



INTERNATIONAL CIVIL AVIATION ORGANIZATION

Third Meeting of the APIRG Communications, Navigation and Surveillance Sub-Group (Nairobi, 26-30 April 2010)

Agenda Item 3: Review and follow up of Recommendations, Conclusions and Decisions applicable to the CNS Sub-Group

Agenda Item 6: Aeronautical Radio Navigation Service (ARNS)

AFI NAVIGATION INFRASTRUCTURE: PROPOSED UPDATED STRATEGY FOR GNSS APPLICATIONS

(Presented by the International Air Transport Association)

SUMMARY
This working paper proposes an updated strategy for the introduction of GNSS in the AFI Region, based on the work carried out by the GNSS Implementation Task Force and the Joint Meetings of APIRG PBN and GNSS Task Forces in accordance with Decision 16/24 of APIRG/16 Meeting (2007).
Action by the meeting is at paragraph 3 .
References: <ul style="list-style-type: none">• ICAO Global Air Navigation Plan (Doc 9750)• ICAO Special AFI RAN Meeting (2008) Report• APIRG/16 Report (2007)

1. INTRODUCTION

1.1. Mindful of the action taken by the Air Navigation Commission (ANC) on APIRG/15 Report on issues pertaining to GNSS implementation, and of IATA's position on SBAS, APIRG/16 opted to delay consideration of the ISA until further cost-benefit analysis in coordination with users demonstrates a conclusive need. This option would have the following advantages:

- a) Benefit from operational experience with the EGNOS system and associated aircraft equipment and procedures that would be gained in the EUR region (the primary service area of EGNOS); and
- b) Prolongation of the current Phase I of the AFI GNSS strategy, which allows the use of Basic GNSS (GPS augmented with ABAS) from en-route down to NPA. The prolongation would be consistent with the fact that Phase I has effectively not been completed properly and uniformly throughout the Region.

1.2. APIRG/16 recommended that the action taken by the ANC on APIRG/15 Report should be referred to the AFI GNSS Implementation Task Force for subsequent amendment to the AFI GNSS Strategy (Decision 16/24).

1.3. In doing this exercise, due account should be taken of the *Navigation Systems Strategy* as outlined in the ICAO Global Air Navigation Plan (Doc 9750) – Global Plan Initiative GPI-21, the scope of which is to enable the introduction and evolution of performance-based navigation supported by a robust navigation infrastructure providing an accurate, reliable and seamless global positioning capability.

2. DISCUSSION

Global Strategy for Navigation Systems - Description

2.1. Airspace users need a globally interoperable navigational infrastructure that delivers benefits in safety efficiency and capacity. Aircraft navigation should be straightforward and conducted to the highest level of accuracy supported by the infrastructure.

2.2. To meet those needs, the progressive introduction of performance-based navigation must be supported by an appropriate navigation infrastructure consisting of an appropriate combination of global navigation satellite systems (GNSS), self-contained navigation systems (inertial navigation system) and conventional ground-based navigation aids.

2.3. GNSS provides standardized positioning information to the aircraft systems to support precise navigation globally. One global navigation system will help support a standardization of procedures and cockpit displays coupled with a minimum set of avionics, maintenance and training requirements. Thus, the ultimate goal is a transition to GNSS that would eliminate the requirement for ground-based aids, although the vulnerability of GNSS to interference may require the retention of some ground aids in specific areas.

2.4. GNSS-centered performance-based navigation enables a seamless, harmonized and cost-effective navigational service from departure to final approach that will provide benefits in safety, efficiency and capacity.

Near-Term Applications

2.5. GNSS implementation will be carried out in an evolutionary manner, allowing gradual system improvements to be introduced. *Near-term applications of GNSS are intended to enable the early introduction of satellite-based area navigation without any infrastructure investment, using the core satellite constellations and integrated multisensor airborne systems.* The use of these systems already allows for increased reliability of non-precision approach operations at some airports.

Medium/ Long-Term Applications

2.6. Medium/longer-term applications will make use of existing and future satellite navigation systems with some type of augmentation or combination of augmentations required for operation in a particular phase of flight.

Regional Strategy for GNSS as part of AFI Navigation Infrastructure

2.7. As a follow-up to APIRG Decision 16/24, the 4th Meeting of AFI GNSS Implementation Task Force (GNSS/I/TF/4) (Nairobi, Kenya, 8-9 December 2008) developed an updated GNSS Strategy.

2.8. GNSS/I/TF/4 called for a joint meeting of APIRG PBN and GNSS Implementation Task Forces to finalize the amended GNSS Strategy with a view to supporting regional PBN requirements as well as non-PBN requirements.

2.9. The 1st Joint Meeting of APIRG PBN and GNSS Task Forces which was held in Nairobi, Kenya from 8 to 10 September 2009, was updated on latest developments concerning PBN and GNSS.

2.10. **Appendix A** to this paper provides a summary of the proposed GNSS Strategy for PBN and non-PBN operations.

2.11. **Appendix B** to this paper shows the proposed GNSS configurations as part of the navigation infrastructure intended to support implementation of PBN navigation specifications in the Region.

3. ACTION BY THE MEETING

3.1. In light of the Global Strategy for Navigation Systems (GPI-21) described in ICAO Doc 9750, the meeting is invited to:

- a) Review, amend and adopt the proposed updated AFI GNSS Strategy for near-term, medium-term and long-term applications, as shown in **Appendix A** to this working paper; and
- b) Review and amend as necessary the AFI GNSS Infrastructure in support of PBN implementation as shown in **Appendix B** to this working paper.

-END-

AFI GNSS Strategy

Short term		Medium term		Long term
Time scale	2008 – 2012		2013 – 2016	2017 and beyond
Certification	Primary for oceanic and remote continental Supplemental for continental	Primary for oceanic and remote continental Supplemental for continental	Primary means from en route to APV	Primary means from en route to CAT-I
Oceanic and Remote Continental En route	GPS with ABAS	GPS with ABAS	Multi-constellation GNSS with ABAS	
Continental En route	GPS with ABAS	GPS with ABAS	Multi-constellation GNSS with ABAS	
Terminal	GPS with ABAS	GPS with ABAS	Multi-constellation GNSS with ABAS	
Approach and Landing	GPS with ABAS	GPS with ABAS, SBAS*	Multi-constellation GNSS with ABAS, SBAS, GBAS	
			CAT I (GLS) CAT II/III/ (GLS) as required	

*As from 18 November 2010, it is expected that ICAO Annex 10, Volume I will enable Category I approach operations supported by satellite-based augmentation system (SBAS). The upper vertical alert limit (VAL) for CAT I operations has drastically been increased from 15.0 m to 35.0 m. However, a vertical alert limit greater than 10 m for a specific system design may only be used if a system-specific safety analysis has been completed.

Appendix B

GNSS Infrastructure in support of PBN requirements

Short term		Medium term		Long term	
Time scale	2008 – 2012		2013 – 2016		2017 and beyond
Certification	Primary for oceanic and remote continental Supplemental for continental	Primary for oceanic and remote continental Supplemental for continental	Primary means from en route to APV		Primary means from en route to CAT-I
Oceanic and Remote Continental/ En route	GNSS Configuration	GPS with ABAS	GPS with ABAS		Multi-constellation GNSS with ABAS
	PBN Nav Spec	RNAV-10, RNP-4	RNAV-10, RNP-4		RNAV-10, RNP-4
Continental En route	GNSS Configuration	GPS with ABAS	GPS with ABAS		Multi-constellation GNSS with ABAS
	PBN Nav Spec	RNAV-5, RNAV-1	RNAV-5, RNAV-2, RNAV-1		RNAV-5, RNAV-2, RNAV-1
Terminal	GNSS Configuration	GPS with ABAS	GPS with ABAS		Multi-constellation GNSS with ABAS
	PBN Nav Spec	RNAV-1 in a surveillance environment Basic RNP-1 in non-surveillance environment	Expand RNAV-1, or RNP-1 application Mandate RNAV-1, or RNP-1 in high density TMAs		RNAV-1 in a surveillance environment Basic RNP-1 in non-surveillance environment
Approach	GNSS Configuration	GPS with ABAS	GPS with ABAS, SBAS*		Multi-constellation GNSS with ABAS, SBAS*
	PBN Nav Spec	RNP APCH: NPA RNP APCH: APV with Baro-VNAV or RNP AR APCH: APV with Baro-VNAV	RNP APCH: NPA RNP APCH: Expand APV (with Baro-VNAV and/or augmented GNSS) Expand RNP AR APCH: APV with Baro-VNAV		RNP APCH: NPA RNP APCH: APV (with Baro-VNAV and/or augmented GNSS) RNP AR APCH: APV with Baro-VNAV

*Although they are not yet included in the PBN concept contained in ICAO Doc 9613, SBAS has been introduced in the spirit of Assembly Resolution A36-23.
