

**GNSS/I/TF/3 - REPORT**

**INTERNATIONAL CIVIL AVIATION ORGANIZATION  
EASTERN AND SOUTHERN AFRICAN OFFICE**



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

**(LAGOS, 29 - 30 JUNE 2005)**

*June 2005*

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**SUMMARY REPORT OF THE THIRD MEETING OF THE  
AFI GNSS IMPLEMENTATION TASK FORCE**

**(Lagos, 29 - 30 June 2005)**

**1. Objective**

1.1 The Third meeting of the AFI GNSS Implementation Task Force (GNSS/I/TF/3) was held in Lagos from 29 to 30 June 2005 at the Sheraton Hotel, Ikeja, in Lagos, Nigeria. The meeting was kindly hosted by the Nigerian Airspace Management Agency (NAMA).

1.2 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, the AFI system test bed (ASTB), the technical, funding and institutional aspects of the operational SBAS over AFI (ISA) and of the AFI GNSS strategy.

**2. Participants and Secretariat**

2.1 The meeting was attended by 17 participants. The meeting noted the regrets of IATA. 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 Mrs. Mary Obeng, RO/CNS, Dakar Office.

**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:

1. Follow-up of the conclusions and decisions of the Second meeting
2. Review of the implementation and performance of the test beds in Zones A, B and C, and planning for the implementation of the AFI System Test Bed (ASTB)
3. Detailed system architecture of the AFI operational SBAS
4. Review of the report of the COM Working Group
5. Funding options and institutional arrangements
6. Cost/benefit analysis of AFI operational SBAS
7. Action plan for implementation of AFI SBAS
8. Future work programme
9. Any other business

**5. List of conclusions and decisions**

<b>Conclusion No.</b>	<b>Title</b>	<b>Page</b>
Conclusion 3/1	ASTB Test Bed operation extension	8
Conclusion 3/2	Structuring of the Inter-regional SBAS over AFI	12
Conclusion 3/3	Proposed Institutional Structure of the ISA	12

**6. List of acronyms**

AFI	Africa-Indian Ocean
AFISNET	AFI Satellite Telecommunication Network
ANSP	air navigation service provider
ASECNA	Agency for the Safety of Air Navigation in Africa and Madagascar
ASTB	AFI System Test Bed
ATNS	Air Traffic and Navigation Services Co. Ltd.
CEMAC	Economic and Monetary Community of Central Africa
COMESA	Common Market of Eastern and Southern Africa
CPF	Central processing facility
ECAA	Ethiopian Civil Aviation Authority
ECAC	European Civil Aviation Conference
ECOWAS	Economic Community of West African States
EGNOS	European geostationary navigation overlay service
ESA	European Space Agency
ESTB	European System Test Bed
EWAN	European wide area network
FIR	Flight Information Region
ISA	Inter-regional SBAS over AFI
KCAA	Kenya Civil Aviation Authority
MCC	Master Control Centre
MEDA	Mediterranean Development Area
NAFISAT	North Eastern AFI VSAT network
RIMS	Reference and integrity monitoring system
SADC	Southern African Development Community
SBAS	Satellite-based augmentation system
VOR	VHF omni-range
VSAT	Very small aperture terminal

## 7. Summary of the discussions and conclusions

### 7.1 Agenda Item 1: Follow-up of the conclusions and decisions of the Second meeting

7.1.1 Under this agenda item, the meeting reviewed follow-up action on the conclusions and decisions of the second meeting of the Task Force. The results of the review are shown in **Appendix B** to this report. The meeting agreed to include Egypt and Nigeria as members of the COM Working Group.

### 7.2 Agenda Item 2: Review of the implementation and performance of the test beds in Zones A, B and C and planning for the implementation of the AFI satellite test bed (ASTB)

7.2.1 Under this agenda item, the meeting reviewed the configuration and performance of the test beds in Central Africa (Zone A), Southern Africa (Zone B) and Eastern Africa (Zone C).

7.2.2 The test bed in AFI is an extension of the EGNOS System Test Bed (ESTB), which is comprised of:

- a) RIMS operated in the ECAC area;
- b) RIMS operated in the AFI area;
- c) the Euridis ground segment operated in Toulouse by CNES;
- d) the central processing facilities (CPF) in Norway (Honefoss) operated by the Norwegian Meteorological Agency (NMA);
- e) communications networks operated by Thales, ASECNA, ATNS, Ethiopia CAA and Kenya CAA; and
- f) a geo-stationary satellite (GEO): Inmarsat-3 – Atlantic Ocean Region East (AOR-E) at 15.5 West (PRN= 120) since 13 June 2005.

7.2.3 The 10 AFI RIMS are deployed in Central, Southern and Eastern Africa, referred to respectively as Zone A, Zone B and Zone C.

- a) AFI Zone A:
  - System managed by ASECNA
  - RIMS operated since May 2003 at Douala, Brazzaville, N'djamena and Lome (now moved to Bangui).
- b) AFI Zone B
  - System managed by South Africa (ATNS), Namibia and Zambia;
  - RIMS operated since October 2004 at East London, Johannesburg, Lusaka and Windhoek.
- c) AFI Zone C
  - System operated in partnership with Central African Republic (ASECNA), Kenya (KCAA) and Ethiopia (ECAA);
  - Coordination by ICAO ESAF Office
  - RIMS operational at Addis Ababa and Bangui since May 2005; and

- 1 RIMS in Nairobi, which is connected, but subject to RF interference in the L1 (GPS) frequency, thus is not used for the computation of the corrections broadcast over the AFI Region. The RIMS needs to be relocated to another site, and KCAA to inform ESA of the potential sites..

7.2.4. The performance level of the AFI Zone A, B, C areas is APV-I. The availability is about 98.5% (between 97% and 100%). The position accuracy is typically 1m in the horizontal plane (95%) and 2m in the vertical plane (95%). Regarding integrity, no misleading information has been detected.

7.2.5. **Appendix C** shows a sample APV-I availability chart over the AFI area on 23 June 2005. Performance of the AFI area can be checked daily on the Internet at: [http://ravel.esrin.esa.it/docs/egnos/estb/IMAGEtech/avail\\_120\\_ESTB.jpg](http://ravel.esrin.esa.it/docs/egnos/estb/IMAGEtech/avail_120_ESTB.jpg).

7.2.6. During the discussions, the meeting was informed that the Inmarsat AOR-E satellite would be available until 31 December 2005. After that date, a new Inmarsat satellite 4 will be in orbit. However, use of this satellite by the test bed will depend on the completion of adaptation work on the uplink stations in Europe.

7.2.7. The meeting discussed the time limit for operation of the test bed. It was agreed to request ESA to extend operations until 30 June 2006. The following conclusion was formulated:

**Conclusion 3/1: ASTB Test Bed operation extension**

That ESA be requested to extend operation of the AFI ASTB Test Bed to 30 June 2006.

**AFI System Test Bed**

7.2.8. In accordance with APIRG/14 Conclusion 14/46, an operational satellite-based augmentation system is to be implemented in the AFI Region as an extension of EGNOS, starting with a pre-operational test bed. The pre-operational test bed, known as the AFI System Test Bed (ASTB), is to be built from the existing Zones A, B and C test beds with the addition of 4 RIMS to be located at Accra, Cape Town, Jeddah and Mahajanga. The objective of the ASTB is to provide APV-I signal over the AFI landmasses. The GEO satellite to be initially used is the Inmarsat-3 AOR-E.

7.2.9. The simulations for the coverage of the ASTB are shown in **Appendices D and E**.

**Implementation of the ASTB**

7.2.10. The deployment of the 4 additional RIMS will be in 2 phases:

- Phase I: Cape Town and Mahajanga;
- Phase II: Accra and Jeddah.

7.2.11. ASECNA informed the meeting that the Mahajanga site was ready. ATNS advised that they required the customs documents from ESA in order to apply for temporary entry permit.

7.2.12. The proposed schedule for deployment of Phase I is as follows:



- |    |                                      |                        |
|----|--------------------------------------|------------------------|
| a) | Site preparation                     | July 2005              |
| b) | RIMS shipment to site                | July-August 2005       |
| c) | Installation and connection          | 1-15 September 2005    |
| d) | RIMS introduction in ASTB operations | 15 Sept.-30 Dec. 2005. |

7.2.13. The meeting agreed on the need for a test plan with ATNS, ECAA and KCAA for application during the last quarter of 2005. Additionally, the meeting requested a training workshop on the PEGASUS software so as to make use of the static receiver (Novatel).

### 7.3 **Agenda Item 3: Detailed system architecture for the AFI operational SBAS**

7.3.1 Under this agenda item the meeting reviewed progress achieved by ESA on the development of the detailed system architecture for the operational SBAS known as *Inter-regional SBAS over AFI (ISA)*.

7.3.2. The development of ISA is included in the EGNOS evolution programme, which has several phases, as shown in **Appendix F**. The ISA will be composed of RIMS installed in the Mediterranean Development Area (MEDA) and RIMS installed south of the Sahara.

#### **ISA Definition Study: Activities performed**

7.3.3. The meeting took note of the work achieved so far as follows:

- Preliminary consolidation ISA Mission Requirements Document (MRD)
- Translation of the ISA MRD into industrial Requirements (SRD)
- Production of ISA detailed statement of work (SOW) definition and study logic
- Assessment of industrial proposal
- Ionospheric experts analysis (scintillation + definition of Africa ionospheric reference scenario + dedicated GJU ionospheric activity on-going)
- ESA internal system level analysis (feasibility analysis)
- Post-processing of ESTB performance in Africa and first return of experience

#### **ISA Industrial Definition Study**

7.3.4. The industrial ISA Definition Study was initiated on 7 June 2005. An intermediate review is planned in October 2005 and a formal preliminary design review (PDR) is planned for 7 January 2006. the following activities are to be realized by industry:

- a) Perform Critical feasibility studies (ionosphere, EWAN telecommunication network extension, CPF extension, bandwidth, message type 28 (MT 28), etc)
- b) Identification / performance of architectural trade-offs (concept of Regional Extension Module)
- c) Preliminary definition of ISA architecture and interfaces
- d) Definition of upgrade steps enabling operational deployments
- e) Definition of Development Plan, critical EGNOS V2.2./2.3 pre-developments

## f) ISA Development: Cost assessment

7.3.5. The meeting expressed its satisfaction with the progress achieved in the technical development of ISA.

**7.4 Agenda Item 4: Review of the report of the first meeting of the GNSS/TF COM Working Group**

7.4.1 Under this agenda item, the Task Force reviewed the report of the COM Working Group which met on 28 June 2005. The meeting took note of the amended work programme and composition of the Working Group as follows:

TASK N°	SUBJECT	TARGET DATE
1	To document lessons learned from the communications point of view during the implementation of the mobile test bed in the AFI region (Areas A, B & C).	Next meeting of AFI/GNSS/I/TF
2	Study and make recommendation for the communications support for the pre-operational and operational AFI SBAS, taking into account latency, reliability, redundancy and cost effectiveness of the system;	Next meeting of AFI/GNSS/I/TF
3	To assess radio frequency (RF), lightning, power supply and security environment at RIMS locations for the pre-operational test bed and operational system.	Next meeting of AFI/GNSS/I/TF

*Composition of the Working Group: Egypt, Ethiopia, Kenya, South Africa, ASECNA and ESA.*

7.4.2. The meeting reviewed the two documents on EGNOS RIMS installation criteria: General RIMS Installation (document 1) and EGNOS RIMS Hosting IRD (document 2). The working group agreed on the development of an AFI adaptation of Document 2 for use by RIMS hosting entities after validation by ESA. Document 1 will be used as it is.

7.4.3. In Document 2 the meeting noted the requirements for:

- a) Power Supply
- b) Lightning Protection
- c) Air conditioning
- d) Radio frequency spectrum protection and interference detection
- e) Security.

7.4.4. The meeting was briefed on the communication systems used for the test bed in zones A, B, and C. The most critical lesson was the latency of data transmission through VSAT. Unintentional interference was detected in Nairobi and in N'djamena.

7.4.5. The meeting reviewed the existing and future VSAT networks; AFISNET, NAFISAT, and SADC. The meeting noted the issue of connecting RIMS to these VSATs when they are co-located, since the RIMS could be installed in the runway area or near the airport VOR, etc. The meeting noted that, there will be four MCCs in Europe, which will give diversity of connections from AFI. The existing and future VSAT networks could provide redundancy in case ISA is provided with a dedicated VSAT network.

7.4.6. The Task Force was briefed on the status of the NAVISAT project being proposed by Egypt. A feasibility study has been commissioned since mid-2004 and is to last 16 months. The three major milestones of the study are:

- The Mission Review: this milestone aims principally at defining and agreeing on the users requirements,
- The System Review: were a system design answering to the users requirement is defined, with preliminary economical figures,
- The Final Review: were consolidated project baseline is presented both in terms of technical and economical data.

7.4.7. The first major milestone has been reached in December 2004, with the successful completion of the Mission Review. A frequency plan has been filed with the ITU in January 2005 and includes:

- Mobile Communication: L-band AMS( R )S
- Navigation: L band (L1 & L5)
- Fixed Communication: C band (feeder + traffic), Ku band (traffic)

7.4.8. Three geostationary orbital positions, compatible with the coverage requirement of NAVISAT, have been selected: 17°E, 20°E, 36.5°E. The next milestone, the “System Review”, was planned for June 2005.

**7.5      Agenda Item 5:              Funding options and institutional arrangements**  
**Agenda Item 6:              Cost/benefit analysis of AFI operational SBAS**

7.5.1. The meeting considered together the papers concerning agenda items 6 and 7.

**Institutional framework for ISA**

7.5.2. The meeting was aware, based on its review of Agenda Item 4, that technical studies for the ISA were progressing at a satisfactory pace and as a consequence, there was urgency for the AFI region to establish organizational structures capable of oversight, administration, operating and maintaining the Inter-regional SBAS over AFI (ISA).

7.5.3. The Task Force reviewed a refinement of the institutional models discussed at its second meeting. The institutional model with the associated cost recovery mechanism is shown at **Appendix G** to this report.

7.5.4. Using the model and after a thorough discussion, the Task Force agreed on the following institutional set-up for ISA.

- a) Three sub-regional ISA service providers to be established:

- i. AFI West and Central area, corresponding to FIRs of ASECNA States and FIRs Accra, Kano and Roberts
  - ii. AFI South, which corresponds to the SADC States; and
  - iii. AFI East, which covers FIRs Addis Ababa, Asmara, Entebbe, Khartoum, Mogadishu, Nairobi and Seychelles.
- b) Each sub-regional ISA service provider to be supervised by a Management Board composed of the concerned States/ANSPs; and
  - c) An AFI-wide ISA Supervisory Board to coordinate with the three sub-regional management boards in b) above and with the Mediterranean Development Area (MEDA).

7.5.5. The proposed structure is shown at **Appendix H**. An example of composition of a sub-regional management board is also shown in Appendix H.

7.5.6. The meeting reviewed the draft list of RIMS for the ISA and made tentative assignments to the sub-regional service providers as shown in **Appendix I**.

7.5.7. The meeting formulated the following conclusions:

**Conclusion 3/2: Structuring of the Inter-regional SBAS over AFI (ISA)**

That the inter-regional SBAS over AFI (ISA) be comprised of:

- a) The RIMS of the AFI part of MEDA (FIRs Algiers, Cairo, Casablanca, Tripoli, Tunis; and
- b) The RIMS be installed south of latitude 20°N.

**Conclusion 3/3: Proposed Institutional Structure of the ISA**

That the ISA component south of latitude 20°N be structured along the three sub-regional components, which are to be co-ordinated by an AFI-wide supervisory board as shown in **Appendix H**.

**Analysis of the benefits of the Inter-regional SBAS over AFI (ISA)**

7.5.8. The meeting reviewed a study on the benefits of the Inter-regional SBAS over AFI (ISA) commissioned by the Galileo Joint Undertaking Unit (GJU) of the European Commission.

7.5.9. The study indicates that the benefits are most likely to arise from safety-of-life applications. The study estimates benefits of around €5M– €10M in the early years, increasing to around €30M per year once all aircraft are equipped with SBAS receivers. The estimated costs of implementing and operating the ground infrastructure of SBAS would be around €10-12M per year – further studies are required to accurately determine both implementation and operating costs. Potentially significant benefits, such as avoiding the costs of replacing conventional navigation aids and the safety benefits have not been yet been quantified in economic terms. It should be noted that the study did not take into account the cost of aircraft equipage.

7.5.10. The members of the Task Force were requested to provide their comments on the study by 31 July 2005.

### **Funding options for the ISA**

7.5.11. The Task Force recalled the funding options for the ISA discussed at its second meeting (cf. Appendix G to the GNSS/I/TF/2 Report). The meeting recognized that funding of ISA could comprise a combination of the following:

- a) Direct input from the designated sub-regional service providers
- b) Input from the European Commission regional programmes, for the preparatory activities; and
- c) Loan from the European Investment Bank (EIB) for ISA infrastructure.

7.5.12. With regard to a) above, the meeting agreed on the need for commitment by ATS providers to invest in ISA implementation. In this regard, it was proposed that a workshop for parties interested in ISA investment and management be organized during the last quarter of 2005.

7.5.13. With regard to b), the Task Force considered valid Conclusion 2/4 of its second meeting on the need to get the support and inclusion of ISA into the priority EDF programmes of regional economic organizations (CEMAC, COMESA, ECOWAS and SADC). The definition of these programmes is to be done in 2005-2006.

7.5.14. The Task Force was briefed on a meeting between ECOWAS and GJU. It emerges from the meeting that ECOWAS was not aware of the ISA and that they requested clarifications on the institutional set-up and called for the participation of other ECOWAS States.

## **7.6 Agenda Item 7: Action Plan for the implementation of AFI SBAS**

7.6.1. Based on its discussions, the Task Force agreed on the following action plan

- a) Convene a meeting of potential investors in the ISA. A tentative period/venue was the week 5 to 9 December 2005, in Cairo, subject to confirmation.
- b) Members of the Task Force to comment on the ISA benefit analysis by 31 July 2005
- c) ESA to provide a report on the test bed trials for the administrations concerned
- d) ESA to set up a static test plan for Zone B and Zone C and assist in training on PEGASUS Tool.
- e) Study with the assistance of a legal consultant (to be funded by ATNS) of the implications of the proposed institutional arrangements; and
- f) Need to establish the institutional structures as soon as possible.

7.6.2. The Task Force amended the AFI GNSS Strategy as shown in **Appendix J**.

**7.7 Agenda Item 8: Future work programme**

7.7.1. The Task Force updated its future work programme and composition as shown in **Appendix K**. The next meeting was tentatively scheduled in March 2006.

**7.8 Agenda Item 9: Any other business**

7.8.1 Nil

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JUNE 28 – 29 LAGOS, NIGERIA.**

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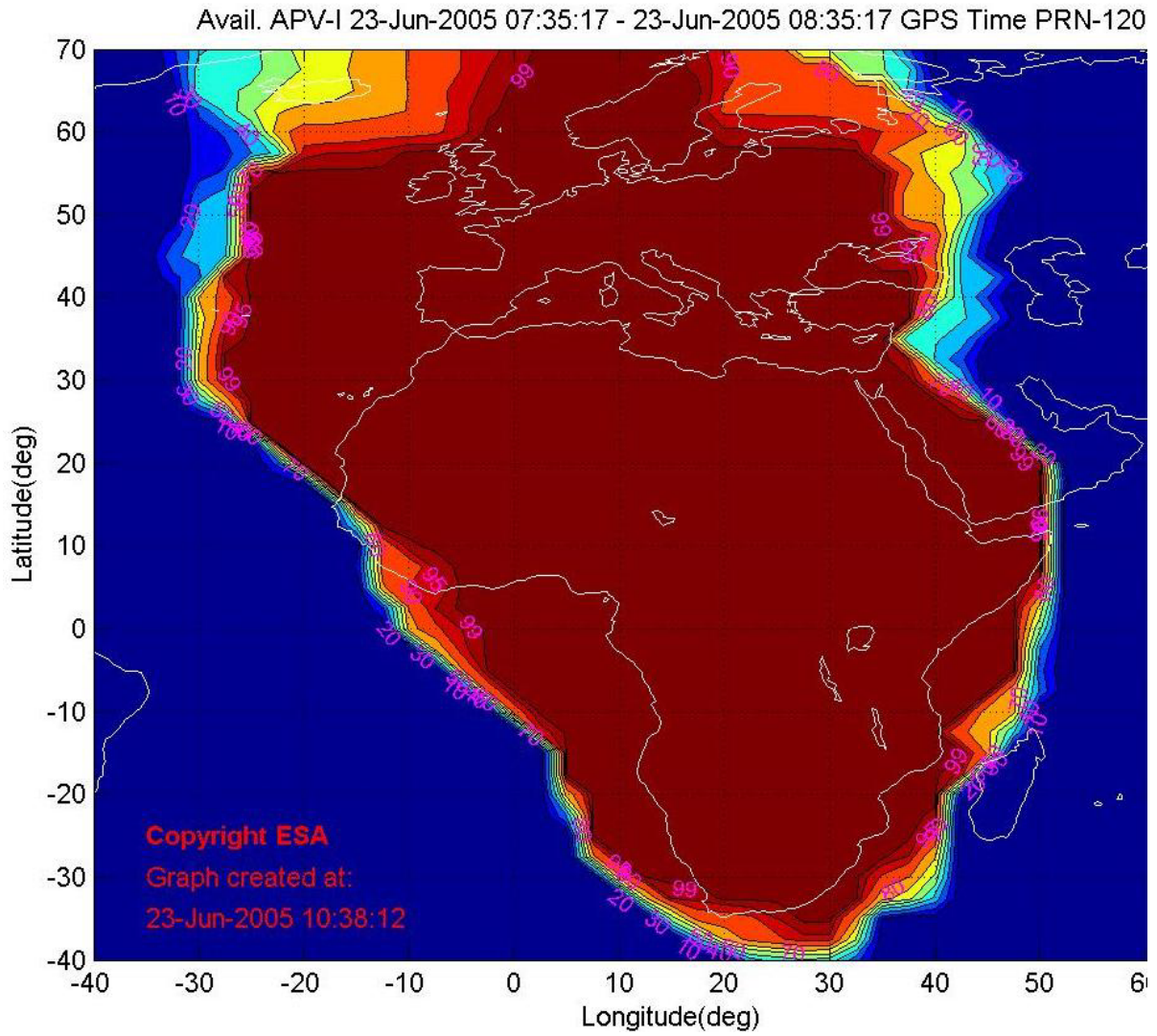


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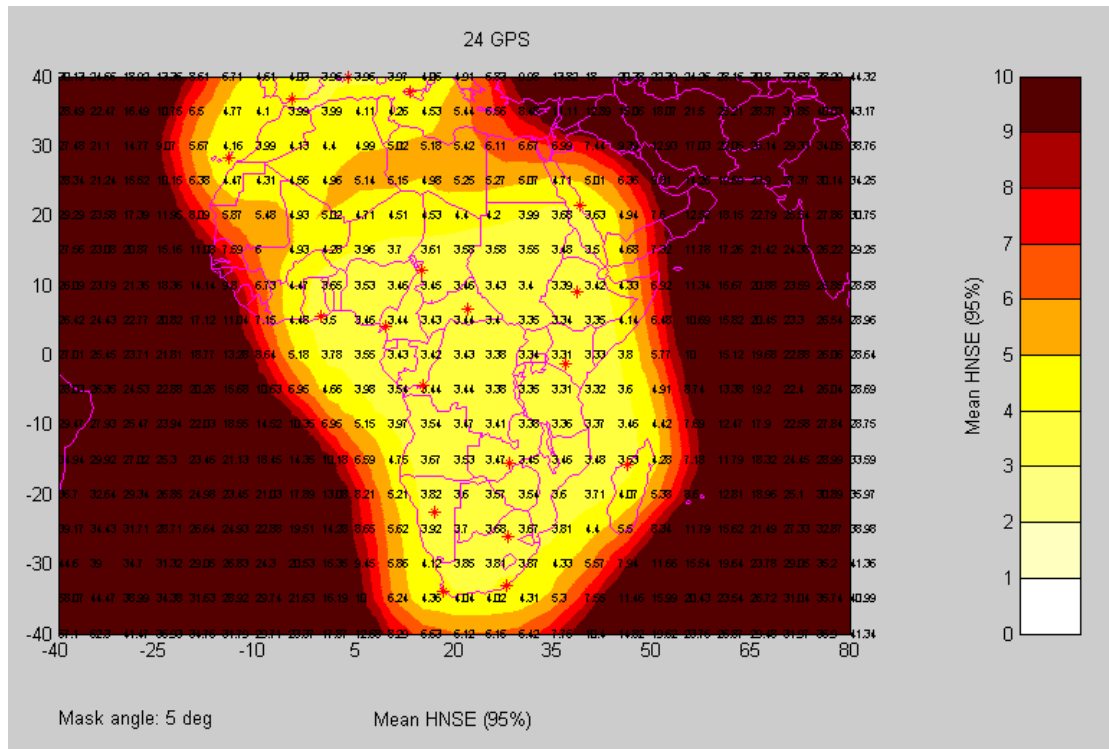
Conc./Dec. Nber	Text	Follow up
<b>Conc. 2/1</b>	<p><b>Conclusion 2/1: Contribution to the assessment of ionospheric effect on SBAS in equatorial regions</b></p> <p>That European Space Agency (ESA) prepare a report on ionospheric effects on SBAS based on data collected at Douala as contribution to the assessment requested by the Eleventh Air Navigation Conference, Recommendation 6/3.</p>	ESA In progress
<b>Dec. 2/2</b>	<p><b>Decision 2/2: GNSS Implementation Task Force Communications Working Group (GNSS/TF/COM/WG)</b></p> <p>That:</p> <ul style="list-style-type: none"> <li>a) A working group be established to study and advise on communication issues related to the implementation of the pre-operational and operational AFI SBAS; and</li> <li>b) The terms of reference of the GNSSTF/COM/WG be: <ul style="list-style-type: none"> <li>1) To document lessons learned from the communications viewpoint during the implementation of the mobile test bed in the AFI region;</li> <li>2) To study and make recommendations for the communications support for the pre-operational and operational AFI SBAS, taking into account latency, reliability and cost effectiveness; and</li> <li>3) To assess radio frequency (RF) environment at RIMS locations for the pre-operational test bed.</li> </ul> </li> <li>c) <b>Composition: South Africa, ASECNA, ESA, Kenya and Ethiopia</b></li> </ul>	Implemented
<b>Conc. 2/3</b>	<p><b>Conclusion 2/3: Finalization of studies for the operational AFI SBAS</b></p> <p>That European Space Agency be advised as soon as possible of the importance to finalize, preferably before the end of 2004, the studies on system architecture details, cost and planning for the AFI SBAS extension of EGNOS.</p>	In progress. Final results to be presented to GNSS/TF in early 2006

<b>Conc./Dec. Nber</b>	<b>Text</b>	<b>Follow up</b>
<b>Conc. 2/4</b>	<p><b>Conclusion 2/4: Support by African Regional Economic Organizations of the AFI SBAS</b></p> <p>That</p> <p>a) a concerted effort be made by States, European partners, international organizations and ICAO to raise the awareness and support by African regional economic organizations of the planned implementation of the AFI SBAS extension of EGNOS; and</p> <p>b) potential complementary contributions of AFI Service Providers to the AFI SBAS investment be identified and defined.</p>	<p>Presentation done at the second meeting of AFI ATS providers.</p> <p>More effort needed.</p>
<b>Conc. 2/5</b>	<p><b>Conclusion 2/5: Institutional arrangements</b></p> <p>That South Africa:</p> <p>a) further develop the proposals at Appendices H and I on institutional arrangements, taking into account experience gained in Europe and suggestions put forward by the meeting</p> <p>b) circulate the final draft to members of the Task Force for comment.</p>	<p>In progress</p> <p>See WP/12 of this meeting</p>

APV-I availability over AFI Region 23 June 2005

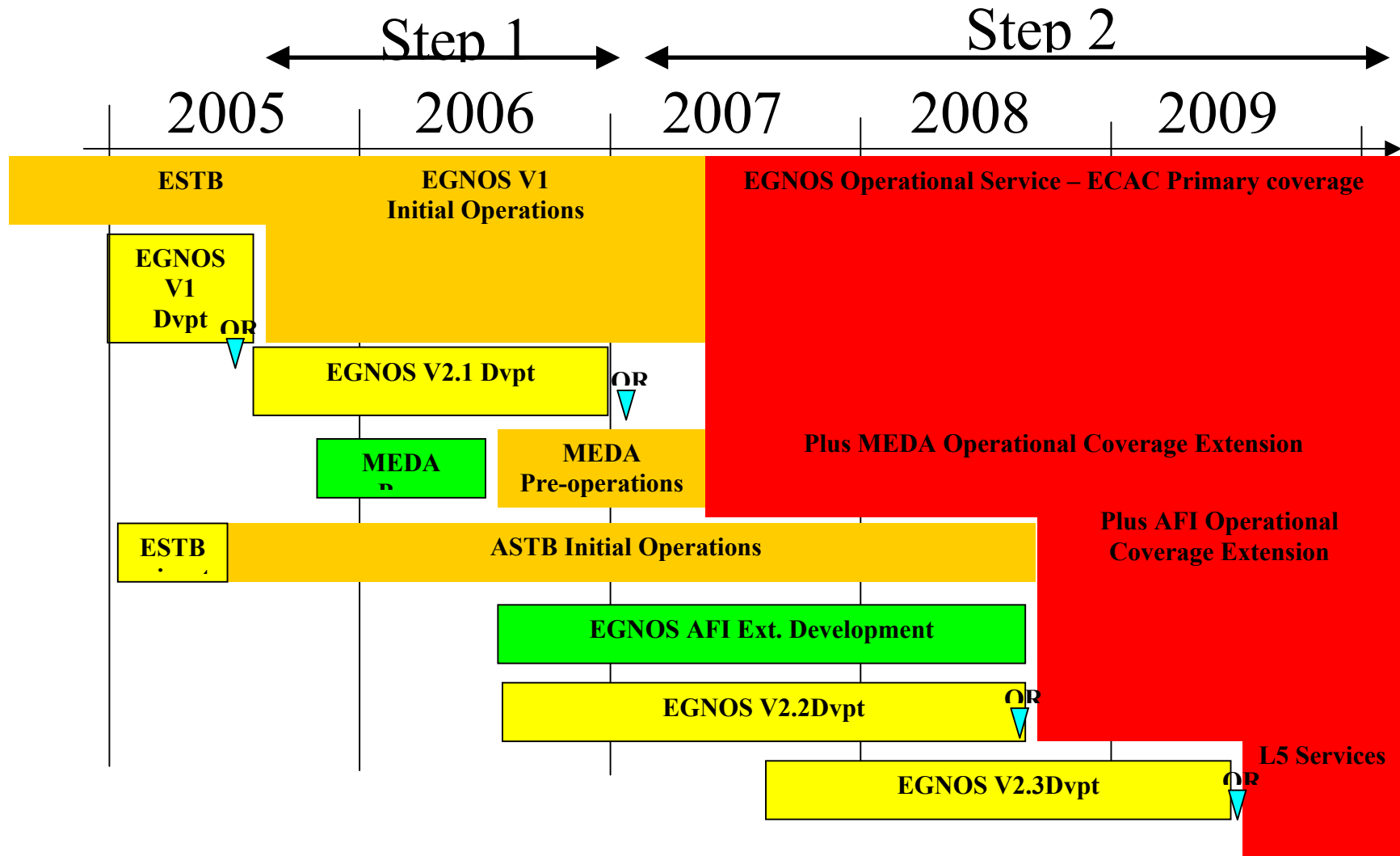


### Simulation for ASTB – Horizontal accuracy

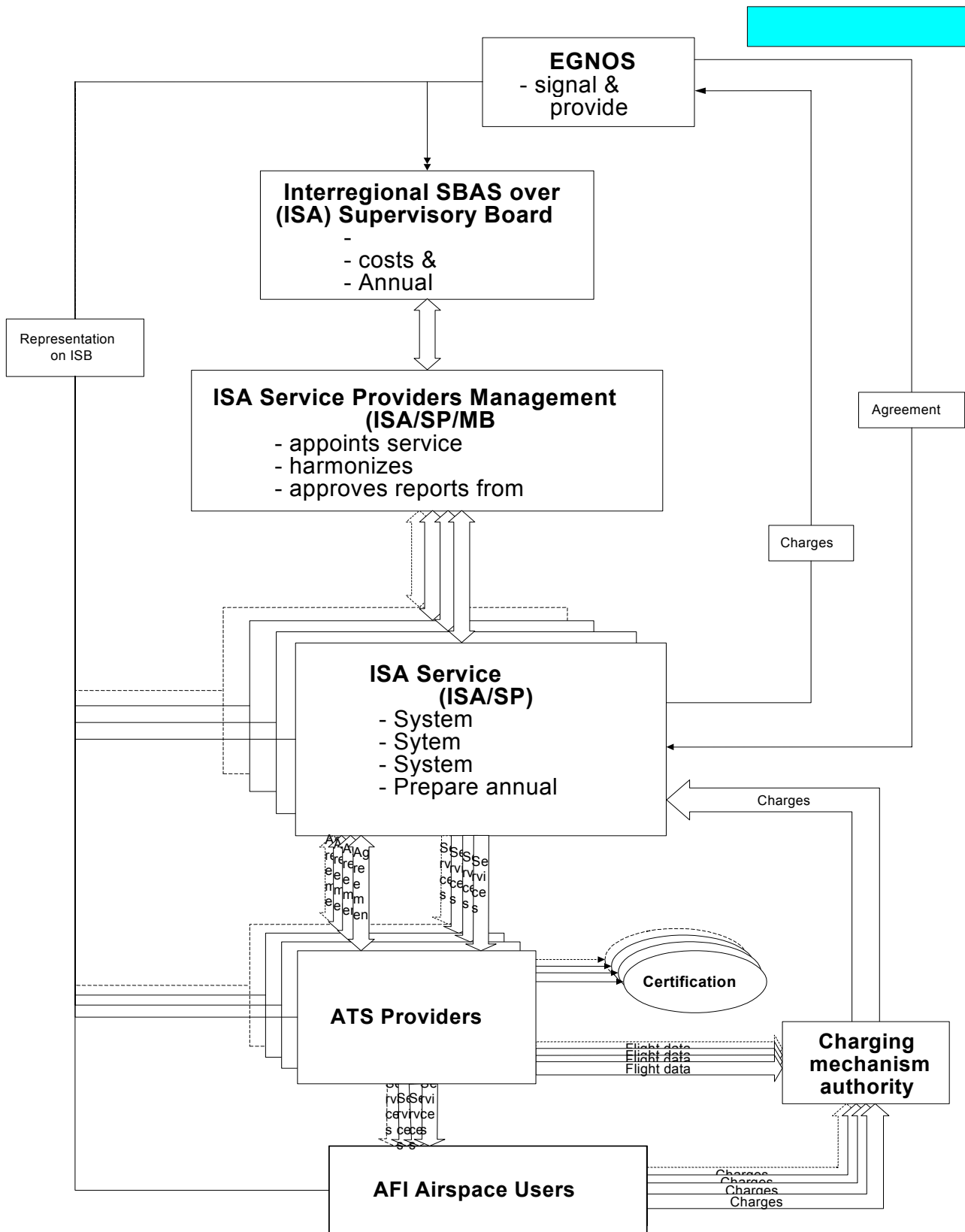




Draft EGNOS evolution programme - ISA

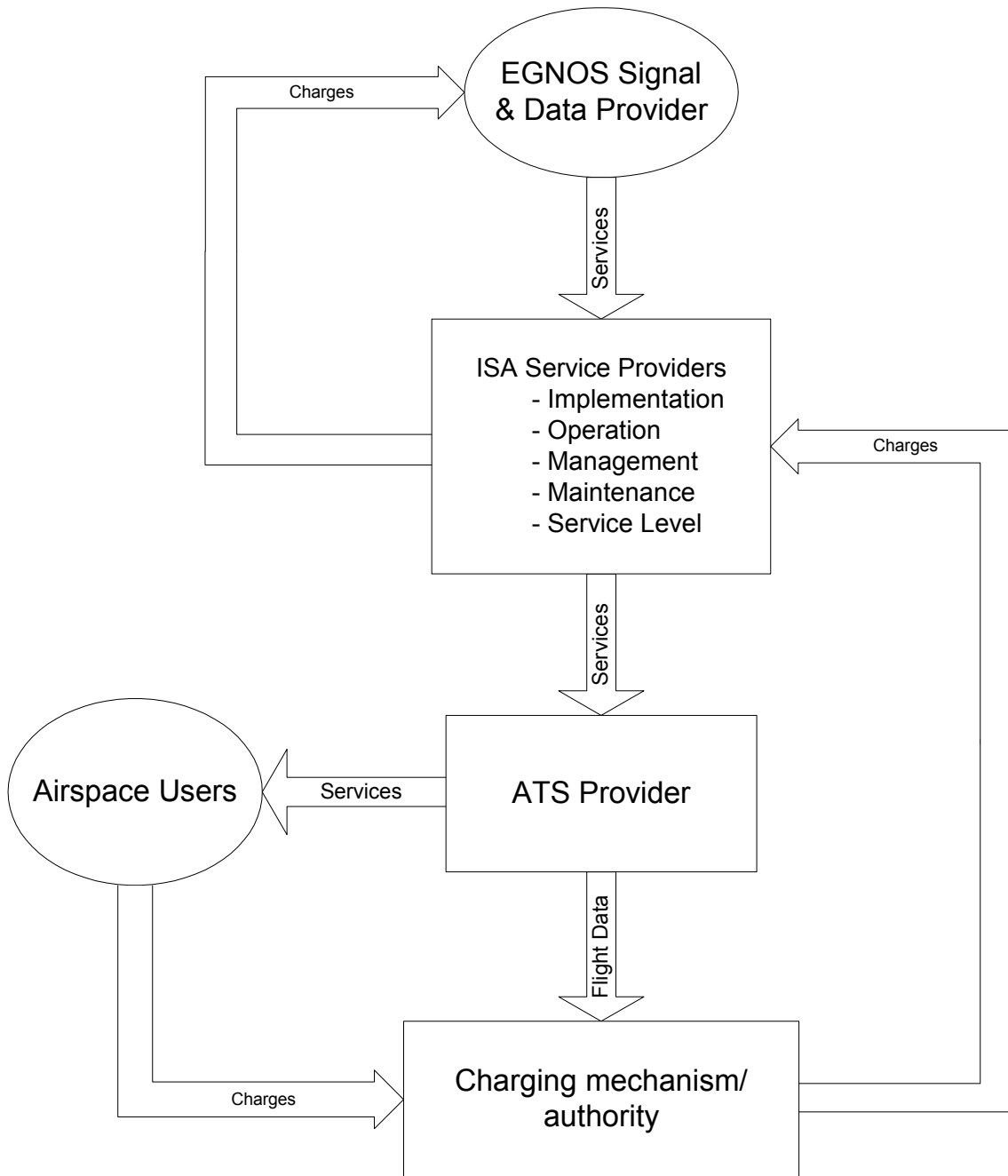


**Institutional set-up model**

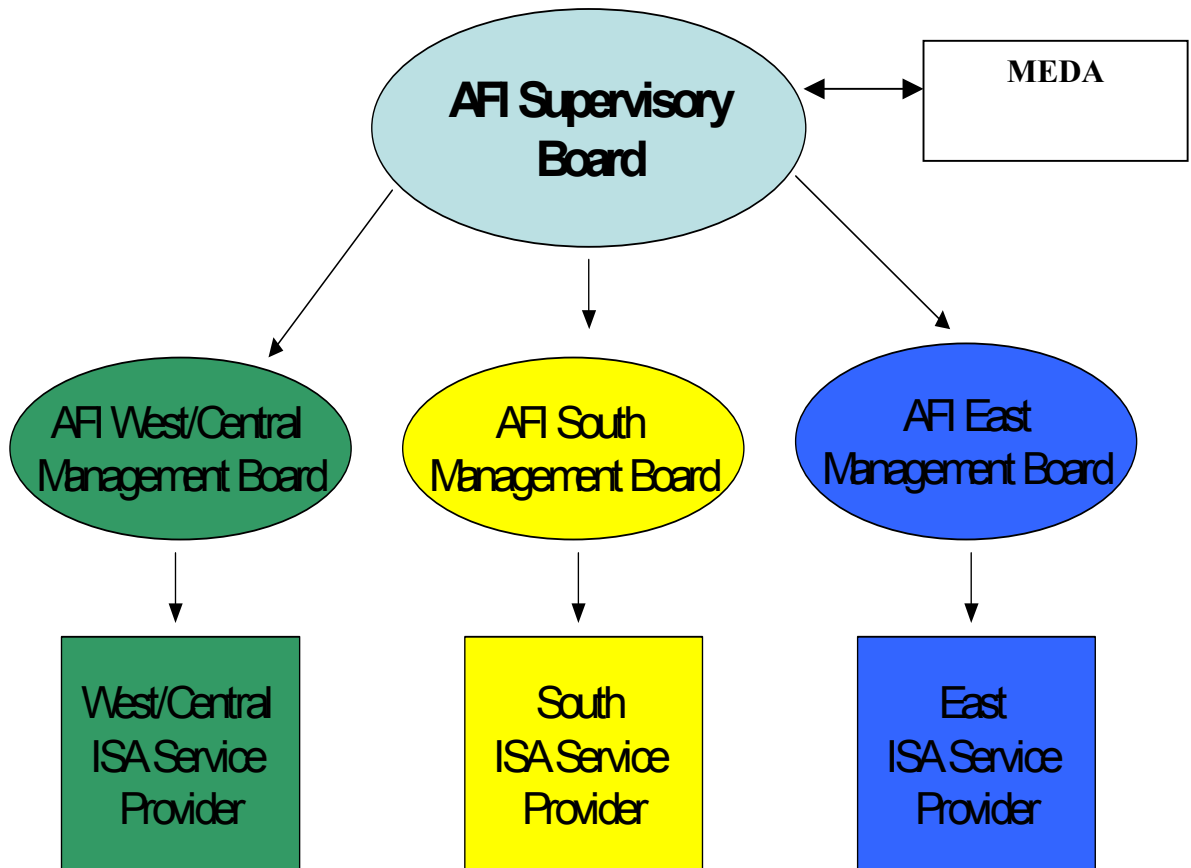


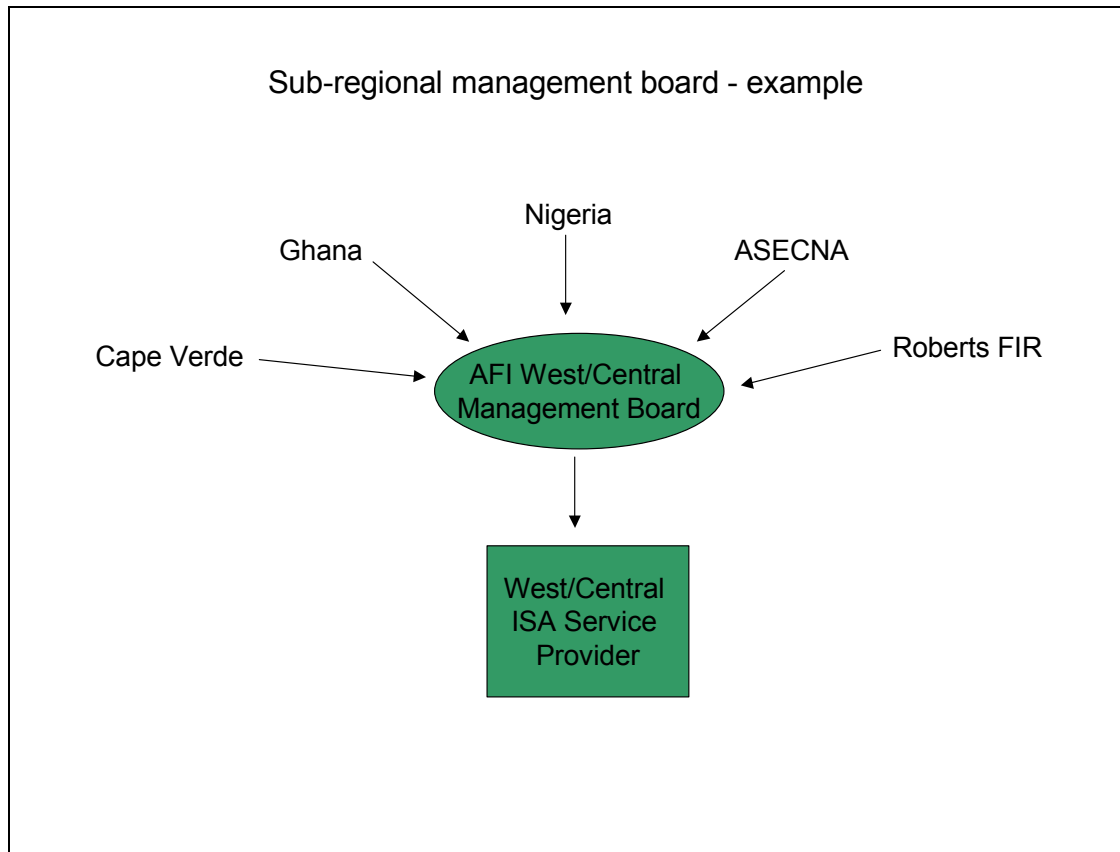


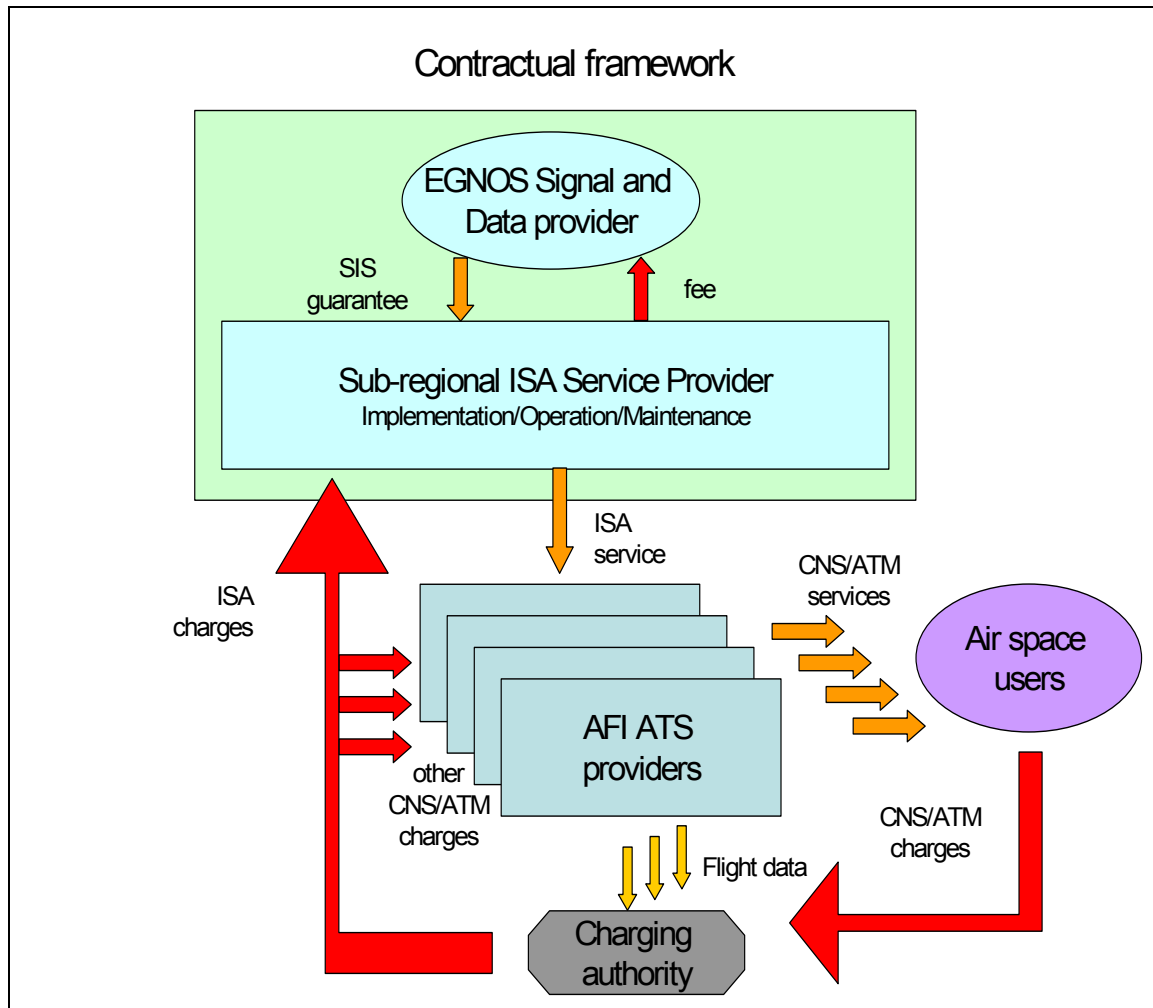
Institutional set-up model



## Institutional structures- proposal







**Draft location of ISA RIMS to be considered during ISA definition**

<b>Location</b>	<b>Latitude</b>	<b>Longitude</b>	<b>Area</b>	<b>Remarks</b>
Accra (Ghana)	0536N	0010W	AFI West and Central	
Addis Ababa (Ethiopia)	0906N	3846E	AFI East	
Agadir (Morocco)	3019N	0924W	MEDA	
Aswan (Egypt)	2358N	3247E	MEDA	
Bamako (Mali)	1232N	0757W	AFI West and Central	
Bangui (Cent. Afr. Rep.)	0424N	1831E	AFI West and Central	
Beira (Mozambique)	1948S	3454E	AFI West and Central	
Bengazi (Lybia)	3206N	2016E	MEDA	
Cape Town (South Africa)	3357S	1836E	AFI South	
Conakry (Guinea)	0934N	1337W	AFI West and Central	
Dar es Salaam (Tanzania)	0655S	3911E	AFI West and Central	
Djibouti (Djibouti)	1133N	4310E	AFI East	
Douala (Cameroon)	0401N	0943E	AFI West and Central	
Durban (South Africa)	2958S	3057E	AFI South	
Faya Largeau (Chad)	1755N	2051E	AFI West and Central	
Khartoum (Sudan)	1535N	3233E	AFI East	
Luanda (Angola)	0851S	1314E	AFI South	
Lusaka (Zambia)	1520S	2827E	AFI South	
Mahajanga (Madagascar)	1540S	4621E	AFI West and Central	ASECNA
N'djamena (Chad)	1208N	1502E	AFI West and Central	
Nairobi (Kenya)	0119S	3656E	AFI East	
Nicosia (Cyprus)			MEDA	
Port Elizabeth (South Africa)	3359S	2537E	AFI South	
Praia (Cape Verde)	1502N	2336W	AFI West and Central	
St. Denis (La Reunion, France)	2053S	5531E		
Tamanrasset (Algeria)	2249N	0528E	MEDA	
Toliara (Madagascar)	2323S	4344E	AFI West and Central	ASECNA
Walvis Bay (Namibia)	2259S	1439E	AFI South	
TBD	TBD	TBD		

## 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 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 of the available capabilities at every step of deployment.
- Methods of application will take into full consideration 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 [20042005](#)**: *Additional ranging and health information on GPS constellation provided via GEO satellites*

- This phase will allow the use of [Basic GNSS as a primary means of navigation](#) for en-route, [approach](#) and [for NPA and as a supplemental means navigation system for TMA](#). Existing ground infrastructure remains intact.

**Phase I-A (up to 2003)**

- An AFI GNSS test bed will be implemented to validate the objectives and differential correction algorithms of the operational EGNOS system to be implemented during Phase I.

**Phase I-B (up to 2004)**

- ☐ ~~This phase will be achieved by the deployment of a network of RIM stations through the AFI Region.~~
- ☐ ~~To prepare EGNOS implementation, numerous activities must be carried out: final system definition, specifications development, cost/benefit analysis (CBA) and funding, preparation of the institutional and operational framework and programmatic issues will be carried out.~~
- ~~This phase will end with EGNOS validation in the AFI Region.~~

### 3.2 Phase II (Medium term) 2005~~6~~-2011: APV-I -I, 20m vertical accuracy, will be available everywhere in the AFI Region

- This phase will ~~allow~~ include for:
  - a) To prepare EGNOS implementation, numerous activities must be carried out: final system definition, specifications development, cost/benefit analysis (CBA) and funding, preparation of the institutional and operational framework and programmatic issues will be carried out, with EGNOS validation in the AFI Region.
  - a)b) En-route phase: sufficient capability to meet en-route navigation requirements everywhere in the AFI Region; GNSS is approved ~~as a sole means system~~ for en-route navigation, taking into account technical and legal developments, and institutional aspects. En-route navigation aids will be progressively withdrawn accordingly in consultation with users.
  - b)c) Terminal areas: 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.
  - e)d) Terminal area VOR/ ~~DME~~/NDB, and Locators not associated with ILS, will be progressively withdrawn in consultation with users during Phase II.
  - e)e) Approach and landing phase: sufficient capability for APV-1 in the whole AFI Region. ILS will continue to be provided at aerodromes<sup>1</sup>.

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.

**3.3 Phase III (Long term) 2012 onwards:** *It is assumed that at least two constellations of navigation satellites will be available. ~~Sole means~~GNSS is approved for navigation services 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.

## 4. Institutional issues

4.1 Phases II and III of the AFI GNSS strategy will require the deployment of AFI specific GNSS components. In order to minimize costs associated with the deployment and operation of these components, AFI should seek cooperation agreements with systems providers in adjacent regions with a view to the joint use of GNSS components where feasible and cost-effective.

4.2 Meanwhile the modalities of installation and cost-recovery of multinational facilities, essentially RIMS, in some AFI States, must be addressed without delay so that deployment can be initiated as soon as technically possible.

## 5. Synopsis of the AFI GNSS strategy

AFI GNSS Strategy				
	Phase I		Phase II	Phase III
Time scale	2000 - 2004 <sup>5</sup>		<del>2005-2006</del> - 2011	2012 - 2017
Certification	<a href="#">Supplemental Basic GNSS</a>	<a href="#">Primary Basic GNSS</a>	<del>Sole means</del> from en route to APV-1	<del>Sole means</del> from en route to CAT I
Oceanic/En route		GPS	GPS with EGNOS	Long term GNSS
Continental/En route		GPS	GPS with EGNOS	Long term GNSS
Terminal	GPS		GPS with EGNOS	Long term GNSS
Approach and landing	(GPS/Baro) NPA		APV-1 SBAS	SBAS CAT I CAT I GBAS CAT II/III GBAS



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## 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	Further development of the AFI GNSS strategy		On-going
2	<p>Define detailed system architecture to meet APV-I over continental AFI and adjacent islands, taking into account, as appropriate, developments in other regions.</p> <ul style="list-style-type: none"> <li>• Perform an AFI SBAS APV-I <b>definition and design</b> phase, including:</li> <li>•</li> <li>• Definition of a Programme organisation</li> <li>• Development and Issue of detailed mission requirements (Service Levels).</li> <li>• Definition of Service Area</li> <li>• Preliminary System Definition and Design</li> <li>• Issue of System Requirement Document</li> <li>• Preparation of a system development plan</li> <li>• Carrying out initial trials/systems tests in order to support the design phase.</li> <li>•</li> <li>• For this purpose, the candidate AFI SBAS Providers will explore the possibility of cooperation agreements with the EOIG (EGNOS operators and Infrastructure Group).</li> <li>• 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.</li> </ul>	ESA	Q1 2006
3	Follow up and assist if required the trials on the Test Bed in Zones A, B and C	GNSS/TF	June 2006
4	Development of action plan for Implementation of the AFI SBAS	ASECNA	Next Meeting
5	Identify and address as appropriate, all actions necessary, including funding contributions from AFI service Providers, legal and institutional aspects, for the timely implementation of the AFI GNSS strategy (ref. AFI/7, Concl. 10/6d)	South Africa* (ASECNA)	Next Meeting
6	Cost/benefits analysis for operational SBAS system	ASECNA* (ESA, IATA)	Next Meeting
7	Simulations, planning and identification of sites for RIMS of the operational SBAS system	ESA	February 2006

GNSS/I/TF/3 Report – Appendix K

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<b>Item</b>	<b>Description</b>	<b>Responsibility</b>	<b>Target Date</b>
8	Review the report of the COM Working Group	GNSS/TF	Next Meeting
9	Review, in due course, the requirements for the implementation of GBAS at identified locations, in accordance with the AFI GNSS strategy		TBD

\* Main responsibility

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

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