INTERNATIONAL CIVIL AVIATION ORGANIZATION

GLOBAL NAVIGATION SATELLITE SYSTEM (GNSS) IMPLEMENTATION STRATEGY FOR THE ICAO AFRICA-INDIAN OCEAN (AFI) REGION

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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 to 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 advantages of the available capabilities shall be taken into consideration 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:**

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.

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 not be replaced, subject to 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 not be replaced during Phase II.

d) Approach and landing phase: 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, ILS CAT I should not be replaced.

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

3.3. Phase III (Long term) 2017 onwards:

3.3.1 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 not be replaced, subject to 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.

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

5. Summary of AFI GNSS Strategy

AFI GNSS Strategy – Synopsis

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

**Note: ICAO Annex 10, Volume I enables 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.*

GNSS INFRASTRUCTURE IN SUPPORT OF PBN REQUIREMENTS

Time scale		**Short term**	**Medium term**	**Long term**
		2008 – 2012	**2013 – 2016**	**2017 and beyond**
Certification		Primary for en-route Supplemental for TMA Non-precision approach (NPA)	Primary means from en route to APV	Primary means from en route to CAT-I
Oceanic and Remote Continental/ En route	GNSS Configuration	Basic GNSS	Basic GNSS	Multi-constellation GNSS
	PBN Nav Spec	RNAV-10, RNP-4	RNAV-10, RNP-4	RNAV-10, RNP-4
Continental En route	GNSS Configuration	Basic GNSS	Basic GNSS	Multi-constellation GNSS
	PBN Nav Spec	RNAV-5, RNAV-1	RNAV-5, RNAV-2, RNAV-1	RNAV-5, RNAV-2, RNAV-1
Terminal	GNSS Configuration	Basic GNSS	Basic GNSS	Multi-constellation GNSS
	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	Basic GNSS	Basic GNSS 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

****Note: Although SBAS operations are not yet included in the PBN concept contained in ICAO Doc 9613, they have been introduced in the spirit of Assembly Resolution A37-11.***

6. SBAS implementation criteria

1. Availability of conclusive cost-benefit analysis (APIRG Conclusion 17/29 refers)
2. Full compliance with ICAO technical requirements (Standards and Recommended Practices);
3. Agreement between stakeholders on pre-implementation cost benefit analyses on case by case basis;
4. Application of the user pays principle across all sectors (SBAS users). National authorities shall prevent cross-subsidization of non civil aviation users of SBAS.

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