International Civil Aviation Organization
Western and Central African Office

Second Joint Meeting of the APIRG Performance Based Navigation and Global Navigation Satellite System Implementation Task Forces (Joint PBN & GNSS/I TFs) (Dakar, Senegal, 2 - 4 March 2010)

Agenda Item 6: Update of AFI GNSS Strategy (Appendix H of Doc 003 **)**

(Presented by the Secretariat)

SUMMARY

Attachment to this paper is the updated GNSS strategy (Appendix H) of Doc 003) The meeting is require to approve for submission to CNS-SG

REFERENCES

DOC 003,ICAO PBN MANUAL DOC9613 , ICAO RCP MANUAL (DOC 9869)

This Working Paper is related to Strategic Objectives: **D**

1. INTRODUCTION

1.1 The ICAO Assembly in its 36th Session held in September 2007 adopted resolution A 36/23 to implement Performance Based Navigation PBN. The Regional PBN plan addressed the strategic objectives for PBN implementation based on established operational requirements.

1.2 The First Joint Meeting of the APIRG Performance Based Navigation and Global Navigation Satellite System Implementation Task Forces (Joint PBN & GNSS/I TFs/1) held in Nairobi, 8-10 September 2009, called on the Task force to update the AFI GNSS implementation strategy to reflect the implementation of PBN.

2. DISCUSSION

2.1 Navigation Infrastructure: The PBN implementation calls for RNAV and RNP operations in phase 1. GNSS supports both RNAV and RNP operations.

2.2 Other navigation infrastructures include INS, VOR/DME, DME/DME and DME/DME/IRU. These navigation infrastructures may satisfy the requirements of RNAV navigation specifications but not those of RNP.

2.3 INS may also be used to support PBN en-route operations with RNAV 10 and RNAV5 navigation specifications.

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

2.5 Uses of DME/DME and DME/DME/IRU may support PBN en-route and terminal area operations based on RNAV 5, RNAV 2 or RNAV 1 navigation specifications. Validation of DME/DME coverage area and appropriate DME/DME geometry should be conducted to identify possible DME/DME gaps, including identification of critical DMEs, and to ensure proper DME/DME service coverage.

2.6 In AFI taking into consideration the work done on GNSS implementation, the use of GNSS as the infrastructure support for PBN looks favourable. GNSS implementation should support the implementation of PBN and as such, should be updated accordingly with respect to the technological development of PBN implementation.

2.7 ICAO support team for PBN will be developing guidance for States on the implementation of GNSS this year.

2.8 Development of a navigation specification for SBAS and its inclusion in the PBN Manual is on the work program for the PBN Support team for 2010.

2.9 Based on recent development and deliberations of the first Joint Meeting of the PBN and GNSS/I Task Forces, the GNSS Implementation Strategy is updated as attached in **Appendix A** to this working paper.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) note the information in this working paper; and

b) review as necessary and approve the proposed New GNSS Implementation Strategy for submission to APIRG/17 through CNS/SG.

APPENDIX A

PROPOSALS FOR AMENDMENTS TO AFI CNS/ATM IMPLEMENTATION PLAN (DOC. 003) (APPENDIX H) (UPDATED VERSION)

Concept of the GNSS Strategy for the AFI Region

1. Introduction

1.1 The purpose of the AFI GNSS strategy is to define an evolution path for replacement of ground-based navigation aids, i.e. VOR/DME/ILS/NDB, ensuring that operational and other concerns such as positive cost-benefit are fully taken into account.

1.2 The AFI GNSS strategy assumes availability of a GNSS meeting of the specified parameters at every phase of deployment. It does not analyze GNSS systems configuration per se nor the advantages and disadvantages of various deployment strategies.

2. General Considerations

2.1 By necessity, satellite-based and ground-based navigation systems will co-exist for a period of time. Considering that the operation of a dual system is detrimental to a positive cost-benefit, users and providers will co-operate with the view of reducing the duration of the transition period as much as possible, having due regard for the following principles:

- The level of safety will not be downgraded during the transition;
- GNSS-based service must, before the end of the transition period, fully meet the required parameters of accuracy, availability, integrity and continuity for all phases of flight;
- During the transition, gradually evolving levels of functionality will be available;
- Operational advantage shall be taken in to consideration the available and capabilities at every step of deployment;
- Methods of application will take into account full consideration of safety considerations of any functional limitations;
- Users must be given sufficient advance notice to re-equip before ground-based systems are decommissioned.

3. **Evolving functionality**

3.1 **Phase I (Short term), up to 2012**: *Additional ranging and health information on GPS constellation provided via GEO satellites*

- This phase will allow the use of GNSS as a primary-means of navigation for en-route, and for NPA; and as a supplemental-means navigation system for TMA. Existing ground infrastructure remains intact.

Table 1: Summary of AFI GNSS Strategy for 2008-2012		
Airspace	**Navigation Specifications**	**Navigation Specifications where operationally required**
	Basic GNSS	
En-Route Oceanic	RNAV-10	RNP-4
En-Route Remote Continental	RNAV-10	RNP-4
En-Route Continental	RNAV-5	RNAV-1
TMA Arrival/Departure	RNAV-1 in a surveillance environment Basic RNP-1 in non-surveillance environment	
	Basic GNSS	
Approach	RNP APCH with Baro-VNAV or RNP AR APCH if required	

3.2 **Phase II (Medium term) -2013 - 2016**:

- This phase will allow for:

a) <u>En-route phase</u>: sufficient capability to meet en-route navigation requirements everywhere in the AFI Region. GNSS will continue to be used as principal en-route navigation. The same principle will be characterized by a clearly planned transition for the use of GNSS as the sole means for en-route navigation. Navigational aids will accordingly be progressively withdrawn in consultation with the Users.

b) <u>Terminal areas</u>: sufficient capability to meet TMA navigation requirements everywhere in the AFI region. GNSS is approved as sole-means for TMAs, taking into account technical and legal developments, and institutional aspects.

c) Terminal area VOR/DME/NDB, and Locators not associated with ILS, will be progressively withdrawn in consultation with users during Phase II.

d) <u>Approach and landing phase:</u> sufficient capability for APV1 in the whole AFI Region. ILS will continue to be provided at aerodromes[1].

Note 1: Where the requirements for approach and landing can be met by APV 1, the withdrawal of ILS CAT I should be considered.

- During Phase II, the implementation of Long- term GNSS will be developed.

Table 2: Summary of AFI GNSS Strategy for 2013-2016		
Airspace	**Navigation Specifications**	**Navigation Specifications where operationally required**
	Basic GNSS	
En-Route Oceanic	RNAV-10	RNP-4
En-Route Remote Continental	RNAV-10	RNP-4
En-Route Continental	RNAV-2, RNAV-5	RNAV-1
TMA Arrival/Departure	Expand RNAV-1, or RNP-1 application Mandate RNAV-1 OR RNP-1 in high density TMAs	
	ABAS or SBAS (SBAS will be included in ICAO PBN concept)	
Approach	Expand RNP APCH with (Baro-VNAV0 and APV (ABAS or SBAS) Expand RNP AR APCH where there are operational benefits	
Approach Precision	Cat I (SBAS, GBAS) and CAT II /III (GBAS)	

3.3 **Phase III (Long term) 2017 onwards**: It is assumed that more constellations of navigation satellites will be available to support GNSS as the sole-means of navigation from en-route to CAT I operations. CAT I by SBAS or GBAS will be available in those locations where analysis of historical MET data or traffic characteristics justifies the requirement. Other requirements will be met by ground-based augmentation system (GBAS).

- During Phase III, ILS CAT I will be withdrawn in consultation with users.

- Where CAT II/III ILS requirements have been confirmed, these facilities will remain unless technical evolution then demonstrates that the requirement can be supported by GBAS or SBAS.

Table 3: Summary of AFI GNSS Strategy for 2017 – and beyond		
Airspace	**Navigation Specifications**	**Navigation Specifications where operationally required**
	Basic GNSS	
En-Route Oceanic	RNAV-10	RNP-4
En-Route Remote Continental	RNAV-10	RNP-4
En-Route Continental	RNAV-5	RNAV-1
TMA Arrival/Departure	RNAV-1 in a surveillance environment Basic RNP-1 in non-surveillance environnent	
	ABAS, SBAS, GBAS **(SBAS and GBAS will be included in ICAO PBN concept)**	
Approach	RNP APCH with (Baro-VNA) RNP AR APCH if required	
Approach Precision	CAT I (SBAS) CAT I/II/III/(GBAS) as required	

4. The strategy will be reviewed periodically. In particular, it will be reviewed and updated at the beginning of each planning phase to ensure continuance relevance in support of the global ATM operational concept, taking into account technological evolution and developments in the field of GNSS.

5. It will be reviewed, and the relevant technological and evolutional issues will be taken into consideration.
