category. The number of administrations with satisfactory PBN planning had more than doubled in less than two years.

2.26 A number of States remained with either 'Marginal' or 'Incomplete' status plans, or had no plan. Administrations with significant aviation activity in this category were Afghanistan (no plan), Indonesia ('Incomplete'), Pakistan ('Marginal'), and Viet Nam ('Incomplete'). Of concern was the proportion of Pacific Island administrations (three quarters of the 40%) that had not provided a PBN Plan to ICAO; however six of these administrations attended the PBN Workshop. **Figure 1** provides an overall view of the Asia/Pacific PBN Plan Status.

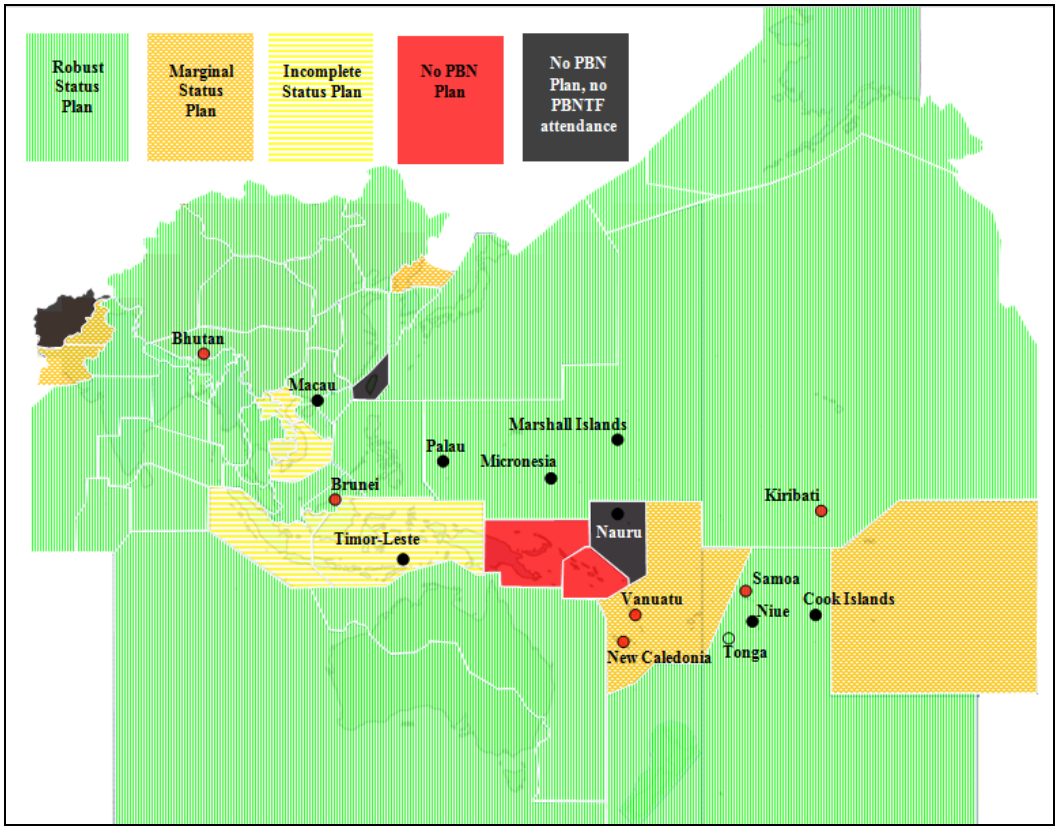

Figure 1: Asia/Pacific State PBN Plan Status

2.27 New Zealand suggested that the PBN Workshop deliverables could be fashioned into a template for the States that had difficulty in creating a PBN Plan. With the assistance of IATA, a template was developed.

2.28 Tonga stated that many small Pacific Island States did not have a CNS infrastructure such as adequate communications and ATS surveillance that supported PBN. The Chairman acknowledged this, but suggested that even simple GNSS procedures alone would derive great benefits.

2.29 Australia stated that they would not meet the timeline of Assembly Resolution A37-11, due to insufficient Baro-VNAV capability within their fleet, and lack of a Space Based Augmentation System (SBAS). The meeting noted that there were a number of domestic operations (such as twin turboprop aircraft) that were not Baro-VNAV capable. Australia noted that even some of the airlines had difficulty in determining if their aircraft were Baro-VNAV capable.

2.30 New Zealand assessed its aerodromes using the A37-11 criteria, noting that they used Baro-VNAV where aircraft were capable of using this procedure. IATA agreed that A37-11 had to be implemented on a needs basis. They noted that many airports were still served only by a conventional approach such as a Non-Directional Beacon (NDB) procedure.

2.31 The meeting discussed the implementation targets for APV approaches in accordance with Assembly Resolution 37-11. The conclusion was that the wording of the resolution 37-11 is not clear enough and that it may lead to States setting unrealistic implementation targets, or misdirecting scarce IFP design resources.

2.32 The meeting suggested the following additional guidelines for the States to use in their planning for implementation of APV approaches in accordance with Assembly Resolution A37-11:

- planning for APV implementation should be carried out at those instrument runways where the configuration of terrain allows for a runway-aligned approach;
- the primary focus should be on those runways served by scheduled air-transport operations by APV-capable aircraft with a maximum certificated take-off mass of 5 700 kg or more; and
- priority should be given to those aerodromes with the best operational and safety benefit-to-cost of implementation ratio.

2.33 The meeting noted that Asia/Pacific would not achieve compliance with Resolution A37-11 even if the timeline was amended, so the following Draft Conclusion was agreed for consideration by the CNS Sub-Group and APANPIRG:

Draft Conclusion PBN/TF/10-3: PBN Procedures with Vertical Guidance

That, given the difficulties that some States had with insufficient fleet capability for Baro-VNAV and no Space Based Augmentation System (SBAS), ICAO HQ was urged to consider alternative requirements or means of achieving the highest possible conformance with the intent of Assembly Resolution A37-11 where practicable.

2.34 Japan stated that the IFPP had simplified the Baro-VNAV design criteria to improve consistency and these were expected to be published in 2014. The Chairman noted that the Baro-VNAV design criteria needed to be improved as the procedure often did not derive lower minima than a standard GNSS approach. Moreover, Baro-VNAV did not cater for slightly offset approaches, even though the definition of a straight-in approach included procedures up to 15 degrees off centreline.

2.35 ICAO provided an update of the progress and accomplishments of the ICAO Flight Procedure Programme (FPP) in 2012. The paper also presented the strategy for FPP Phase 2 covering 2013 to 2017. The FPP in co-operation with its partner organizations conducted a total of fourteen courses and workshops in 2012, with nearly 400 students from eighteen administrations in the Asia/Pacific Region. The training and workshops were focused on support in the areas of procedure design, quality assurance process and PBN implementation.

2.36 The Regional Navigation Strategy for the Asia/Pacific Region was a list of high-level navigation policies that had been developed by the CNS-MET Sub-Group of APANPIRG. Under the recent re-organization of APANPIRG, the Strategy fell under the responsibility of the CNS Sub-Group, which the PBN/TF reported to. The latest version of the Regional PBN Implementation Plan (Version 3.0, September 2011) provided detailed guidance for administrations in the field of PBN. APSAPG had been tasked by APANPIRG with the development of an Asia/Pacific Seamless ATM Plan, which incorporated the Aviation System Block Upgrade (ASBU) modules, including those related to PBN.

2.37 It was important that there was alignment and an appropriate hierarchy between the Regional Navigation Strategy for the Asia/Pacific Region and documents that provided implementation guidance regarding PBN. The Regional Navigation Strategy for the Asia/Pacific Region contained a prescriptive statement of PBN specifications, which means that it was not confined to overall objectives, as might be expected in a high-level policy statement.

2.38 The Regional PBN Implementation Plan included Short-Term (2008-2012) strategies and a Medium-Term Implementation Plan (2013-2016). With the passage of time, these strategy timeframes had become out-of-date.

2.39 The PBN/TF/10 meeting extensively discussed proposed amendments to the Regional Navigation Strategy for the Asia/Pacific Region and the Regional PBN Implementation Plan, and also took the opportunity to provide feedback on the early draft excerpt of the Asia/Pacific Seamless ATM Plan related to PBN.

2.40 The draft Asia/Pacific Seamless ATM Plan excerpt included a passage that required the establishment of a PBN specification for all ATS routes. During discussion at the PBN Workshop, Australia had advised that it intended to re-designate PBN specifications for all domestic RNAV routes. RNAV5 was being used as the baseline in order to confirm the area semi-widths and minimum safe altitudes for routes. Australia advised that the RNAV specification was being supported by GNSS, and that this would be confirmed in the Australian AIP, as the RNAV5 specification allowed use of other navigation aids such as VOR and DME.

2.41 It was recognised that while the original intention of PBN was to create a harmonised world-wide navigation scheme, unfortunately there was no hierarchy between specifications; thus an aircraft with a higher performing capability such as RNP2 was not able to utilise a route with a lower specification such as RNAV5. Australia had deemed higher performing navigation specifications as being able to be used on RNAV5 routes, in effect creating a hierarchy between specifications.

2.42 The following Draft Conclusion was agreed by the PBN/TF/10 for consideration by the CNS Sub-Group and APANPIRG:

Draft Conclusion PBN/TF/10-4: PBN Implementation Guidance Updates

That, recognizing the need for alignment of PBN Strategies and Guidance Material, as well as development of the Asia/Pacific Seamless ATM Plan, the following documents be updated with regard to PBN:

a) Regional Navigation Strategy for the Asia/Pacific Region, appended as **Appendix xx**; and

b) Asia/Pacific Regional PBN Implementation Plan Version 4.0, appended as **Appendix xx**.

2.43 The Secretariat presented information related to future planning of the PBN/TF. The meeting recalled that the PBN Task Force had been formed in 2007 under APANPIRG Conclusion 18/52. PBN/TF/8 and PBN/TF/9 had both discussed the future of the Task Force.

2.44 It was noted by APANPIRG that the new CNS Sub-Group could oversee PBN development, and that the proposed Regional Sub-Office (RSO) could also play a part in day-to-day PBN implementation assistance, along with the Asia/Pacific Flight Procedures Programme (FPP).

2.45 Apart from the future updating of PBN material, IATA asked for reassurance that there be a continued focus on PBN implementation. The Task Force recognised the need for continuing PBN and APV activity in the region, particularly supporting smaller States with PBN implementation.

2.46 The meeting agreed to the following Draft Conclusion for consideration by the CNS Sub-Group and APANPIRG:

Draft Decision PBN/TF/10-5: Dissolution of the PBN Task Force

That, subject to:

a) the establishment of suitable oversight of PBN implementation within the Asia/Pacific Region; and

b) endorsement by APANPIRG/24 of the –

(i) Asia/Pacific Regional PBN Implementation Plan Version 4.0 amendment; and

(ii) PBN components within the Asia/Pacific Seamless ATM Plan;

the Performance-based Task Force (PBN/TF) be dissolved and any on-going tasks be delegated to the CNS Sub-Group or as directed by APANPIRG.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) note the information contained in this paper; and

b) discuss any relevant matters as appropriate.

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