INTERNATIONAL CIVIL AVIATION ORGANIZATION
EASTERN AND SOUTHERN AFRICAN OFFICE

SUMMARY OF THE DISCUSSIONS AND CONCLUSIONS OF THE FIRST MEETING OF THE AFI GNSS IMPLEMENTATION TASK FORCE

(DAKAR, 17 - 18 NOVEMBER 2003)

November 2003

SUMMARY REPORT OF THE FIRST MEETING OF THE AFI GNSS IMPLEMENTATION TASK FORCE

(Dakar, 17 - 18 November 2003)

1. Objective

1.1 The First meeting of the AFI GNSS Implementation Task Force (GNSS/I/TF/1) was held in Dakar from 17 to 18 November 2003 at the ICAO WACAF Office. The purpose of the meeting was to review and act on the work programme items assigned by APIRG, progress on the implementation of the AFI GNSS test bed and of the AFI GNSS strategy.

2. Participants and Secretariat

2.1 The meeting was attended by all members of the Task Force. The list of participants is at **Appendix A** to this report.

2.2 The secretary and moderator of the meeting was Mr. A. Sene, RO/CNS Nairobi. He was assisted by Mr. Prosper Zo'o Minto'o and Mrs. Mary A. Obeng, both RO/CNS Dakar Office.

2.3 Mr. A. Cheiffou, Regional Director of the WACAF Office and Secretary of APIRG attended the closure of the meeting and was briefed on its results.

3. Working language

3.1 The meeting held its deliberations in English and the documentation was provided in that language.

4. Agenda

4.1 The meeting adopted the following agenda:

Agenda Item 1: Review of the terms of reference, work programme and composition of the GNSS Implementation Task Force

Agenda Item 2: Review and amendment if required of Technical Note 1 (TN01) – *Civil Aviation Requirements for Inter-regional SBAS over AFI*

Agenda Item 3: Review of the results of test bed trials in Central Africa and status of trials in Southern Africa

Agenda Item 4: Review of the status of implementation of GNSS in the AFI Region

Agenda Item 5: Review and analysis of concepts for institutional, funding and cost recovery arrangements

Agenda Item 6: Development of an action plan for implementation of the AFI SBAS

Agenda Item 7: Future work programme

Agenda Item 8: Any other business

Summary of the discussions and conclusions

5.1 Agenda Item 1: Review of the terms of reference, work programme and composition of the GNSS Implementation Task Force

5.1.1 Under this agenda item, the GNSS Implementation Task Force took note of its terms of reference, work programme and composition, as adopted by APIRG/14.

5.1.2 The work programme was amended by consolidation of the items related to institutional issues into a single task, and by the addition of a task on cost/benefit analysis. This latter task was assigned to ASECNA who will be assisted by IATA and the European Partners.

5.1.3 The meeting agreed on the membership of France in the Task Force. The meeting was informed that the European Union could also be a member of the Task Force.

5.1.4 The amended work programme and composition are shown under the report on Agenda Item 7.

5.2 Agenda Item 2: Review and amendment if required of Technical Note 1 (TN01) – *Civil Aviation Requirements for Inter-regional SBAS over AFI*

5.2.1 The meeting reviewed and updated TNO1 with the latest results from the Fourth Meeting of the GNSS Panel regarding signal-in-space requirements for APV 1 approach. Provisions regarding recording of GNSS signals were added. However, paragraph 13, regarding Interoperability and Compatibility Requirements; will be amended at the next meeting after confirmation of the current requirements for EGNOS.

5.2.2 The amended TNO1 is at **Appendix B**.

5.3 Agenda Item 3: Review of the results of test bed trials in Central Africa and status of trials in Southern Africa

5.3.1 ASECNA, in coordination with ESA, presented the results of the trials in Central Africa (Zone A). It showed that:

- accuracy was well maintained within APV1 requirements;
- availability was average due to equipment failures, communications problems and ionospheric effects;
- integrity was good, when APV1 was available.

5.3.2 The results showed that effects of the ionosphere needed a deeper study. In this regard, ASECNA recommended that the four RIMS stay for at least 3 months in Zone A, in order to permit static data collection on GPS and EGNOS signals for a better evaluation of the impact of ionospheric phenomena. ESA supported this proposal and indicated that an ionospheric receiver would be made available to ASECNA for installation at Douala, thus allowing correlation of ionospheric effects and EGNOS errors. A copy of the presentation is available on the ICAO Web site (http://www.icao.int/esaf, click on APIRG, and then on GNSS Task Force).

5.3.3 The meeting recalled that the Eleventh Air Navigation Conference (2003) recommended that States continue collection of ionospheric data in the equatorial regions and exchange data between States and regions and requested ICAO to assess the results of the data collection and develop appropriate guidance material (Rec. 6/3).

5.3.4 Regarding the test trials in Area B (Southern Africa), ESA proposed to provide 4 additional RIMS by 1 February 2004.

5.3.5 In view of the above, the meeting agreed that the RIMS already in Area A would continue to stay in place.

5.3.6 Regarding the test trials in Area C (Eastern Africa), the meeting noted that ESA planned to make the simulations in January 2004.

5.3.7 ASECNA emphasized the importance of training staff on the implementation and analysis of SBAS data.

5.4 Agenda Item 4: Review of the status of implementation of GNSS in the AFI Region

5.4.1 Under this agenda item, the meeting reviewed the progress made by States in the implementation of Basic GNSS, as recommended in Phase I of the AFI GNSS strategy. The meeting noted that:

(a) only four States have published an AIC approving the use of GPS for en-route and TMA navigation;
(b) four States have published RNAV GNSS NPA procedures; and
(c) twenty-three States had designed and tested RNAV GNSS NPA procedures.

5.4.2 The results of the review are shown in **Appendix C** to this report.

5.4.3 The meeting was informed that France would publish the AIC for en-route to NPA use of GPS in December 2003, and that Kenya would publish RNAV GNSS NPA procedures in December 2003. The meeting also advised that the Central African States would hold a GNSS Seminar in January 2004 where the issue of GPS approvals would be considered. ASECNA informed the meeting that all necessary information for GPS approvals had been provided to its member States and that 4 of these would soon approve publication of the appropriate AIC or AIP SUP.

5.4.4 The meeting discussed the reasons for the slow progress in implementing Basic GNSS and agreed on the need to consult States on the reasons for the lack of progress. In this regard, it was observed that SARPs for GPS are already included in Annex 10 and that States needed to file a difference in case GNSS was not being used in their airspace. It was further observed that there was a need to progress faster in implementing Basic GNSS in order for States to gain experience well before the introduction of APV1, as decided by APIRG/14. The following conclusion was then adopted:

CONCLUSION 1/1: IMPLEMENTATION OF BASIC GNSS

THAT STATES THAT HAVE NOT APPROVED THE USE OF GPS (FROM EN-ROUTE TO NON-PRECISION APPROACH) BE CONSULTED ON THE REASONS FOR THEIR LACK OF PROGRESS.

5.4.5 ESA made a presentation on the status of EGNOS. A copy of the presentation is available on the ICAO Web site (http://www.icao.int/esaf, click on APIRG, and then on GNSS Task Force).

5.4.6 France informed the meeting on operational benefits expected from the implementation of APV procedures at several of its airports, including St. Denis (La Réunion). A central office of GNSS procedures will be operational early 2004 in Bordeaux, responsible for the design of NPA and APV procedures in France and possible support to other interested States and organizations.

5.5 Agenda Item 5: Review and analysis of concepts for institutional, funding and cost recovery arrangements

5.5.1 Under this Agenda Item, ESA made a presentation on the EGNOS Institutional Arrangements. The presentation contained two possible scenarios linking AFI SBAS providers with EUR EGNOS providers. A copy of the presentation is posted on the ICAO Web site (http://www.icao.int/esaf, click on APIRG and then on GNSS Task Force).

5.5.2 South Africa recalled the meeting that it was responsible for the study of institutional aspects during Phase 2 of the GNSS Study (1997-1999) and was ready to assume the same for the GNSS/I/TF. It was clarified that by decision of the GNSS Study Group, institutional matters had been left out of Phase 2.

5.5.3 IATA presented a paper proposing the refinement of simulations for the operational system while minimizing the number of States where infrastructure would be deployed, the designation of 5 ATS providers as the AFI EGNOS Providers.

5.5.4 ASECNA reminded the meeting that it was associated with South Africa for the development of institutional arrangements.

5.6 Agenda Item 6: Development of an action plan for implementation of the AFI SBAS

5.6.1 Under this agenda item, ASECNA introduced a “road map” for the phased implementation of the AFI extension of EGNOS. After discussions, the meeting agreed, with slight amendments on the plan of action.

5.6.2 The plan of action comprises 3 stages.

Stage 1: Implementation of a stationary test bed dedicated to the AFI Region

a) The objectives of this stage are to:
- Validate signal-on-space and performance criteria. This information would also be used as input to cost/benefit studies;
- get preliminary data for the certification of the system (safety cases);
- study on a longer timescale ionospheric issues and to validate the algorithms aiming at minimizing their effects;
- study more precisely the failure modes and their impacts; and

- validate the expansion model without affecting the European system.

b) It was agreed that the location of the RIMS for the stationary test bed would be defined by simulations to be initiated by ESA as soon as possible (January 2004). The configuration of the extended test bed would be as close as possible to the topology of the operational system. ESA could make available to the AFI Region RIMS and the CPF of the ESTB after the operational implementation of EGNOS scheduled in April 2004. The meeting agreed that the study of institutional arrangements should be started in this first stage; South Africa would be the leader of this task (institutional issues), assisted by ASECNA and ESA.

c) For this stage, the meeting agreed that it was essential that a small number of aircraft be equipped with certified SBAS avionics.

Stage 2: Architectural, financial and institutional studies

The objectives of this stage are to:

a) finalize architecture of the AFI operational SAS;
b) evaluate costs and benefits;
c) finalize institutional issues, including funding and cost recovery; and
d) designation of the AFI SBAS Provider.

Stage 3: Implementation of the operational system

The objectives of this stage are to:

a) installation and testing of the ground system components in the AFI Region;
b) validation of the overall system; and
c) certification of the overall system.

5.6.3 The meeting agreed to continuously refine the plan of action. A tentative schedule is shown in **Appendix D** to this Report.

5.7 Agenda Item 7: Future work programme

5.7.1 The meeting updated its work programme as show in **Appendix E** to this Report. The Task Force made the following assignment of responsibilities:

a) cost/benefit: ASECNA supported by IATA and ESA;
b) institutional issues: South Africa supported by ASECNA.
c) Simulations for RIMS locations of the stationary test bed: ESA
d) Simulation for mobile test bed in Area C: ESA

5.7.2 The Task Force agreed that reports on the above tasks should be available at the second meeting, which was tentatively planned to be held in March/April 2004 in

Johannesburg. In this context, Nigeria proposed to host the third meeting in Abuja/Lagos. The offer was kindly accepted.

5.8 Any other business

5.8.1 ESA informed the meeting of a Board meeting to be held on 27 November 2003, where the expansion of EGNOS to AFI and the availability of ESTB RIMS will be discussed.

---------END---------

APPENDIX A / APPENDICE A

List of participants / Liste des participants

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(Dakar, 17 – 18 November 2003)

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Participants: 28
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International organization: 5

APPENDIX B

CIVIL AVIATION PERFORMANCE REQUIREMENTS

FOR ISA

(INTERREGIONAL SBAS OVER AFI)

AFI GNSS STRATEGY PHASE 2

TN01

Version 0.3

Prepared by:	Reviewed by:	Approved by:
ASECNA ATNS	~~AFI/GNSS~~ ~~Study Group~~GNSS Implementation Task Force	APIRG

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TABLE OF CONTENTS

1. SCOPE OF THE DOCUMENT

The present document translates the GNSS Signal-in-Space (S.I.S.) performance requirements, as expressed in SARPs [Ref. 3] and AWOP-16 Report [Ref. 4], into Civil Aviation Performance Requirements for Interregional SBAS over AFI (ISA).

In line with Phase II of the AFI GNSS strategy, ISA will be able to provide, as an augmentation to GPS~~, primary means operations,~~ from e~~E~~n-route to NPA operations over the AFI FIR area , limited to the south at 60° S, for APV1 operations over AFI Land Masses, including adjacent islands.

In line with Phase III as described in the AFI GNSS strategy, CAT-1 would be proposed as an optional service for some selected areas as described in Appendix A. This option has not yet been decided.

2. CIVIL AVIATION HIGH LEVEL OBJECTIVES FOR ISA

ISA constitutes the Satellite-based Augmentation System (SBAS) to complement GPS over the AFI service area, defined in paragraph 6 of this document. The ultimate goal of ISA, used in conjunction with GPS, is to meet the navigation performance requirements, as required in SARPs, for the following phases of flight:

- from en-route down to NPA;~~,~~
- For APV 1 over the land masses and adjacent islands; and
- Eventually, for CAT-1 Precision Approach over selected areas) as defined in Appendix A.

3. AFI GNSS PERFORMANCE REQUIREMENTS

The scope of this chapter is to propose GNSS civil aviation performance requirements over AFI region. The basis for these requirements are expressed in the three following documents:

- AFI Operational requirements: AFI Basic Air Navigation Plan and FASID [Ref. 1]
- AFI GNSS strategy: AFI FASID, Appendix B to Table CNS-3.[Ref. 2]
- ICAO SARPs for GNSS Signal in Space: Annex 10, Volume I [Ref. 3]

Definitions

In line with ICAO definitions the GNSS accuracy, integrity, continuity and availability are interpreted as follows:

Accuracy
Accuracy is defined as the position error that will be experienced by a user - equipped with a "fault-free" receiver - with a certain probability at any instant in time and at any location in the coverage area. In general, the probability is 95%.

Integrity
The integrity risk is defined as the probability that a user - equipped with a "fault-free" receiver – will experience a horizontal position error larger than the horizontal alert limit (HAL) and a vertical position error larger than the vertical alert limit (VAL) without an alarm being raised within the specified Time-to-alarm (TTA) at any instant in time and at any location in the coverage area.

Continuity

Continuity is defined as the probability that a user equipped with a “fault-free” receiver is able to determine its position with the specified accuracy and is able to monitor the integrity of its determined position over the time interval applicable for the corresponding phase of flight at any location in the coverage area.

Availability
Availability is defined (for En-Route, Terminal, NPA, APV1, APV2, CAT-I and departure) as the probability that a user equipped with a “fault-free” receiver is able to determine its position with the specified accuracy and is able to monitor the integrity of its determined position at the initiation of a certain phase of flight at any location in the coverage area. For the precision approach phase of flight the system is defined to be available when the associated accuracy, integrity **and continuity** requirements are met.

AFI GNSS SIS Requirements

The following GNSS Performance Requirements, as expressed in Tables 1, 2 and 3, represent the APIRG translation of SARPs for application to ISA in the AFI Region.
Accuracy and Alert Limit, being expressed at the output of the user receiver, are presented in Table1 as Navigation System Requirements.
Integrity Risk, Continuity Risk and Availability are presented in Tables 2 and 3 as Signal-in-Space requirements.
The Alert Limit, which defines the non-integrity event, is also expressed in Table 2 with the Signal in Space Integrity Risk requirements.
It has to be noticed that the ICAO GNSS SARPs propose ranges of requirements for continuity and availability as these requirements are depending on the ATS specificity of each region.
Therefore the AFI Region has selected its own requirements as expressed in Table 3.

<table>
<tr><th>Phase of Flight</th><th>En-route oceanic</th><th colspan="2">En-route continental/Terminal</th><th>Initial Appr/NPA</th><th>APV1</th><th>APV2</th><th>CAT-1</th></tr>
<tr><td><s>Associated RNP</s></td><td><s>RNP 10</s></td><td><s>RNP 5</s></td><td><s>RNP 1</s></td><td><s>RNP 0.3</s></td><td><s>RNP 0.3/125</s></td><td><s>RNP 0.03/50</s></td><td><s>RNP 0.02/40</s></td></tr>
<tr><td>Horizontal
(95 %)</td><td>2 NM
(3.7 Km)</td><td colspan="2">← 0.4 NM →
(0.74 Km)</td><td>220 m
(720 ft)</td><td colspan="3">←
16 m
(52 ft)
→</td></tr>
<tr><td>Vertical
(95 %)</td><td colspan="4">N.A.</td><td>20 m
(66 ft)</td><td>8 m
(26 ft)</td><td>6 m to 4.0 m
(20 ft to 13 ft)</td></tr>
<tr><td rowspan="2">HAL
Alert Limit

VAL</td><td>4 NM
(7.4 Km)</td><td>2 NM
(3.7 Km)</td><td>1 NM
(1.85 Km)</td><td>0.3 NM
(556 m)</td><td colspan="3">←
40 m (130 ft)
→</td></tr>
<tr><td colspan="4">←
NA.
→</td><td>50 m
(164 ft)</td><td>20 m
(66 ft)</td><td>15 m to 10 m
(50 ft to 33 ft)</td></tr>
</table>

Table 1: Navigation System Accuracy Requirements (SARPs)

Phase of Flight	En-route	En-route/Terminal		Initial Appr./NPA	APV1	APV2	CAT-1
~~Associated RNP~~	~~RNP 10~~	~~RNP 5~~	~~RNP 1~~	~~RNP 0.3~~	~~RNP 0.3/125~~	~~RNP 0.03/50~~	~~RNP 0.02/40~~
Integrity Risk	10^{-7}/hr				$2x10^{-7}$/Appr.		
HAL Alert Limit	4 NM (7.4 Km)	2 NM (3.7 Km)	1 NM (1.85 Km)	0.3 NM (556 m)	40 m (130 ft)	40 m (130 ft)	40 m (130 ft)
VAL	N.A.				50 m (164 ft)	20 m (66 ft)	15 m to 10 m (50 ft to 33 ft)
Time to Alert	5 min	15 sec		10 sec		6 sec	

Table 2: Signal in Space Integrity Requirements (SARPs)

Phase of Flight	En-route oceanic	En-route continental/Terminal		Initial Appr./NPA	APV1	APV2	Cat. 1
~~**Associated RNP**~~	~~RNP 10~~	~~RNP 5~~	~~RNP 1~~	~~RNP 0.3~~	~~RNP 0.3/125~~	~~RNP 0.03/50~~	~~RNP 0.02/40~~
Continuity Risk	10^{-6}/hr	← 10^{-6}/hr →		10^{-5}/hr	← $8x10^{-6}$ in any 15 s (2) →		
Global Availability (1)	*0.999*	*0.9999*	*0.9999*	← *0.9999* →		← *0.99999* →	
Local Availability	← N.A. →				← 0.9975 (3) →		

(1) As required in [Ref. 3] for GNSS SARPs
(2) As required in [Ref. 3] for ILS CAT 1
(3) ~~Insert~~ See N~~n~~ote 5 of Table 3.7.2.4-1 in SARPs (Annex 10, Volume I, page 42G)

Table 3: AFI Continuity, Availability Signal in Space Requirements

4. GNSS SAFETY REQUIREMENTS

Taking into account:

- The GNSS integrity and continuity performance requirements as they are expressed in Tables 1, 2 and 3,
- The feared event classification and the associated relationship with the probability of occurrence as expressed in AWOP 16 Report [Ref. 4],

the following event classification shall be used as a reference for the ISA system safety analysis,

- **Non Integrity Event**

In every operational configuration ~~(Primary or Sole Means)~~, any event which may induce a loss of the GNSS Integrity at user level, should be considered as having the capability to lead to a ~~an~~ **hazardous event.**

- **Non Continuity Event**

~~In a Sole Means operational configuration:~~

From ~~RNP 5~~ En-route to ~~RNP 1~~ Terminal, any event which may induce at user level a loss of Continuity shall be considered as having the capability to lead to a **hazardous event**, provided the duration of the non-continuity event is greater than a certain duration. As the Air Traffic Services requirements on the duration of this event are not yet defined, it is proposed, as a starting point, to consider that a non-continuity event duration greater than 15 minutes could lead to an hazardous event.

For ~~RNP 0.3~~ NPA, a non-continuity event, within the duration conditions as described above, will be considered as having the capability to lead to a **major event.**

For ~~RNP 0.03/50~~ APV-II and ~~RNP 0.02/40~~Cat I, a non-continuity event shall be considered as having the capability to lead to a **major event**, whatever the duration of the event.

5. ISA SERVICE DESCRIPTION

ISA system will provide three levels of navigation service:

- **ISA basic level A** consists of the broadcasting of ranging, basic differential corrections (cf. Annex 10, para. 3.7.3.4.2 c)) and integrity information from the GEO channels in order to provide a navigation service, in association with GPS and a RAIM having a FDE capability, with the objective to improve the availability and continuity of the GNSS integrity monitoring function.

- **ISA APV 1 level B** provides the basic service level A~~2~~ with in addition the capability to broadcast ionospheric corrections needed to provide a vertical guidance according to APV 1 performance requirements.

- **ISA CAT-I level C** consists of the broadcasting of differential corrections and ionospheric corrections in order to provide CAT-I precision approach performance requirements in selected areas.

In accordance with the AFI GNSS strategy, ISA will initially implement the Basic Level A and the APV1 Level B. It is assumed that, for operations from en-route to NPA ~~(RNP 0.3)~~, the Integrity Monitoring function of ISA will be used in combination with RAIM (Receiver Autonomous Integrity Monitoring as defined in DO 229 [Ref. 5]), ISA being given priority.

6. ISA SERVICE AREA

The shaded area in Figure1 comprises the footprint of all flight information regions (FIR) of AFI States.
ISA Basic Service Level A shall be provided in the entire AFI FIR coverage volume (shaded area in Fig.1), down to 60° S.
- ISA APV 1 Level B shall be provided over the entire AFI Land Masses and adjacent islands as defined in Appendix A
- ISA CAT-I Level C shall be provided, as an option, over selected AFI FIR land masses (see Appendix A for definition of these specific regions)

7. ISA AIRBORNE RECEIVER REQUIREMENTS

For ISA level A, Level B and Level C, ISA receiver shall comply with DO 229 RTCA MOPS [Ref. 5].

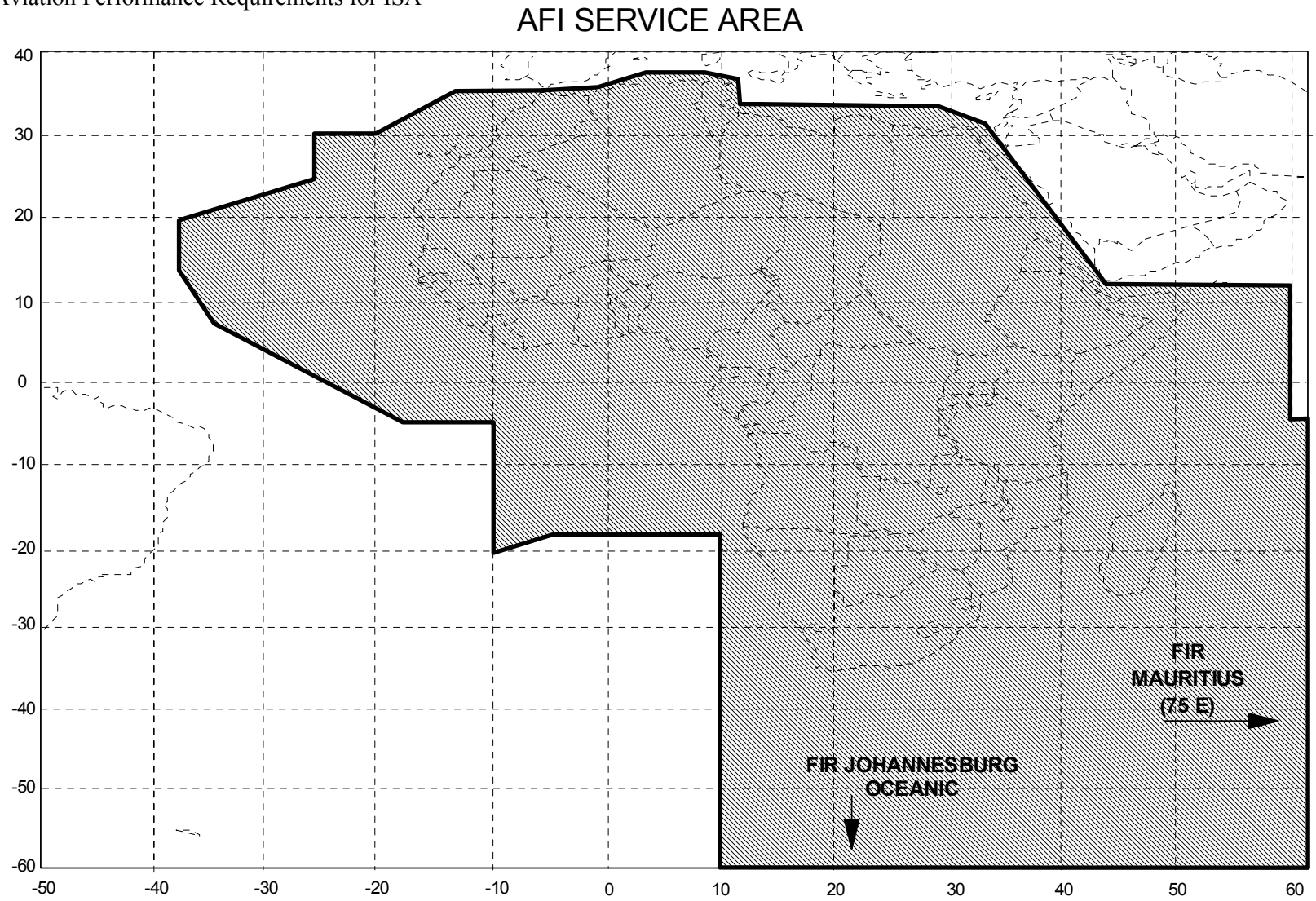

AFI SERVICE AREA
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-50
-40
-30
-20
-10
0
10
20
30
40
50
60
FIR
MAURITIUS
(75 E)
FIR JOHANNESBURG
OCEANIC

Figure 1

8. ISA CIVIL AVIATION PERFORMANCE REQUIREMENTS

ISA is intended to provide a ~~primary means~~ radio-navigation capability for civil aviation. ~~However, whether in primary or sole means configuration, t~~The full integrity and accuracy requirements must be met throughout the service area for the system to be declared available. These requirements are expressed in Tables 4 and 5.

For the En-route to NPA phases of flight these requirements shall be met throughout the AFI FIR area as shown in Figure 1.

For APV 1 approach these requirements shall be met throughout the AFI land masses area, including adjacent islands.

For CAT-I precision approach these requirements shall be met throughout AFI selected land masses area or over specific locations as presented in Figure 2 (TBD).

The duration of APV 1, CAT-I approaches, taken into account for the non-continuity risk, has been set to 150 seconds.

.

The continuity and availability requirements to be applied to the ISA system shall be those shown in Table 4.

Basic Level A Performance Requirements

ISA Level A service shall provide the following capability:
Compliance, from en-route to NPA, within the AFI FIR area, with the accuracy and integrity requirements, as shown in Table 5.

APV 1 Level B Performance Requirements

ISA APV 1 level B service shall provide the following capabilities:

a) Compliance with the basic Level A operational capability,
b) Compliance, for APV 1, within the AFI land masses and adjacent islands, with accuracy and integrity requirements, as shown in Table 6.

CAT-I Level C Performance Requirements

The ISA CAT-I Level C service shall provide the following capabilities:

a) Compliance with the basic Level A and APV 1 Level B operational capability.
b) Compliance, for CAT-I Precision approach within the AFI selected Land Masses areas, with the accuracy and integrity requirements as shown in Table 7.

Specific ISA Signal in Space Performance Requirements

The ISA signal-in-space shall be required to comply with the following minimum continuity and availability requirements.

	From En-route to NPA (Level A)	For APV1 and CAT-I (Level B and Level C)
Continuity	10-5/h	8 x 10-5/appr
Availability	Global : 0.999	Local : 0.99

Table 4

Note: The above ISA system En-Route/NPA requirements shall be met by implementing the ISA ground integrity monitoring function independent from any additional benefit achieved by use of RAIM.

BASIC LEVEL A	~~RNP 10~~En-route oceanic	~~RNP 5~~En-route continental	~~RNP1~~ Terminal	~~RNP 0.3~~ NPA
Accuracy 95% *	2 NM (3.7 Km)	← 0.4 NM (0.74 Km) →		220 m (720 ft)
Integrity Risk **	← 10^{-7} /hr →			
Alert Limit *	4 NM (7.4 Km)	2 NM (3.7 Km)	1 NM (1.85 Km)	556 m (0.3 NM)
Time to Alert	5 min	← 15 s →		10 s

* Accuracy and Alert Limit Requirements are Navigation System Requirements.
** Integrity Risk Requirements are Signal in Space Requirements.

Table 5: ISA Basic Level A Requirements

APV 1 LEVEL B	En-route ~~RNP 10~~ oceanic	En-route ~~RNP 5~~ continental	Terminal ~~RNP1~~	Initial Appr./ ~~RNP 0.3~~ NPA	APV I ~~RNP 0.3/125~~
Accuracy 95% *	2 NM (3.7 Km)	0.4 NM (0.74 Km)		220 m (720 ft)	H : ~~220~~ 16 m V : 20 m
Integrity Risk **	10^{-7} /hr				$2x10^{-7}$/Appr
Alert Limit *	4 NM (7.4 Km)	2 NM (3.7 Km)	1 NM (1.85 Km)	556 m (0.3 NM)	H : ~~556~~ 40 m V : 50 m
Time to Alert	5 min	15 s		10 s	10 s

Table 6: ISA APV 1 Level B Requirements

CAT-I LEVEL C (for reference)	En-route ~~RNP 10~~ oceanic	En-route continental ~~RNP 5 To RNP 2~~	Terminal ~~RNP1~~	Initial Appr./NPA ~~RNP 0.3~~	APV-I ~~RNP 0.3/125~~	APV-II ~~RNP 0.03/50~~	CAT-I ~~RNP 0.02/40~~
Accuracy 95% * H	2 NM	← 0.4 NM →		220 m	~~220~~ 16 m	16 m (H)	
Accuracy 95% * V	← N.A. →				20 m	8 m (V)	4 m (V)
Integrity Risk **	← 10^{-7} /hr →				$2x10^{-7}$/Appr	$2x10^{-7}$/Appr	
Alert Limit *	4 NM	2 NM	1 NM	556 m	~~556~~ 40 m (H) 50 m (V)	40 m (H) 20 m (V)	40 m (H) 10 m (V)
Time to Alert	5 min	15 s		10 s	10 s	6 s	

* Accuracy and Alert Limit Requirements are Navigation System Requirements.
** Integrity Risk Requirements are Signal in Space Requirements.

Table 7: ISA Level C Requirements

9. SERVICE LIFE TIME

The ISA Navigation Service shall be provided in compliance with the performance requirements for a minimum lifetime of 15 years.

10. ATC INTERFACE

General Requirements

In order to be compliant with the ICAO provisions, Air Traffic Services should be aware of all the events which could lead to ATC operating limitations, implementation of alternative ATC procedures, or increase of the procedural risk.

It would be the responsibility of the Air Traffic Services provider, in any State, to be aware of the status information for GNSS. Therefore, ISA Provider will have to make the operational status of the system available to the ATS providers.

Three general status information have been identified so far, as a minimum:

- the current system status
- notice of changes to the system status in the near future (the next 20 minutes)
- longer term prediction for flow control management (at least 24 hours in advance)

The update rate of this information is still under consideration. A 15 minutes update rate is proposed as a working assumption.
The content of the ISA ATC interface shall comply with these high level requirements.

ISA Requirements

The ATC interface data required as an output from the ISA system will be for the provision of advisory information only, and failure to provide it will have minor consequences in terms of safety.
ISA operational status of the system will need to be made available to ATS providers.
ISA shall make the following data sets available:

- GPS/GLONASS/ GEO Almanacs
- GPS /GLONASS/GEO Satellite Status
- EGNOS System Status
- GPS /GLONASS/GEO Satellite Unavailability Notice
- ISA Ground Segment Unavailability Notice.

The data shall be provided under the responsibility of the States.

Recording of ISA and GNSS core systems signals

The signals of ISA and the GNSS core systems will be recorded at representative locations in the service area for purposes of post-incident/accident investigations. The locations will be defined by agreement between the ISA provider and the ATS providers.

11. APPLICABLE STANDARDS

ISA will be required, whatever the regulation process, to demonstrate the compliance with the following standards.

The ISA system shall comply with the ICAO GNSS SARPs for SBAS, as amended.

The ISA user segment shall comply with the DO 229-~~B~~C RTCA MOPS, as amended.

This ISA requirements document will need to be updated as and when these applicable references are reissued.

12. ISA SAFETY REQUIREMENTS

The GNSS SARPs SIS requirements will be applied to ISA according to the following derivation, taking into account that ISA safety requirements shall have to meet safety requirements ~~designed in the view of a sole means application~~.

- **Non Integrity Event**
  The GNSS safety event classification is fully translated to ISA and therefore an EGNOS non-integrity event shall be considered as a **hazardous event.**

- **Non Continuity event**

  En Route to ~~RNP 1~~ Terminal
  Following the combined use of ISA and RAIM/FDE, ISA being given the priority, a loss of ISA continuity shall be considered as a **major event** provided the duration of the event is greater than 15 minutes.

  If the duration of the non-continuity is lower than 15 minutes it will be considered as a minor event.

  ~~RNP 0.3 and RNP 0.3/125~~ NPA and APV-I
  As an ISA non-continuity event should cover a wide area, and as the RAIM continuity and availability performances are limited in the NPA and APV 1 approach configuration, ISA non-continuity event shall be considered as a **major event**, provided the duration of the non continuity is greater than 15 minutes.
  If the duration of the non-continuity is lower than 15 minutes, it will be considered as a minor event.

  ~~RNP 0.02/40~~ Cat I

The GNSS safety event classification is fully translated to ISA and therefore an ISA non continuity, whatever the duration of the event, shall be considered as a **major event**.

13. INTEROPERABILITY AND COMPATIBILITY REQUIREMENTS

(to be updated with EGNOS provisions)

ISA shall ensure interoperability with other SBAS. The following levels of interoperability shall be distinguished:

a- ISA shall be compatible with other SBAS from the user perspective. This level of interoperability is ensured through the ICAO SARPs [Ref. 3].

b- Outside the specified ISA coverage area, the level of performance has to be declared.

c- ISA shall allow the inclusion of data from other SBAS to enable service performance improvement.

d- ISA shall allow the inclusion of data from other SBAS to enable service prediction improvement.

14. REFERENCES

[Ref. 1]: AFI Basic Air Navigation Plan and FASID, Document 7474

[Ref. 2]: AFI/GNSS strategy

[Ref. 3]: ICAO GNSS SARPs, Annex 10, Volume I

[Ref. 4]: AWOP 16 Report, Montreal (June/July 97)

[Ref. 5]: DO 229~~B~~C RTCA MOPS

APPENDIX A

AFI APV 1 and CAT-I ~~Coverage~~ service a~~A~~reas

APV1 service area: Area1
CAT-I service area: Areas 2A, 2B and 2C

AREA 1:

The area including land masses in the AFI region and adjacent islands is the area bounded by lines joining the following points (see Figure 1, bold line and Table 1):

(contour for APV-I to be redrawn)

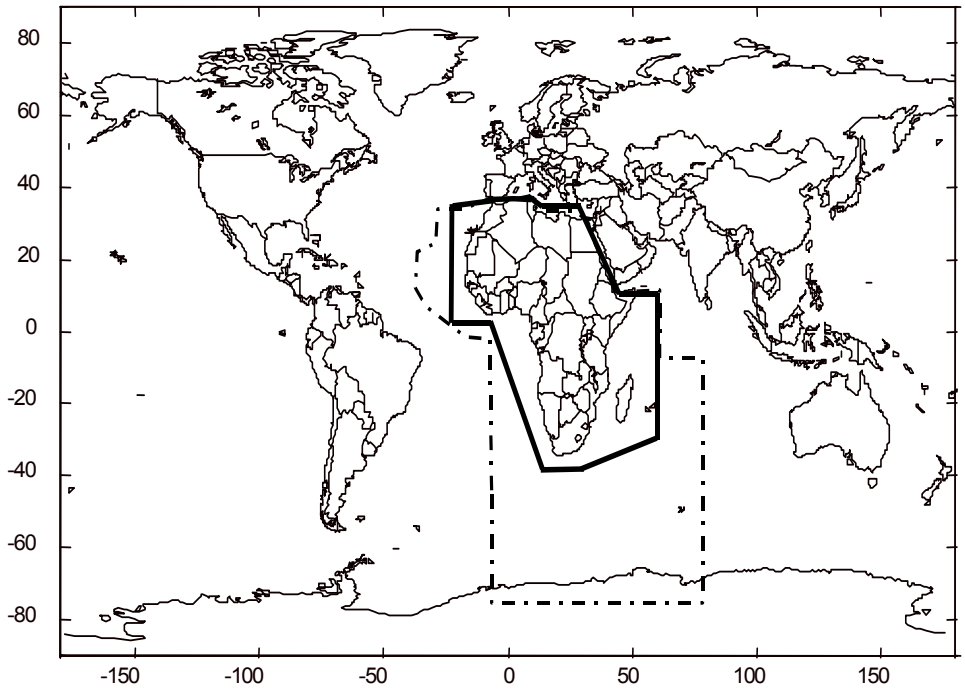


Figure 1: AFI Land masses and adjacent islands

No.	Latitude	Longitude	No.	Latitude	Longitude
1	35N	27W	7	10N	60E
2	38N	7W	8	27S	60E
3	38N	10E	9	35S	31E
4	35N	14E	10	36S	14E
5	35N	31E	11	~~6N~~0N	~~7W~~10W
6	~~12N~~15N	43E	12	~~6N~~10N	27 ~~25~~W

TABLE 1

AREA 2

Table 2 describes proposed (TBC) CAT-I service areas (for future expansion; not fully analyzed)

	Lat. min	Lat. max	Long. min	Long. max
2A	5° North	20° North	20° West	20° East
2B	15° South	0°	30° East	45° East
2C	35° South	20° South	15° East	35° East

Table 2: CAT-I service areas (TBC)

AFI AIR TRAFFIC MANAGEMENT SYSTEM IMPLEMENTATION BY STATE - (NAVIGATION COMPONENTS)																			
AREA OF ROUTING	**REGIONS/STATES AFFECTED**	**SYSTEM COMPONENTS**	1994	95	96	97	98	99	2000	1	2	3	4	5	6	7	8	9	2010
AR-1	AFI Region	GNSS en-route																	
	Cape Verde																		
	Morocco																		
	Senegal																		
	Spain																		
AR-1	AFI Region	GNSS TMA/NPA																	
	Cape Verde*																		
	Morocco																		
	Senegal*																		
	Spain																		

* : not approved and published

AFI AIR TRAFFIC MANAGEMENT SYSTEM IMPLEMENTATION BY STATE - (NAVIGATION)																			
AREA OF ROUTING	**REGIONS/STATES AFFECTED**	**SYSTEM COMPONENTS**	1994	95	96	97	98	99	2000	1	2	3	4	5	6	7	8	9	2010
AR-2	AFI Region	GNSS en-route																	
	Angola																		
	Ghana																		
	Senegal																		
	South Africa																		
AR-2	AFI Region	GNSS TMA/NPA																	
	Angola*																		
	Ghana																		
	Senegal*																		
	South Africa*																		

* : not approved and published

AFI AIR TRAFFIC MANAGEMENT SYSTEM IMPLEMENTATION BY STATE - (NAVIGATION COMPONENTS)																			
AREA OF ROUTING	**REGIONS/STATES AFFECTED**	**SYSTEM COMPONENTS**	1994	95	96	97	98	99	2000	1	2	3	4	5	6	7	8	9	2010
AR-3	AFI Region	GNSS en-route																	
	Burundi																		
	Comoros																		
	Djibouti																		
	Egypt																		
	Eritrea																		
	Ethiopia																		
	France (Reunion)																		
	Kenya																		
	Libya																		
	Madagascar																		
	Mauritius																		
	Rwanda																		
	Seychelles																		
	Somalia																		
	Sudan																		
	Tanzania																		
	Uganda																		

AFI AIR TRAFFIC MANAGEMENT SYSTEM IMPLEMENTATION BY STATE - (NAVIGATION COMPONENTS)																				
AREA OF ROUTING	**REGIONS/STATES AFFECTED**	**SYSTEM COMPONENTS**	1994	95	96	97	98	99	2000	1	2	3	4	5	6	7	8	9	2010
AR-3	AFI Region	GNSS TMA/NPA																	
	Burundi																		
	Comoros																		
	Djibouti																		
	Egypt (2005)																		
	Eritrea																		
	Ethiopia																		
	France (Reunion)																		
	Kenya*																		
	Libya																		
	Madagascar*																		
	Mauritius*																		
	Rwanda																		
	Seychelles*																		
	Somalia																		
	Sudan																		
	Tanzania																		
	Uganda*																		

*: not approved and published

AFI AIR TRAFFIC MANAGEMENT SYSTEM IMPLEMENTATION BY STATE - (NAVIGATION COMPONENTS)																				
AREA OF ROUTING	**REGIONS/STATES AFFECTED**	**SYSTEM COMPONENTS**	1994	95	96	97	98	99	2000	1	2	3	4	5	6	7	8	9	2010
AR-4	AFI Region	GNSS en-route																	
	Algeria																		
	Angola																		
	Botswana																		
	Cameroon																		
	Central African Republic																		
	Chad																		
	Congo																		
	D.R. of Congo																		
	Equatorial Guinea																		
	Gabon																		
	Lesotho																		
	Libya																		
	Malawi																		
	Mozambique																		
	Namibia																		
	Niger																		
	Nigeria																		
	Sao Tome & Principe																		
	South Africa																		
	Swaziland																		
	Tunisia																		
	Zambia																		
	Zimbabwe																		

AFI AIR TRAFFIC MANAGEMENT SYSTEM IMPLEMENTATION BY STATE - (NAVIGATION COMPONENTS)																				
AREA OF ROUTING	**REGIONS/STATES AFFECTED**	**SYSTEM COMPONENTS**	1994	95	96	97	98	99	2000	1	2	3	4	5	6	7	8	9	2010
AR-4	AFI Region	GNSS TMA/NPA																	
	Algeria																		
	Angola*																		
	Botswana*																		
	Cameroon*																		
	Central African Republic																		
	Chad																		
	Congo																		
	D.R. of Congo*																		
	Equatorial Guinea																		
	Gabon*																		
	Lesotho*																		
	Libya																		
	Malawi*																		
	Mozambique*																		
	Namibia*																		
	Niger																		
	Nigeria																		
	Sao Tome & Principe																		
	South Africa*																		
	Swaziland*																		
	Tunisia																		
	Zambia*																		
	Zimbabwe*																		

* : Not approved and published

AFI AIR TRAFFIC MANAGEMENT SYSTEM IMPLEMENTATION BY STATE - (NAVIGATION COMPONENTS)																			
AREA OF ROUTING	**REGIONS/STATES AFFECTED**	**SYSTEM COMPONENTS**	1994	95	96	97	98	99	2000	1	2	3	4	5	6	7	8	9	2010
AR-5	AFI Region	GNSS en-route																	
	Benin																		
	Burkina Faso																		
	Chad																		
	Côte d'Ivoire																		
	Gambia																		
	Ghana																		
	Guinea																		
	Guinea Bissau																		
	Liberia																		
	Mali																		
	Mauritania																		
	Niger																		
	Nigeria																		
	Senegal																		
	Sierra Leone																		
	Togo																		

AFI AIR TRAFFIC MANAGEMENT SYSTEM IMPLEMENTATION BY STATE - (NAVIGATION COMPONENTS)																				
AREA OF ROUTING	**REGIONS/STATES AFFECTED**	**SYSTEM COMPONENTS**	1994	95	96	97	98	99	2000	1	2	3	4	5	6	7	8	9	2010
AR-5	AFI Region	GNSS TMA/NPA																	
	Benin*																		
	Burkina Faso*																		
	Chad																		
	Côte d'Ivoire*																		
	Gambia																		
	Ghana																		
	Guinea																		
	Guinea Bissau																		
	Liberia																		
	Mali*																		
	Mauritania																		
	Niger																		
	Nigeria																		
	Senegal*																		
	Sierra Leone																		
	Togo																		

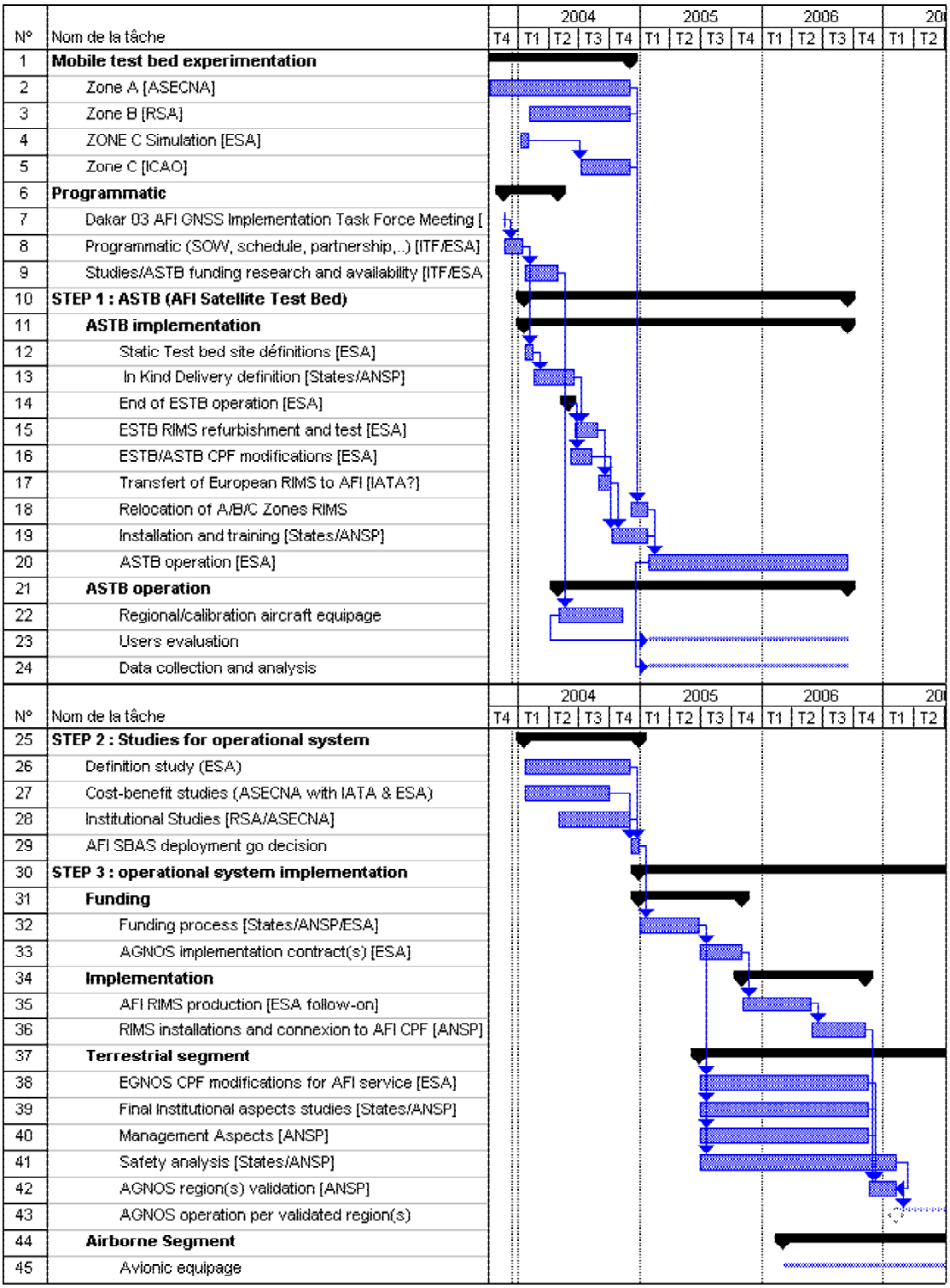
* Not approved and published

AFI AIR TRAFFIC MANAGEMENT SYSTEM IMPLEMENTATION BY STATE - (NAVIGATION COMPONENTS)																			
AREA OF ROUTING	**REGIONS/STATES AFFECTED**	**SYSTEM COMPONENTS**	1994	95	96	97	98	99	2000	1	2	3	4	5	6	7	8	9	2010
AR-6	AFI Region	GNSS en-route																	
	Comoros																		
	France (Reunion)																		
	Madagascar																		
	Mauritius																		
	Seychelles																		
	South Africa																		

AFI AIR TRAFFIC MANAGEMENT SYSTEM IMPLEMENTATION BY STATE - (NAVIGATION COMPONENTS)																			
AREA OF ROUTING	**REGIONS/STATES AFFECTED**	**SYSTEM COMPONENTS**	1994	95	96	97	98	99	2000	1	2	3	4	5	6	7	8	9	2010
AR-6	AFI Region	GNSS TMA/NPA																	
	Comoros																		
	France (Reunion)																		
	Madagascar*																		
	Mauritius*																		
	Seychelles*																		
	South Africa*																		

* : Not approved and published

Draft Action Plan Schedule



N°	Nom de la tâche
1	**Mobile test bed experimentation**
2	Zone A [ASECNA]
3	Zone B [RSA]
4	ZONE C Simulation [ESA]
5	Zone C [ICAO]
6	**Programmatic**
7	Dakar 03 AFI GNSS Implementation Task Force Meeting [
8	Programmatic (SOW, schedule, partnership,..) [ITF/ESA]
9	Studies/ASTB funding research and availability [ITF/ESA
10	**STEP 1 : ASTB (AFI Satellite Test Bed)**
11	**ASTB implementation**
12	Static Test bed site définitions [ESA]
13	In Kind Delivery definition [States/ANSP]
14	End of ESTB operation [ESA]
15	ESTB RIMS refurbishment and test [ESA]
16	ESTB/ASTB CPF modifications [ESA]
17	Transfert of European RIMS to AFI [IATA?]
18	Relocation of A/B/C Zones RIMS
19	Installation and training [States/ANSP]
20	ASTB operation [ESA]
21	**ASTB operation**
22	Regional/calibration aircraft equipage
23	Users evaluation
24	Data collection and analysis
25	**STEP 2 : Studies for operational system**
26	Definition study (ESA)
27	Cost-benefit studies (ASECNA with IATA & ESA)
28	Institutional Studies [RSA/ASECNA]
29	AFI SBAS deployment go decision
30	**STEP 3 : operational system implementation**
31	**Funding**
32	Funding process [States/ANSP/ESA]
33	AGNOS implementation contract(s) [ESA]
34	**Implementation**
35	AFI RIMS production [ESA follow-on]
36	RIMS installations and connexion to AFI CPF [ANSP]
37	**Terrestrial segment**
38	EGNOS CPF modifications for AFI service [ESA]
39	Final Institutional aspects studies [States/ANSP]
40	Management Aspects [ANSP]
41	Safety analysis [States/ANSP]
42	AGNOS region(s) validation [ANSP]
43	AGNOS operation per validated region(s)
44	**Airborne Segment**
45	Avionic equipage

TERMS OF REFERENCE, FUTURE WORK PROGRAMME AND COMPOSITION OF THE AFI GNSS IMPLEMENTATION TASK FORCE

1. **Terms of reference** :

Carry out studies on technical and institutional issues for the progressive implementation of GNSS in the AFI Region, in accordance with the AFI GNSS strategy.

2. **Work Programme**

Item	Description	Responsibility	Target Date
1	Inclusion of GNSS in AFI FASID		On-going
2	Further development of the AFI GNSS strategy		On-going
3	Define detailed system architecture to meet APV-I over continental AFI and adjacent islands, taking into account, as appropriate, developments in other regions.	ESA	2005
4	• Perform an AFI SBAS APV-I **definition** and **design** phase, including: • • Definition of a Programme organisation • Development and Issue of detailed mission requirements (Service Levels). • Definition of Service Area • Preliminary System Definition and Design • Issue of System Requirement Document • Preparation of a system development plan • Carrying out initial trials/systems tests in order to support the design phase. • • For this purpose, the candidate AFI SBAS Providers will explore the possibility of cooperation agreements with the EOIG (EGNOS operators and Infrastructure Group). • In this context, an AFI GNSS pre-operational test bed will be implemented to validate the objectives, design parameters and algorithms for Phase II and III of the AFI GNSS strategy.	ESA	2005
5	Follow up and assist if required the trials on the Test Bed		On-going
6	Development of action plan for Implementation of the AFI SBAS	ASECNA	Next Meeting
7	Identify and address as appropriate, all actions necessary, including funding, legal and institutional aspects, for the timely implementation of the AFI GNSS strategy (AFI/7, Concl. 10/6d)	South Africa* (ASECNA)	Next Meeting
8	Review, in due course, the requirements for the implementation of GBAS at identified locations, in accordance with the AFI GNSS strategy		

Item	Description	Responsibility	Target Date
9	Cost/benefits analysis for operational SBAS system	ASECNA* (ESA, IATA)	Next Meeting
10	Simulations for location of RIMS of the operational SBAS system	ESA	Next Meeting
11	Simulations for mobile test bed in Zone C	ESA	Next Meeting

* Main responsibility

3. **Composition**: Cameroon, Egypt, France, Nigeria, South Africa, Tunisia, ASECNA, IATA, ICAO
