INTERNATIONAL CIVIL AVIATION ORGANIZATION
EASTERN AND SOUTHERN AFRICAN OFFICE

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

(JOHANNESBURG, 22 - 23 JUNE 2004)

June 2004

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

(Johannesburg, 22 - 23 June 2004)

1. Objective

1.1 The Second meeting of the AFI GNSS Implementation Task Force (GNSS/I/TF/2) was held in Johannesburg from 22 to 23 June 2004 at the Aviation Training Academy. 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 15 participants, among them 6 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.

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: Briefing on worldwide GNSS implementation activities

- Navigation Systems Panel (NSP)
- Follow-up to AN-Conf/11
- GNSS Implementation in ICAO Regions
- Status of GPS, Galileo, EGNOS, WAAS and other SBAS

Agenda Item 2: Review of implementation of the mobile test bed

- Area A
- Area B
- Area C

Agenda Item 3: Review of the work for the implementation of the AFI satellite test bed (ASTB)

- simulations/lessons learned from mobile test bed
- selection of sites
- funding issues
- avionics equipage

Agenda Item 4: Review of the studies for the operational SBAS over AFI

- GNSS Service Implementation Plan, Issue 1, Version 0
- Cost/benefit studies
- Institutional studies
- Simulations

Agenda Item 5: Review and update of TN01 - *Civil Aviation Requirements for Inter-regional SBAS over AFI*

Agenda Item 6: Review of the results of the survey on the implementation of Basic GNSS in the AFI Region

Agenda Item 7: Future work programme

Agenda Item 8: Any other business

5. List of conclusions and decisions

Conclusion/ Decision N°	Test	Page

Conclusion/ Decision N°	Test	Page
Conc. 2/4	**Conclusion 2/4: Support by African Regional Economic Organizations of the AFI SBAS** That 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 b) potential complementary contributions of AFI Service Providers to the AFI SBAS investment be identified and defined.	15
Conc. 2/5	**Conclusion 2/5: Institutional arrangements** That South Africa: 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 b) circulate the final draft to members of the Task Force for comment before the third meeting.	15

6. List of Appendices

7. Summary of the discussions and conclusions

7.1 Agenda Item 1: Briefing on worldwide GNSS implementation activities

7.1.1 Under this agenda item, the GNSS Task Force was briefed on the work programme of the Navigation Systems Panel (NSP), the results of the Eleventh Air Navigation Conference (2003), the status of implementation of GNSS in the ASIA/PAC and CAR/SAM Regions, the status of GPS, Galileo, WAAS, EGNOS and other SBAS being developed.

7.1.2 With regard to the Eleventh Air Navigation, the meeting noted Recommendation 6/1 – *Transition to satellite-based air navigation*, which encouraged States to move rapidly to satellite-based navigation with a view to achieving a worldwide APV-I capability. This has been the objective of the AFI Region as set in the GNSS implementation strategy. The meeting also noted Recommendation 6/2 – *Guidelines on mitigation of GNSS vulnerabilities*, and in particular paragraph k) on retention of DME. Recommendation 6/3 – *Assessment of atmospheric effects on SBAS performance in equatorial regions* was noted. In this regard, it was agreed that an input from the AFI Region would be made using the data collected with the test beds in Central Africa, Southern Africa and Eastern Africa. The task force also noted Recommendation 6/9 – which called on States to support and participate in SBAS pre-operational activities.

7.1.3 During discussion, the meeting noted that a CAT I precision approach capability would not be achievable with current SBAS being deployed and therefore there was a need to review the objectives of the GNSS strategy and the AFI SBAS mission document Technical Note 01 – *Civil Aviation Requirements for Inter-regional SBAS over AFI (ISA).* It was agreed that this review would be undertaken in Agenda Item 5 of the meeting.

7.2 Agenda Item 2: Review of the implementation of the mobile test bed

7.2.1 Under this agenda item, the meeting considered 3 working papers reporting on the implementation of EGNOS mobile test bed in Central Africa (Zone A), Southern Africa (Zone B) and Eastern Africa (Zone C).

WP/6 – Zone A trial results

7.2.2 This paper was presented by ASECNA and the European Space Agency (ESA). The test bed has been operating since June 2003 with 4 reference and integrity monitoring stations (RIMS) located at Brazzaville, Douala, Lome and N'djamena. The signal-in-space has been continuously transmitted since July 2003 on two Inmarsat satellites as follows:

- AOR-E (GEO 120) until 14 October 2003; and
- IOR-E (GEO 131) since 20 October 2003.

7.2.3 The initial Central Processing Facility (CPF) configuration was using a secondary area for Area A, that is message type MT27. The static campaign done in September 2003 shows good accuracy but poor availability for APV-1 (84%). In February 2004, ESA integrated Zone A in the primary ECAC area (homogeneous mode), i.e. without MT27. Intensive static tests have been done since February 2004 at Douala. A routine performance monitoring of the Zone A test bed has been initiated since February 2004. Each week, a set of 24 hr data from the Douala RIMS is retrieved from the ESTB ftp server at Norwegian Mapping Agency. The computed performance plots are available on the ESA ESTB website: http://esamultimedia.esa.int/docs/egnos/estb/results.htm

7.2.4 The performance assessments of the static tests show that accuracy is complying with the APV-1 SARPs with horizontal position error (HPE) around 3m (95%) and vertical position error around 4.5m (95%). Availability of APV-1 service is more than 98% with the 4 RIMS. During the period no misleading information leading to a non-integrity event has been detected.

7.2.5 A specific analysis of the ionosphere behaviour is underway with a dedicated receiver located at Douala. A complimentary evaluation of equatorial region behaviour is envisaged with an extension of the Zone A trials or through an extensive Zone C campaign.

7.2.6 The meeting adopted the following conclusion:

Conclusion 2/1 Contribution to the assessment of ionospheric effect on SBAS in equatorial regions

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.

WP/9 – Implementation of the EGNOS test bed in Zone B

7.2.7 The paper was presented by ATNS of South Africa. In Zone B, RIMS are installed at East London and Johannesburg in South Africa, Lusaka (Zambia) and Windhoek (Namibia). The communication network for Zone B is shown in **Appendix B**. The most critical circuit is the circuit from Lusaka to Honefoss. The section Lusaka/Johannesburg is via VSAT and will slightly increase the latency. It is expected that the total latency will be less than 1 second.

7.2.8 Training on the installation and operation of the RIMS was conducted in Johannesburg from 24 to 28 May 2004 with the participation of technicians from Namibia, South Africa and Zambia. Operation of the test bed is expected at the end of July 2004.

WP/2 – EGNOS Test Bed in Eastern Africa (Zone C)

7.2.9 The kick-off meeting on the EGNOS Test Bed in Eastern Africa was held in Nairobi, from 6 to 7 May 2004 at the ICAO ESAF Regional Office. The purpose of the meeting was to review all preparatory actions to be taken for the successful

implementation of an EGNOS test bed in Eastern Africa as part of the implementation of Phase I of the AFI GNSS. The participating States in this project are Central African Republic, Ethiopia and Kenya.

7.2.10 The results of APV1 simulations, based on positioning of the RIMS at Addis Ababa, Bria and Nairobi, showed that the predicted vertical performances were well within the SARPs about 4 to 5 meters accuracy (95%). The vertical protection limit was shown to be above 95% in the area of interest. Regarding communications, frame relay at 16 kbps will used at Addis Ababa, VSAT at Bria and leased line at Nairobi. The test bed is planned to be operational by 1 October 2004.

7.2.11 The GNSS Task Force noted the difficulty of establishing reliable communications between the RIMS and the EGNOS CPF. It was noted that this problem could be compounded by the implementation of a pre-operational test bed. The meeting agreed on the need to establish a Communications Working Group. The following Decision was adopted:

Decision 2/2: GNSS Implementation Task Force Communications Working Group (GNSSTF/COM/WG)

That:

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

b) The terms of reference of the GNSSTF/COM/WG be:

i) To document lessons learned from the communications viewpoint during the implementation of the mobile test bed in the AFI region;

ii) 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

iii) To assess radio frequency (RF) environment at RIMS locations for the pre-operational test bed

c) Composition: South Africa, ASECNA, ESA, Kenya and Ethiopia

7.3 Agenda Item 3: Review of the work for the implementation of the AFI satellite test bed (ASTB)

7.3.1 Under this agenda item the meeting reviewed lessons learned from the implementation of the mobile test bed in Central Africa (Zone A), the results of simulations for the selection of sites for the AFI satellite test bed (ASTB) and avionics equipage.

Lessons from the test bed in Central Africa (Zone A)

7.3.2 The meeting was presented with a comparison of simulation and measurements carried out with a receiver located at Douala. It is recalled that for the test bed in Zone A, the RIMS are located in Brazzaville, Douala, Lome and N'djamena (para 7.2.2 above refers). The simulated vertical protection level (VPL) availability for APV-1 with a standard ionospheric model is 100% and for the degraded ionospheric model > 90%. The real measurements are as follows:

Day and expenditure	Measured VPL availability for APV-1
14/03/2004 – 24 hours	99.48%
25/04/2004 – 24 hours	99.57%
12/05/2004 – 24 hours	99.92%
20/05/2004 – 24 hours	99.70%

7.3.3 A comparison of the measurements with simulations based on the standard ionospheric model shows that there is a difference of about 0.56%. The simulation results are therefore consistent with the measurements.

WP/14 – Implementation of the AFI satellite test bed

7.3.4 In accordance with APIRG Conclusion 14/46, a pre-operational test bed is to be implemented as a first step in the extension of EGNOS to the AFI Region. The Task Force agreed that the best way to progress in this direction is to build up from the mobile test beds in Zones A, B and C. The objective will be to connect the service areas of the mobile test beds by installing additional RIMS at suitable locations. This will establish the AFI satellite test bed (ASTB). The process is shown in **Appendix C**. It is planned that three mobile test beds will be operational in AFI in 2004. In 2005, five additional RIMS will be moved from the European ESTB to the AFI Region. The tentative locations of the 5 RIMS are: Accra, Beira, Bamako, Luanda and Mahajanga.

7.3.5 The simulations for the ASTB were derived from those done for the operational SBAS. They are shown in WP/13 and correspond to Scenario 01.

IP/9 – Avionics equipage

7.3.6 ASECNA described the avionics suite installed in its flight calibration aircraft to evaluate SBAS performances for APV-1 operations.

7.3.7 During the discussions, the meeting was informed that there were only 2 certified stand-alone receivers in the USA and that there was not yet a receiver certified for integration with FMS.

7.4 Agenda Item 4: Review of the studies for the operational SBAS over AFI

7.4.1 Under this agenda item, the meeting reviewed the preliminary results of simulations for the operational Inter-regional SBAS over AFI (ISA), the GNSS

service implementation plan, the ISA funding options and proposals for institutional arrangements.

WP/13 – Preliminary simulations results

7.4.2 ESA presented the preliminary results of the simulations for the Inter-regional SBAS over AFI (ISA). Three scenarios considered were based on the number of RIMS taken into account in 3 geographical areas: Europe (EGNOS), North Africa and Mediterranean area (MEDA) and Africa South of the Sahara (AFI).

7.4.3 The 3 scenarios are:

Scenario 1:	34 EGNOS + 4 MEDA + 15 AFI	=	53
Scenario 2:	34 EGNOS + 4 MEDA + 20 AFI	=	58
Scenario 3:	34 EGNOS + 4 MEDA + 25 AFI	=	63

7.4.4 The results are shown in **Appendices D, E, F**, which indicate the availability of the horizontal protection level (HPL) and vertical protection level (VPL) in grid format. The following conclusions were drawn:

a) Scenario 01 (15 RIMS) allows partial coverage of the continental AFI only;
b) Scenario 02 (20 RIMS) allows coverage of most of continental AFI except Madagascar, Mauritius, Seychelles, north eastern Somalia and western Namibia;
c) Scenario 03 (25 RIMS) allows coverage of continental AFI, including Madagascar, except Mauritius and Seychelles;
d) The results provide a preliminary estimation based on EGNOS IONO derived macro models;

7.4.5 The following study consolidation steps are planned for 2004/2005:

a) detailed architecture analysis for ISA (ESA during Q4 2004 and Q1/2 2005);
b) dedicated IONO research activity for AFI (ESA Iono Expert Team and Galileo Joint Undertaking);
c) AFI test bed (ASTB) deployment (2004/2005) and dedicated performance analysis campaign to complement system studies;

7.4.6 The Meeting adopted the following conclusion:

Conclusion 2/3: Finalization of studies for the operational AFI SBAS

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.

WP/12 – GNSS Service Implementation Plan

7.4.7 The Galileo Joint Undertaking of the European Commission presented the action plan for implementation of an operational inter-regional SBAS over AFI (ISA) service. The short-term priorities are:

a) establish a business plan involving sectors from civil aviation and additional
b) define detailed architecture for the infrastructure, including test bed implementation;
c) establish funding framework and activate financing opportunities;
d) support AFI states to proceed with infrastructure implementation;
e) stimulate application development and user involvement through additional demonstration and awareness activities, including outside civil aviation sector.

7.4.8 A consultant has been contracted to develop the business plan, including the operational framework and financing plan.

7.4.9 The European Space Agency, as noted in para 7.4.5 above, will develop the detailed architecture and infrastructure implementation plan.

WP/11 – ISA funding options

7.4.10 The paper was introduced by the Consultant to the Galileo Joint Undertaking (para. 7.4.8 refers). The meeting was informed of the Programme for the Development and Demonstration of Applications for Galileo and EGNOS (Pro DDAGE), which aims at conducting demonstration projects in Europe, Eastern Europe, Mediterranean and sub-Saharan African countries.

7.4.11 The funding avenues considered in the study for ISA are:

a) European Commission's DG Development (Transport/Airports) which comprises:
   i) country specific grants;
   ii) regional programmes;
   iii) inter Africa-Caribbean-Pacific (ACP) funds.
b) European-Investment Bank (EIB);
c) Others – World Bank, bi-lateral development funds, African Development Bank, etc.

7.4.12 **Appendix G** gives more details on funding options a) and b).

7.4.13 The meeting agreed on the need to get the support of African regional economic groups (CEMAC, COMESA, ECOWAS, SADC, UEMOA) as well as the identification of potential contributions for ATS providers and adopted the following conclusion:

Conclusion 2/4: Support by African Regional Economic Organizations of the AFI SBAS

That

c) 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

d) **potential complementary contributions of AFI Service Providers to the AFI SBAS investment be identified and defined.**

Review of the institutional framework

7.4.14 Under this agenda item, the meeting reviewed WP/8 – *Institutional arrangements: AFI SBAS as a multinational air navigation facility/service* from the Secretariat and WP/10 – *Conceptual issues relative to institutional framework, funding and cost recovery arrangements of SBAS over the AFI Region* presented by South Africa. The two papers are shown at **Appendices H** and **I** to this report.

7.4.15 The meeting welcomed the two papers as they constituted a concrete approach to a long-standing task. The meeting opted to further refine Appendix D of WP/10 and Appendix A of WP/8. Regarding Appendix D of WP/10, the Task Force made the point that the ISA Service Providers (ISAP/SP) were not directly providing a service to airspace users but to ATS providers. The meeting requested that this relationship be inserted in the diagram in the same way it is shown in Appendix A of WP/8. The meeting adopted the following conclusion:

Conclusion 2/5: Institutional arrangements

That South Africa:

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

b) **circulate the final draft to members of the Task Force for comment before the third meeting.**

7.5 Review and update of TN01 – Civil Aviation Requirements for Inter-regional SBAS over AFI

7.5.1 Under this agenda item, the GNSS Task Force continued the review and update of TN01 – *Civil Aviation Requirements for Inter-regional SBAS over AFI (ISA)* that was initiated at its first meeting.

7.5.2 The meeting agreed that the document be referred to as "Requirements Document 01" instead of "Technical Note 01".

7.5.3 The meeting agreed to delete references to CAT-1 (because of the difficulty of its provision by SBAS due to ionospheric effects) and to APV-II (not an AFI requirement).

7.5.4 Regarding the definition of the service area of ISA and in particular the expression "including adjacent islands", the meeting noted the results of the preliminary simulations (cf Agenda Item 4), which indicated that APV-I coverage of Mauritius/Plaisance airport is technically impossible (lack of islands to East, South) and that APV-I coverage of Seychelles would be costly. In view of these results, the meeting to modify the coverage terms to say "including adjacent islands when cost-beneficial".

7.5.5 The meeting agreed to align the definitions of accuracy, integrity, continuity and availability with those of Annex 10.

7.5.6 In Tables 3 and 4, J.P. Dupont is to confirm the figures for APV-I local availability.

7.5.7 Paragraph 4 – GNSS Safety Requirements is to be reviewed through consultations with Eurocontrol.

7.5.8 The amended Requirements Document 01 is at **Appendix J**.

7.6 Agenda Item 6: Review of the results of the survey on the implementation of Basic GNSS in the AFI Region

7.6.1 The meeting reviewed the results of the consultation of States on the reasons for the lack of progress in the implementation of Basic GNSS (Conclusion 1/1 of the first meeting refers).

7.6.2 Five States in the AFI Region replied to the survey. The meeting noted that States are requesting training in the following areas:

- regulation and legislation for approvals;
- ATC;
- Pilot;
- GNSS NOTAM; and
- Flight checking of procedures.

7.6.3 The Task Force noted that the FAA has agreed to conduct workshops on GNSS NOTAM, flight checking and legislation on GNSS during 2004. IATA agreed to provide a sample of the model draft legislation developed for the SADC States. The Galileo JU announced that they would define a training package for APV-I before the next meeting.

7.6.4 Based on is discussions, the meeting agreed on the need to advise and support States to implement Basic GNSS and work with partners (FAA, Galileo JU, etc.) to provide training packages.

7.7 Agenda Item 7 – Future work programme

7.7.1 The meeting amended the work programme of the Task Force as shown in **Appendix K**.

7.7.2 The date of the next meeting, planned to be held in Nigeria would be determined through consultations between members.

7.8 Agenda Item 8: Any other business

7.8.1 The meeting was briefed on the GNSS PANS-OPS training course held in Dakar from 17 to 28 May 2004. The FAA sponsored the workshop. A second workshop is planned in Nairobi in January 2005.

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APPENDIX A

Second Meeting of the AFI GNSS Implementation Task Force

(Johannesburg, 22-23 June 2004)

List of Participants

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APPENDIX A

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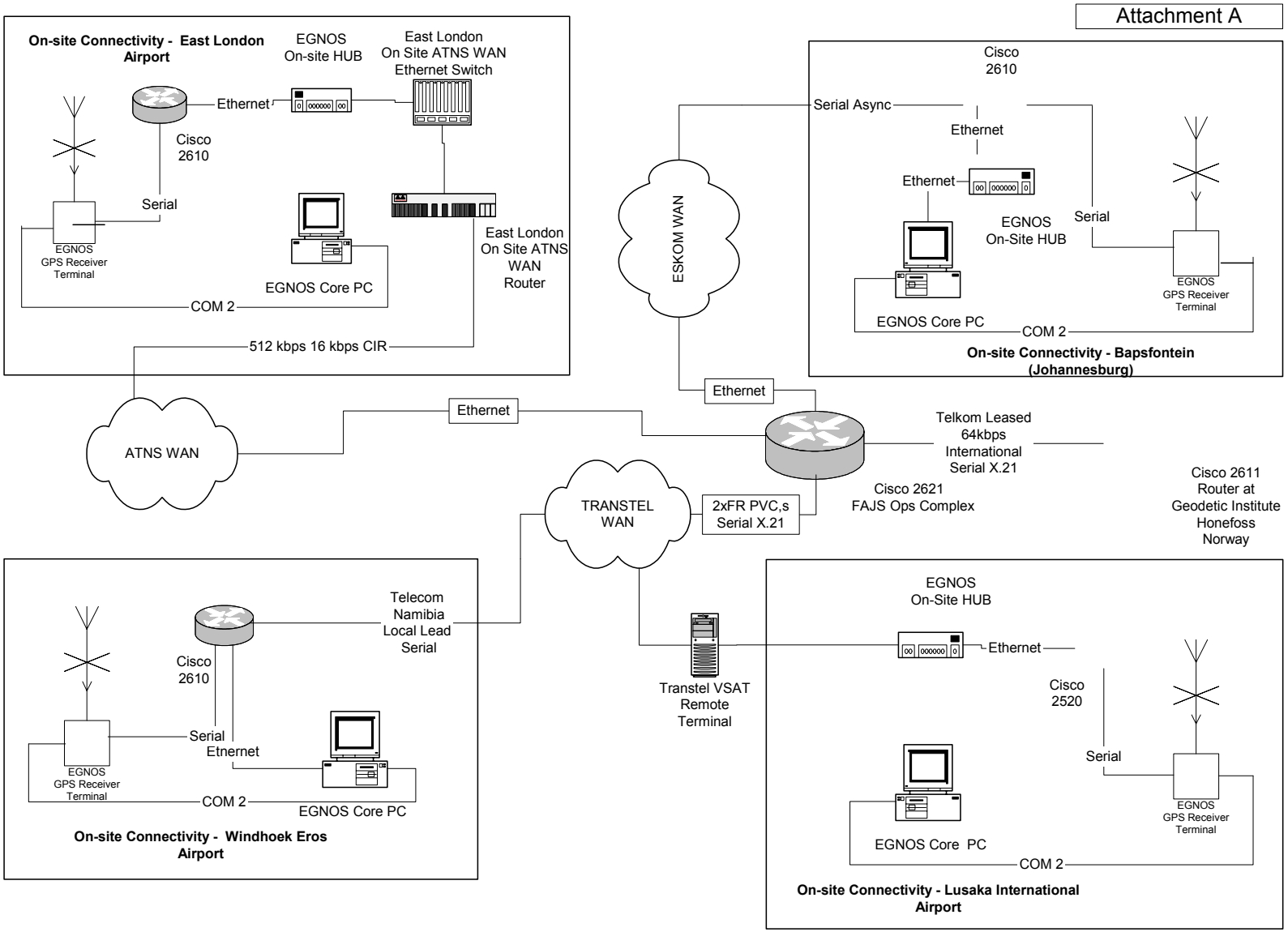
ICAO	Mr. Amadou Sene	RO/CNS, ESAF Office,	P.O. Box 46294, 00100 Nairobi, Kenya	Amadou.sene@icao.unon.org	Tel : +254 20 622367 Fax : +254 20 623028


Attachment A
On-site Connectivity - East London Airport
EGNOS On-site HUB
East London On Site ATNS WAN Ethernet Switch
Ethernet
Cisco 2610
Serial
EGNOS GPS Receiver Terminal
EGNOS Core PC
East London On Site ATNS WAN Router
COM 2
512 kbps 16 kbps CIR
ESKOM WAN
Cisco 2610
Serial Async
Ethernet
EGNOS On-Site HUB
Serial
EGNOS GPS Receiver Terminal
EGNOS Core PC
COM 2
On-site Connectivity - Bapsfontein (Johannesburg)
ATNS WAN
Ethernet
Telkom Leased 64kbps International Serial X.21
Cisco 2621
FAJS Ops Complex
Cisco 2611 Router at Geodetic Institute Honefoss Norway
TRANSTEL WAN
2xFR PVC,s Serial X.21
Telecom Namibia Local Lead Serial
Cisco 2610
Serial
Etnernet
EGNOS GPS Receiver Terminal
COM 2
EGNOS Core PC
On-site Connectivity - Windhoek Eros Airport
Transtel VSAT Remote Terminal
EGNOS On-Site HUB
Ethernet
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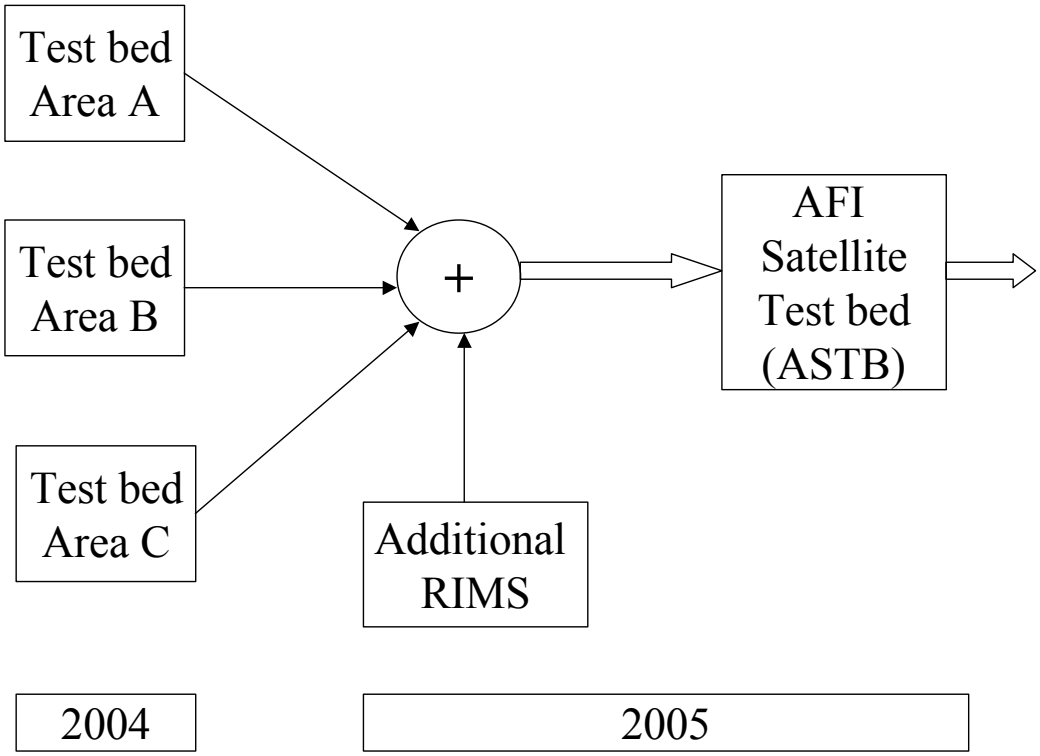
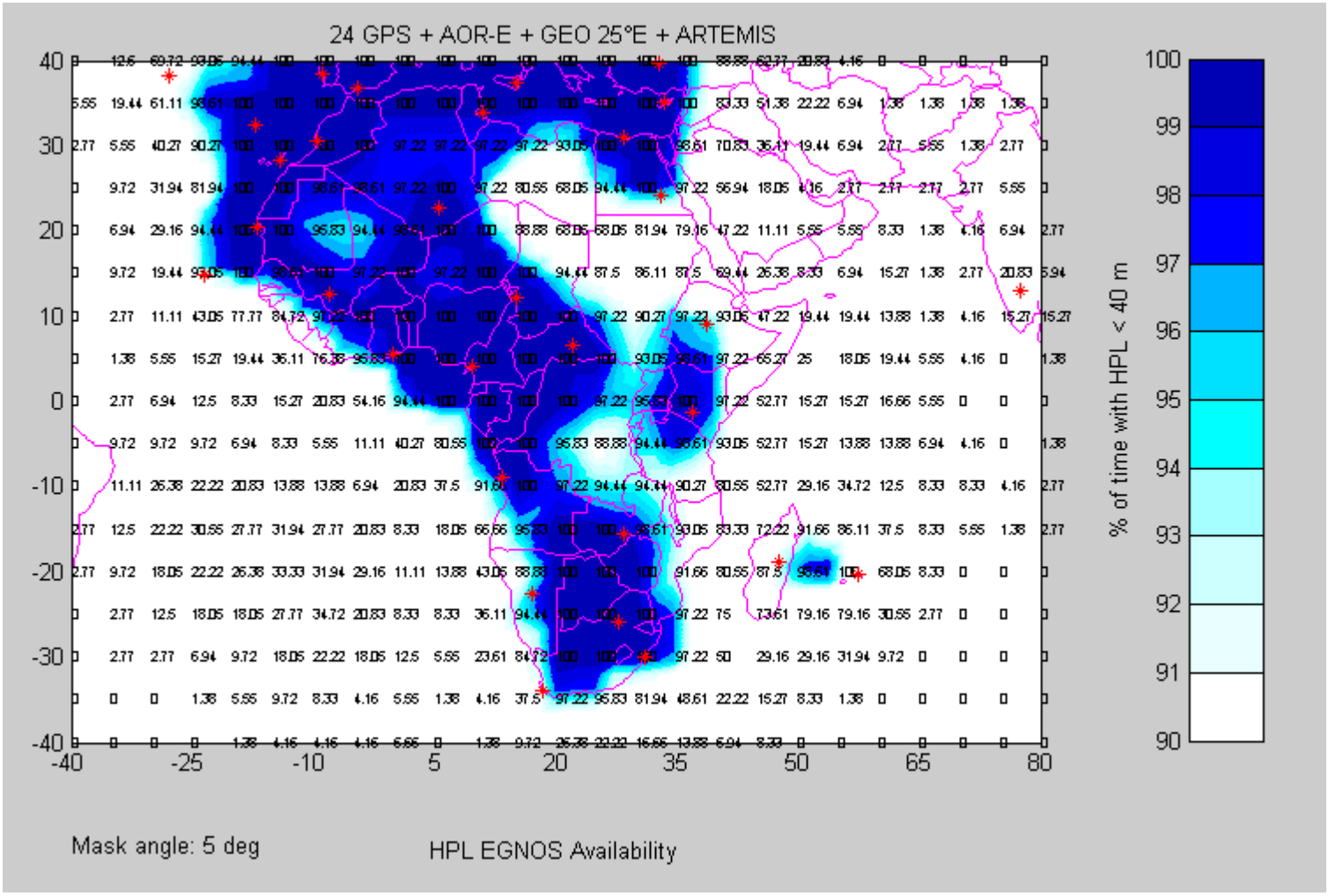
EGNOS Core PC
COM 2
On-site Connectivity - Lusaka International Airport

Implementation of the AFI Satellite Test Bed (ASTB)



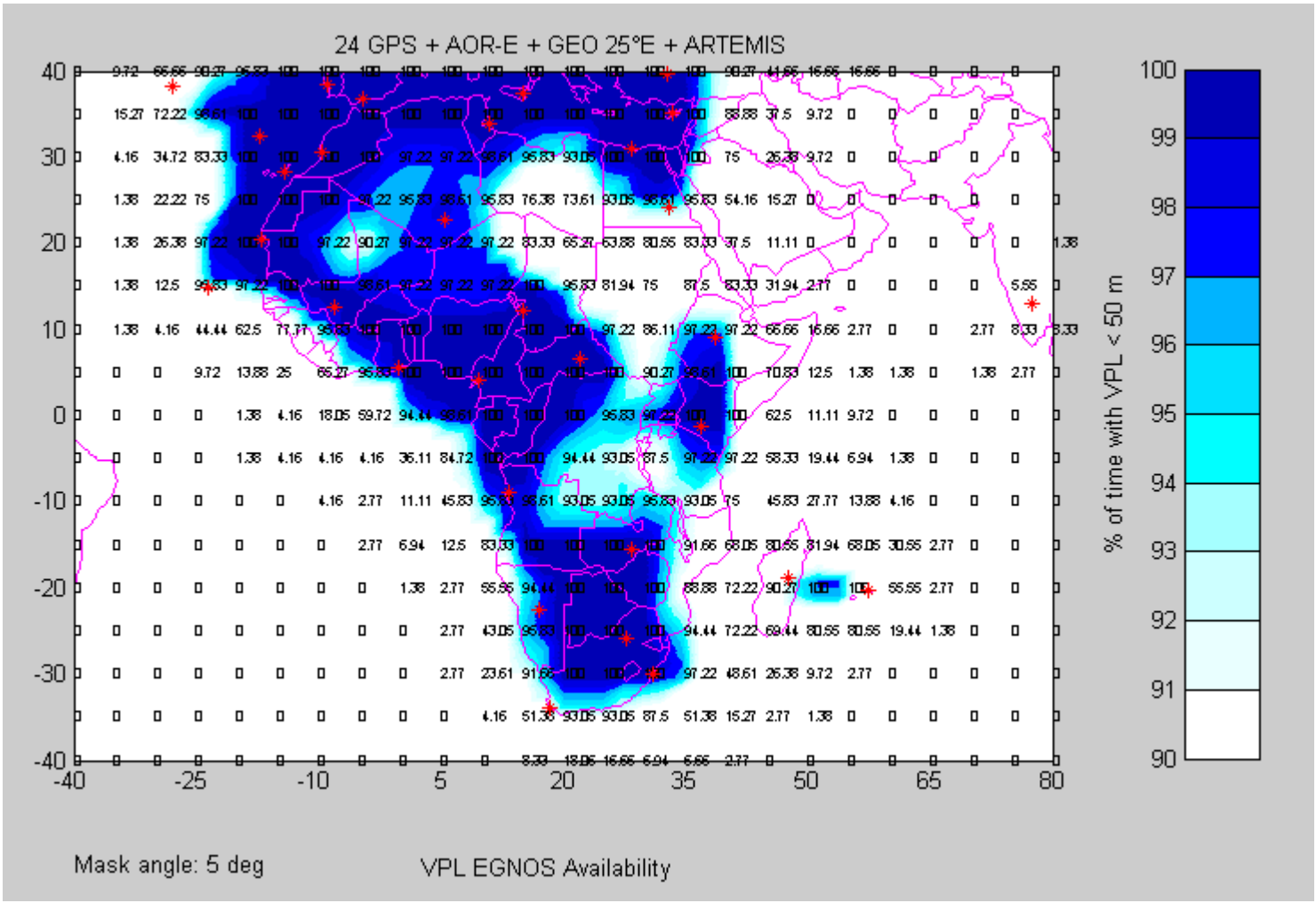
APPENDIX D

HPL Availability – Scenario 01



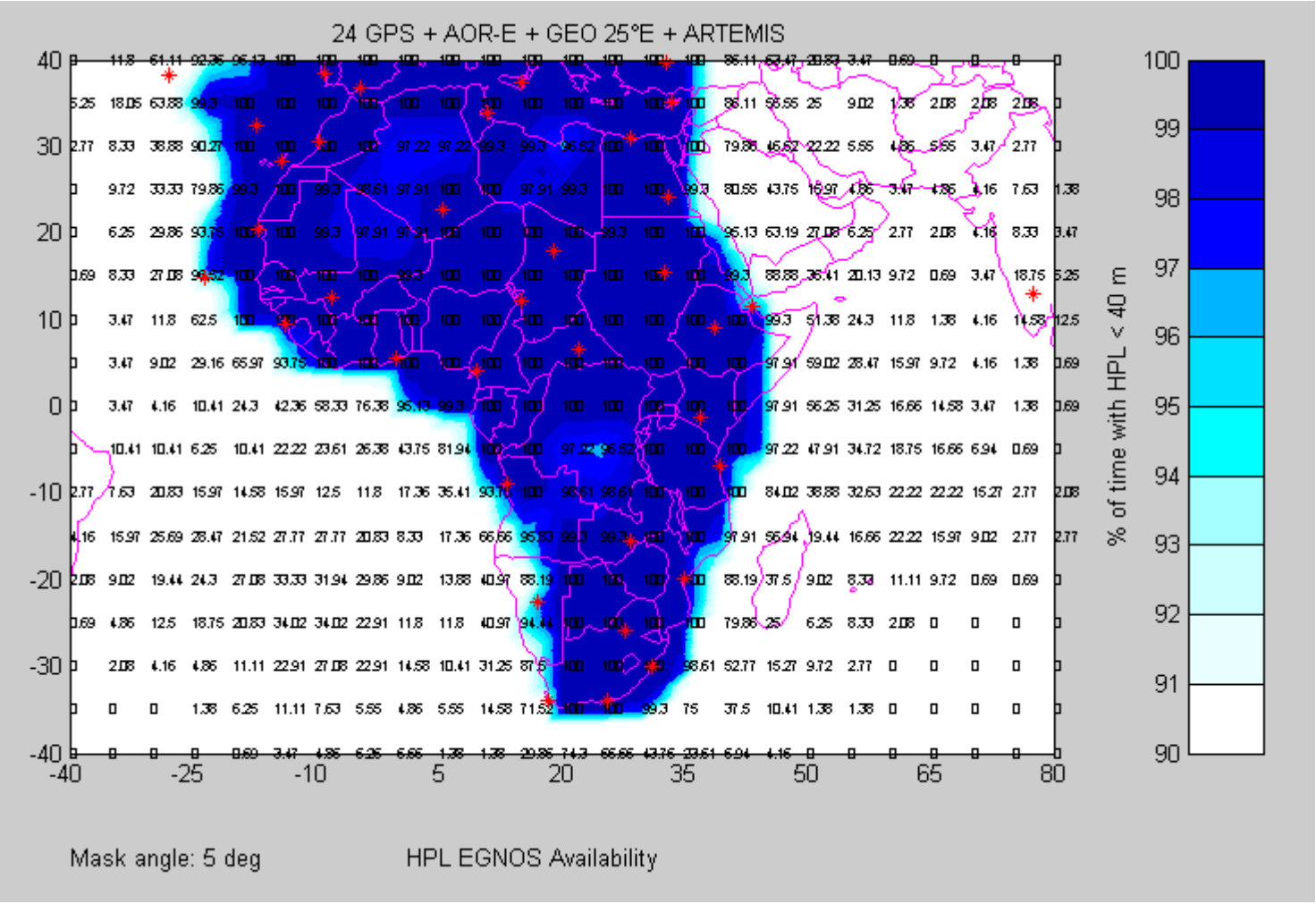
APPENDIX D

VPL Availability – Scenario 01



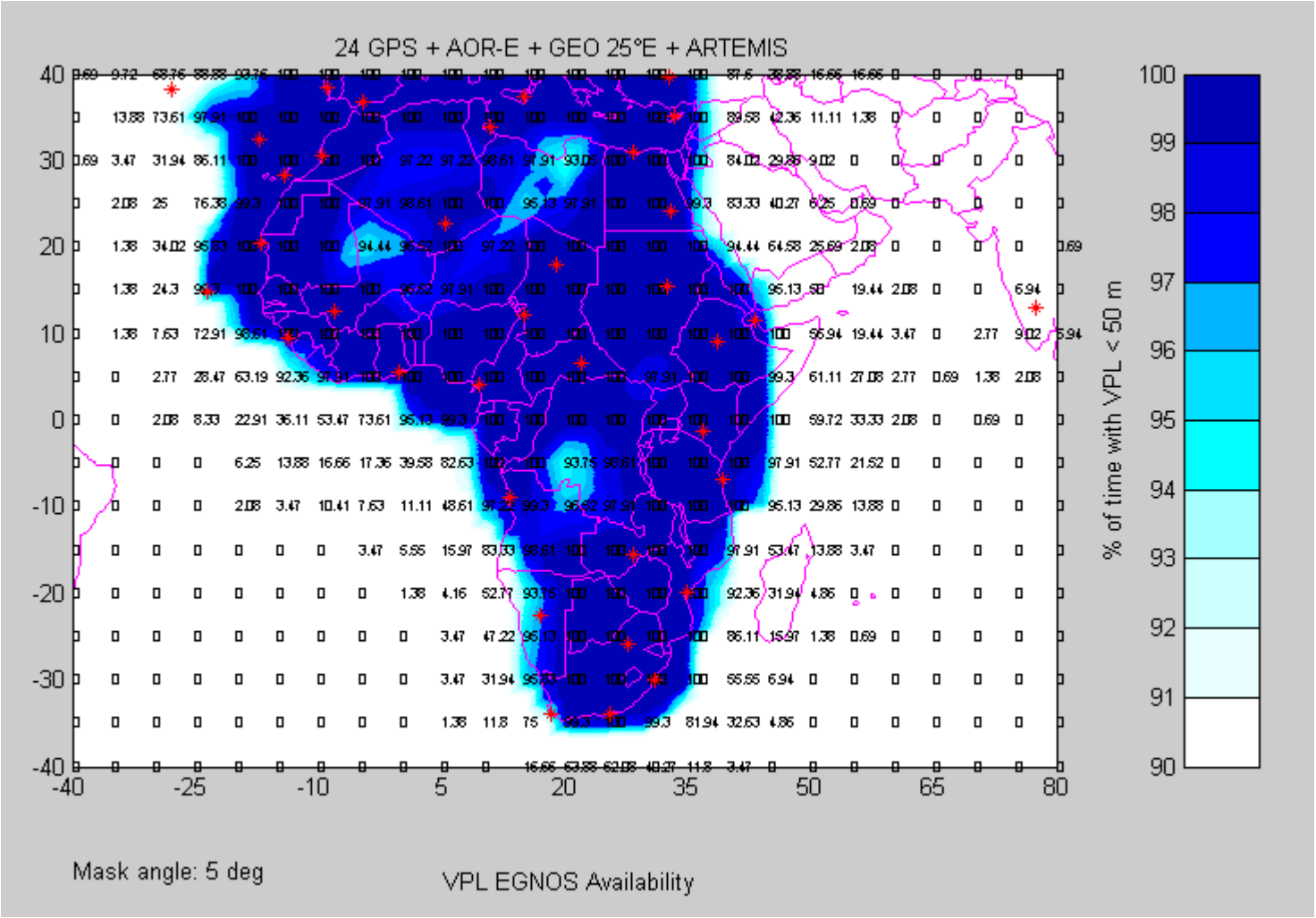
APPENDIX E

HPL Availability – Scenario 02



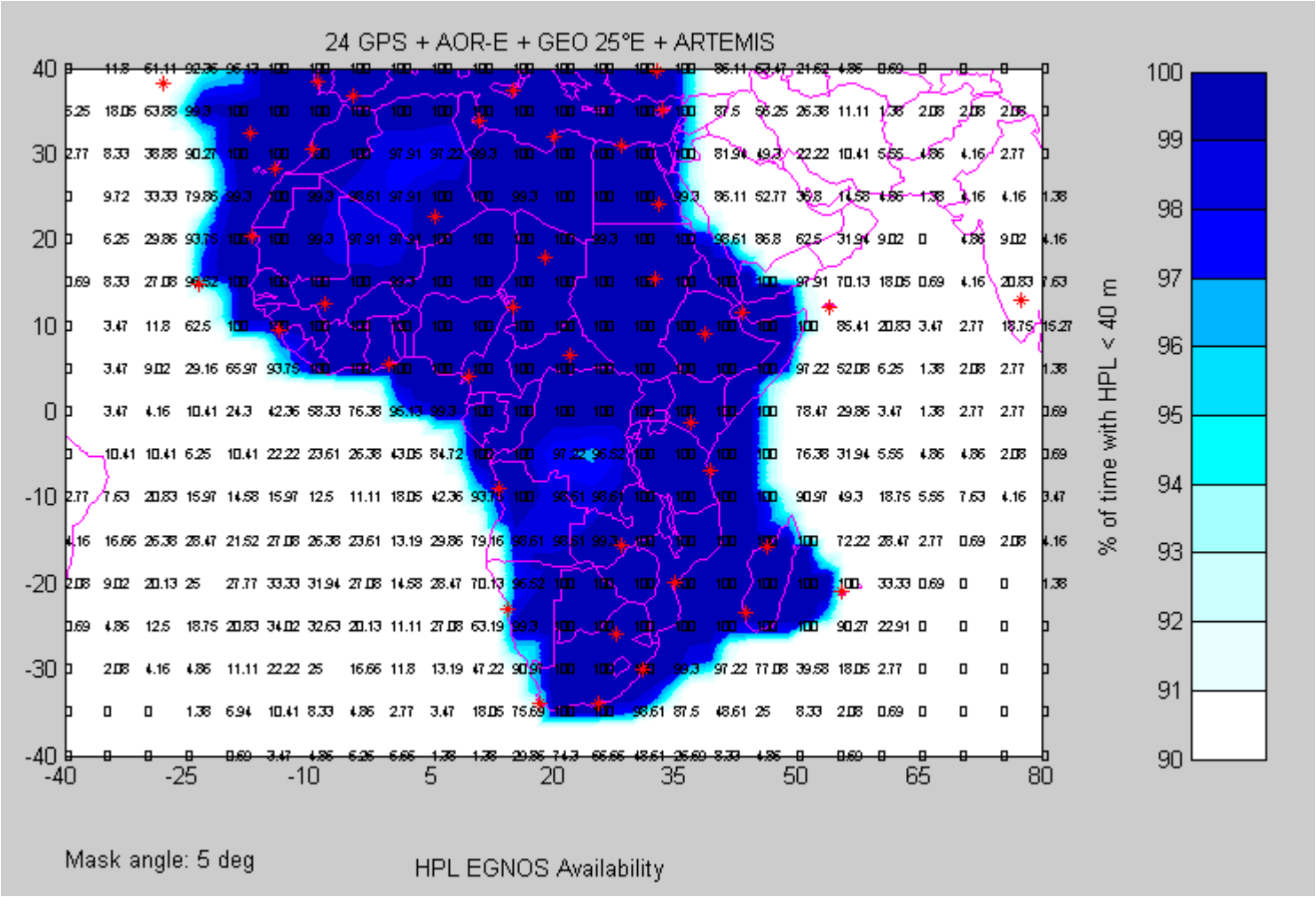
APPENDIX E

VPL Availability – Scenario 02



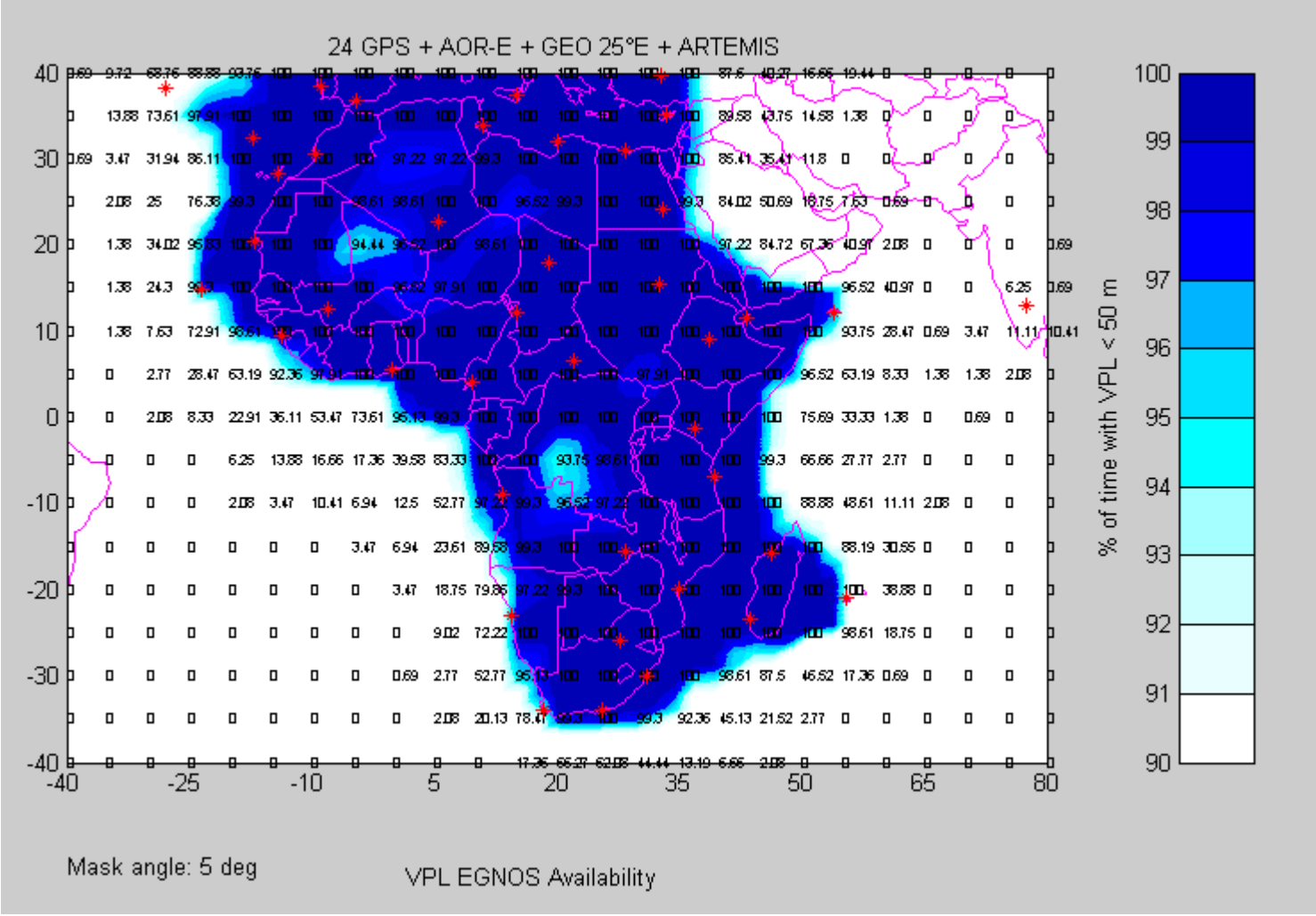
APPENDIX F

HPL Availability – Scenario 03



APPENDIX F

VPL Availability – Scenario 03



Funding options for the Inter-regional SBAS over AFI (ISA)

1. The funding avenues considered in the study for ISA are:

   a) European Commission's DG Development (Transport/Airports) which comprises:
      i) country specific grants;
      ii) regional programmes;
      iii) inter Africa-Caribbean-Pacific (ACP) funds.

   b) European-Investment Bank (EIB); and

   c) Others – World Bank, bi-lateral development funds, African Development Bank, etc.

DG Development Country specific programmes

2. These programmes constitute the largest proportion of the budget (about €10 billion). Each country in Africa has been allocated a budget. The funds are typically used for transport infrastructure projects (e.g. roads). The monies have already been earmarked to a 5-year project plan. This option does not seem the best for ISA at this stage.

Regional Indicative Programme

3. The budget for this programme is overall €1.3 billion. It is estimated that €192 million will be allocated during 5 years to all transport and communication projects for the 4 regions of Africa. Funding report must be done through all duly mandated regional economic groupings: COMESA, ECOWAS, CEMAC, SADC, UEMOA, etc. The funds have already been earmarked to a 5-year project plan; but a review process starting in 2005 will open a window of opportunity. A project proposal should satisfy the following criteria:

   a) have a regional dimension;
   b) focus on harmonization/coordination of policies rather than investment per se (e.g. training, capacity building, institutional issues);
   c) promote economic integration.

DG Development Inter-ACP funds

4. Projects funded under this chapter must benefit at least 3 regions (Africa has 4 regions). Infrastructure projects can be funded. At the moment, the funds are all earmarked (€1 million for liberalization of air transport over 5 years).

European Investment Bank (EIB)

5. The EIB typically supports construction and upgrading of transport infrastructure. It funds up to 50% of the required capital. Large projects are financed

directly (40 K€ to 25 M€) and must contribute to the European Union's development assistance policies. The Bank offers long-term loans (4-20 years) and at a fixed or variable interest rates available at a spread below LIBOR (London Interbank Offered Rate) on a cost-plus basis. The Bank usually seeks an adequate security for its lending from a bank or banking syndicate, a financial institution, or large company with a good credit rating.

INTERNATIONAL CIVIL AVIATION ORGANIZATION

AFI GNSS IMPLEMENTATION TASK FORCE
SECOND MEETING

(Johannesburg, 22 – 23 June 2004)

Agenda Item 4: Review of the studies for the operational SBAS over AFI

Institutional arrangements: the AFI SBAS as a multinational air navigation facility/service

(Presented by the Secretariat)

1. **Introduction**

1.1. The first meeting of the Task Force defined a 3-step action plan for the implementation of the AFI SBAS. Institutional arrangement studies are to be uninitiated during Stage 1 and completed during Stage 2, i.e. by the end of 2004.

1.2. The meeting assigned the institutional studies task to South Africa, supplemented by ASECNA.

1.3. At the GNSS/I/.TF/1, ESA made a presentation on EGNOS institutional arrangements complemented with two options for linkage with the AFI Region.

1.4. IATA at GNSS/I/TF/1 also made a proposal whereas a limited number of ATS Providers would be jointly appointed as the AFI SBAS provider. In the run-up to GNSS/I/TF/2, IATA made a proposal for consideration of an arrangement similar to those established for VSAT provision: representation of all concerned on a Supervisory Board, which appoints an AFI SBAS provider (cf. email dated 2 June 2004).

1.5. The purpose of this paper is to contribute to the debate and give structure to the various ideas by making use of guidance material contained in the GEN Part of the AFI FASID.

2. **Discussion**

2.1. The AFI SBAS will be constituted of RIMS suitably located in the Region that will provide a navigation service from en-route to landing to international aviation throughout a service area defined in TN01. the AFI SBAS will be part of the ANP infrastructure, since the RIMS will be included in the FASID Table CNS 3.

2.2. The preceding paragraph shows that the AFI SBAS can be classified as a multinational air navigation facility/service, the definition of which is:

> *"A facility/service specifically identified as such and included in the AFI Regional Plan for the purpose of serving international air navigation in airspace extending beyond the airspace serviced by a single state in accordance with the AFI Regional Plan."*

2.3. Once it is agreed that the AFI SBAS is a multinational air navigation facility/service, then the development of institutional arrangement is straightforward. As agreement based on the guidelines of the FASID would have to be developed.

2.4. Based on previous proposals, a possible institutional arrangement is shown in **Appendix A** to this paper. The AFI States would have to sign into an agreement establishing the multinational facility/service, its operator, its regulator. The agreement would cover the following aspects:

a) Objective of the agreement
b) Obligations of States party to the agreement
c) Definition and description of the facility/service
d) Establishment and operation of the facility/service
    1) AFI SBAS Provider
    2) Certification
e) Liability aspects
f) Managerial aspects
    1) Governing bodies
    2) Decision making arrangements
g) Consultation
    1) States not represented on the governing body
    2) Aircraft operators' organizations
    3) EGNOS Provider.
h) Financial aspects
    1) Pre-implementation considerations
    2) Cost determination
    3) Cost sharing
    4) Recovery of costs from users
    5) Budgeting
    6) Authority to approve the budget
    7) Financial auditing
    8) Taxation and other government levies
i) Procedures for settlement of disputes
j) Accessories, withdrawals, amendments to and termination of agreement

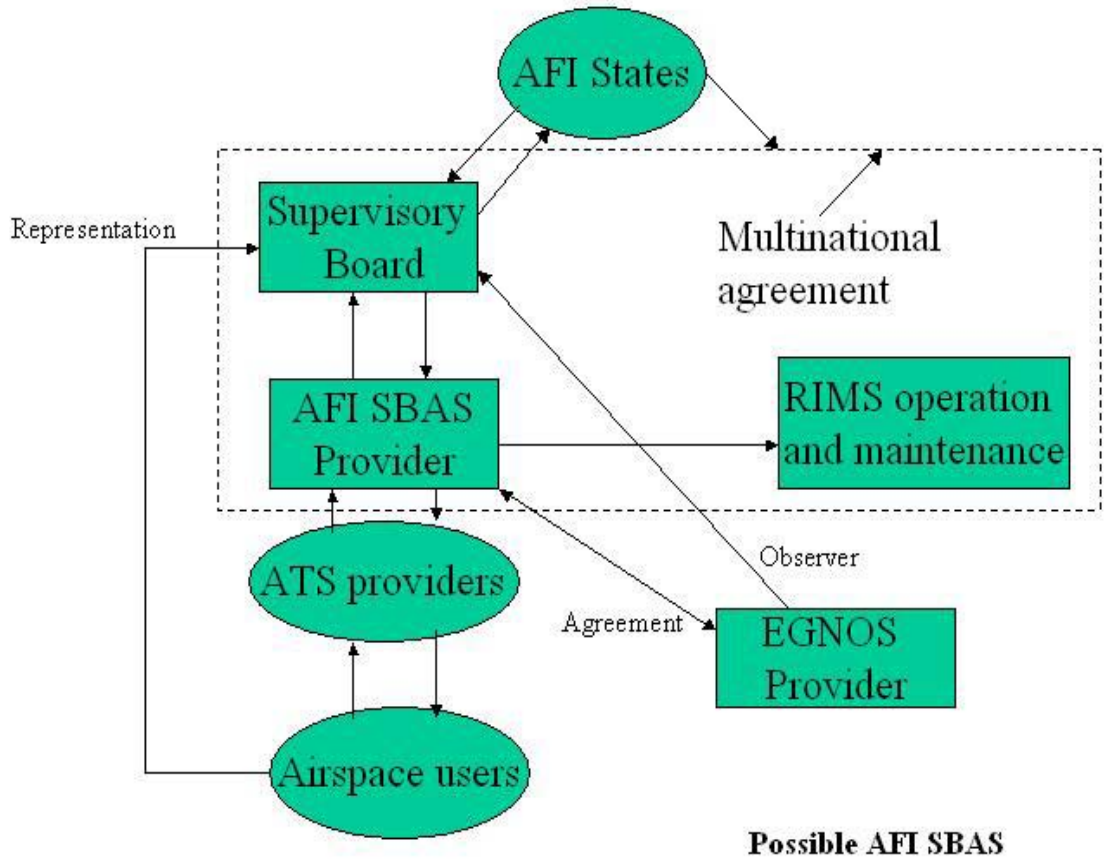
3. Action by the meeting

3.1 The Meeting is invited to:

a) review and discuss the proposal made in this paper;
b) agree that the SBAS is a multinational air navigation facility/service; and
c) request South Africa to further develop the proposals put forward herein.

— — END — —

APPENDIX A



Possible AFI SBAS institutional arrangement

INTERNATIONAL CIVIL AVIATION ORGANIZATION EASTERN AND SOUTHERN AFRICAN OFFICE

Second Meeting of the AFI GNSS Implementation Task Force: Johannesburg

22 – 23 June, 2004.

Johannesburg, South Africa

Agenda Item 4: Review of the studies for the operational SBAS over Africa

(Presented by the Air Traffic and Navigation Services Company, South Africa)

Abstract

This paper addresses the conceptual issues regarding the Institutional Framework for the implementation, funding and cost recovery arrangements of SBAS over the AFI Region

1) GNSS Institutional Issues: Background and Introduction

The Institutional Framework for the implementation of GNSS in Africa was one of the original Work Packages of the former GNSS Work Group and at that time South Africa accepted responsibility to address this. For various reasons this issue has never been properly attended to and it is therefore still one of the items identified as part of the Work Programme of the newly formed AFI GNSS Implementation Task Force.

As identified in the GNSS Strategy for the AFI Region, Phases II and III will require the deployment of AFI specific GNSS components. During this transition to SBAS, institutional issues will be one of the focus points. The object of the study will be to identify and develop an Institutional framework to support the introduction of satellite-based navigation systems and services as specified under the preferred implementation scenario and concepts for early operational benefit. The institutional framework is to provide a list of prioritized steps required to be implemented by the AFI Region in order to ensure the successful implementation of SBAS in the region.

2) Discussion

Key institutional elements include developing a programme organization, establishing a legal framework and government coordination, developing an acquisition strategy and financing the project. Some of the high level considerations that need to be addressed are based on the model for the provision of VSAT in Southern Africa. The key elements are addressed below.

a) Programme Development Organization

To start its process of deploying the recommended architecture, the AFI Region must establish an organization capable of oversight and administration of the installation project and eventually of running and maintaining the Interregional SBAS over AFI (ISA).

As presented by ESA at the First Task Force meeting this could be accomplished with ISA as part of EGNOS or as a separate entity where the ISA provider will be responsible for the operations and maintenance of the African sites. The two concepts are shown in the attached diagrammes (Appendix A and B) together with the two suggested models for the AFI Region (Appendix C and D). In the case of Appendix D an ISA Supervisory Board (ISB) would be responsible for the oversight of the service in the AFI Region whereas the model in Appendix B would be in partnership with EGNOS. AFI States would take responsibility for the ISA through participation in the ISB. A proposal regarding the composition of the ISB should be developed.

The tasks of this ISB would be to provide centralized coordination, establishment of costs and charges and the provision of annual reports. The actual acquisition and deployment of the ISA terrestrial elements would be the responsibility of ISA Service Providers (ISA/SP). The ISB could appoint an ISA Service Providers Management Board (ISA/SP/MB) to harmonize deployment and approve annual reports from the appointed ISA/SP. The ISA/SP/MB should include a combination of acquisition and financial experts, as well as support from technical experts from States, who would be responsible for technical and operational aspects of the deployment effort. Agreements will have to be established between the ISA/SP and the EGNOS Signal and Data Provider to cover the level of service and costs for data processing and signal provision.

Key elements in the establishment of an institutional program development organization includes:

- Establish the organizational structures most suited for the ISA
- Develop a charter to define the missions of these structures

- Define the compositions of these structures
- Establish a budget for this organization's administration
- Define terms of reference, roles and responsibilities

b) Establish a Legal Framework and Government Coordination

The lack of a legal and liability framework for GPS has prevented many nations from adopting Basic GNSS. The first Task Force meeting noted that only four States have published AIC approving the use of GPS for en-route and TMA navigation and RNAV GNSS NPA procedures. Twenty-four States have designed and tested RNAV GNSS NPA procedures. APIRG/14 urged States to implement basic GNSS in order for States to gain experience before the introduction of APV.

Perhaps a more critical concern would be establishing a basis for system ownership when the States adopt systems requiring a ground-based infrastructure. Member States would have to establish a basis for the ownership of the system. This is a more complicated issue, since it would involve responsibility and management of financial system benefits, liability responsibility for the signal and jurisdiction within airspace.

It would be advisable to acquire the support of regional legal experts who may be able identify any legal barriers that could affect program support and funding. This may be included in the mission of the ISB for this project. It would be critical to identify and resolve any critical issues before investment is secured.

Key issues in establishing a legal framework and government coordination includes:

- Describe possible ownership model(s) and a legal concept of ownership, management and control of the system
- Establishment of SLA agreements between EGNOS Signal and Data Provider
- Develop options relating to the institutional and regulatory framework of the ISA
- Identify and resolve any problematic legal concerns

c) Develop an Acquisition Strategy

Deployment of the EGNOS Ranging and Integrity Monitoring station (RIMS) and its elements would be coordinated by the ISA/SP/MB. This entity would initially harmonize deployment and functioning of the ISA. It is foreseen that each appointed ISA/SP could be assigned responsibility for a number of RIMS in an area, including provision of SBAS operational status to ATS providers and other required elements necessary for operational use. The ISA/SP would be responsible for the actual acquisition, deployment and eventually for operation of the SBAS elements. The total number of RIMS and final locations would depend on the final system design.

Key issues in developing an acquisition strategy include:

- Designing a system acquisition strategy that maximizes value to the purchaser
- Decide whether to procure this project on a regional- or sub-regional basis
- Appointment of Service providers and define their responsibilities and functions
- Establish conditions to ensure that procurement is handled in a transparent manner
- Control of the acquisition process should be the responsibility of the ISA/SP/MB
- Certification of the system for Full Operational Service must be addressed
- In addition to acquisition, deployment, training, control, operation and maintenance should be ISA/SP responsibilities.

d) Financing of the Project

Although the existing basic GNSS services are free, including new services, the cost to aviation for the provision of SBAS would involve funding. Funding would consist of an initial capital outlay for deployment and ongoing operational costs which would include data transmission cost, the processing of the data, the provision of the signal-in-space, monitoring and maintenance. Deployment could be financed through a loan from a development institution while operational cost could be recovered through a common user navigation charge collection system. Studies should be completed to establish different financing options and recommend the best option for acceptance. Further financing opportunities may be available for sharing planning and deployment costs with non-aviation user groups.

Kinds of financial sources could include international development institutions, private investment organization and unilateral grants and loans. Because of the low level of investment risk associated with aviation projects, funding may be readily available through these institutions.

Key issues in financing the project include:

- Analyze deployment and operational costs and funding for infrastructure and financing of organizational structures
- Explore possible financing options – financing by the Service Provider, joint financing by Sates, joint financing by States/development institutions, etc.
- Developing potential cost recovery strategies to recover initial investment and operational costs
- Possible sharing deployment and operational costs with non-aviation user groups
- Study the establishment of a common navigation charge collection structure

3) Conclusion

This presentation on the institutional issues is submitted to the meeting for discussion. More detailed studies will have to be performed on a number of issues and a consultant may have to be appointed to assist with this task. The completion of this task is scheduled for the last quarter of 2004.

4) Action by Task Force

The concept of the institutional framework is submitted to the Task Force for their comments and consideration to use it as guidance material for further study.

Attachments

Appendix A

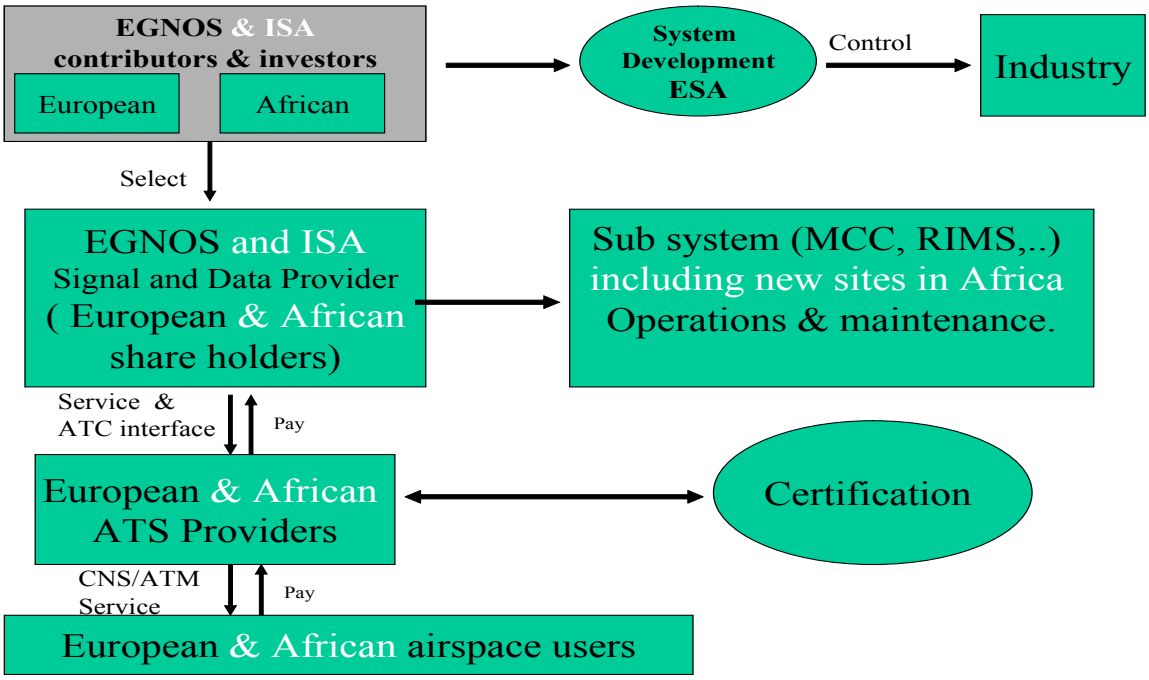
Appendix B

Appendix C

Appendix D

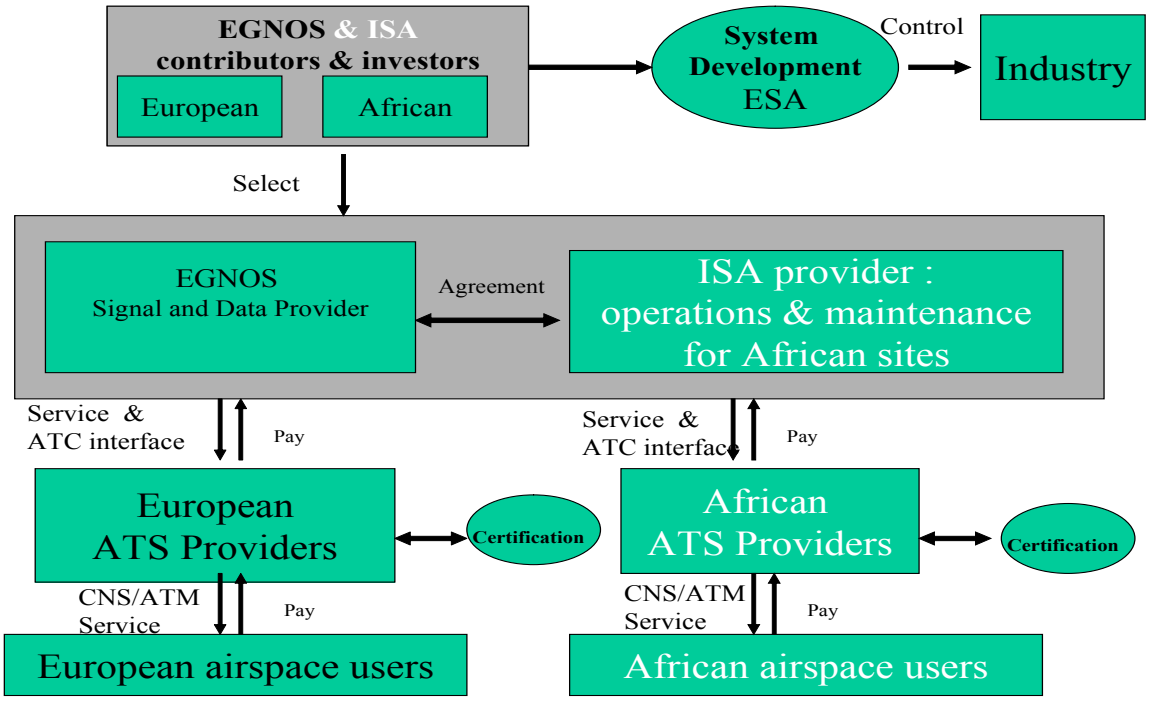
Appendix A

Potential EGNOS & ISA framework (Europe & Africa): option 1

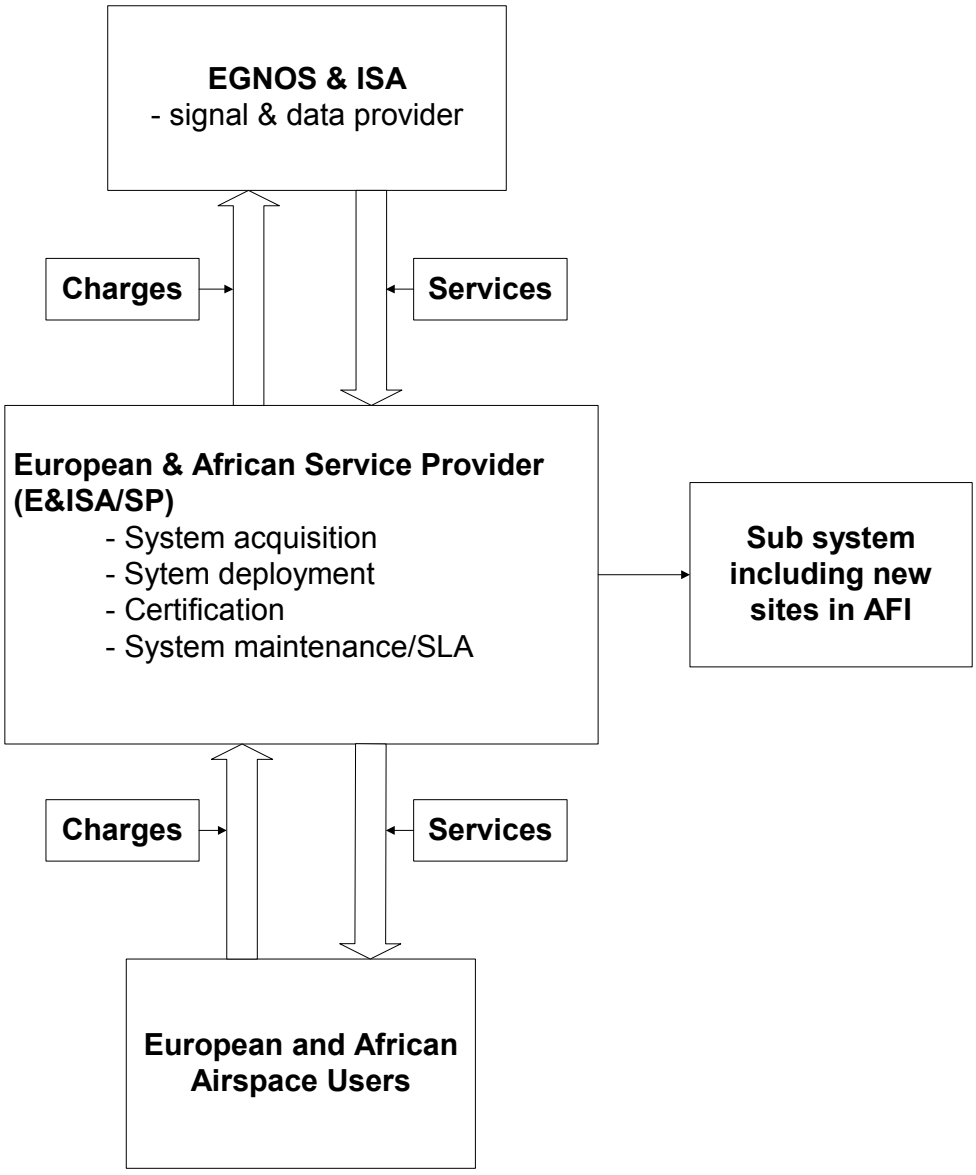


Appendix B

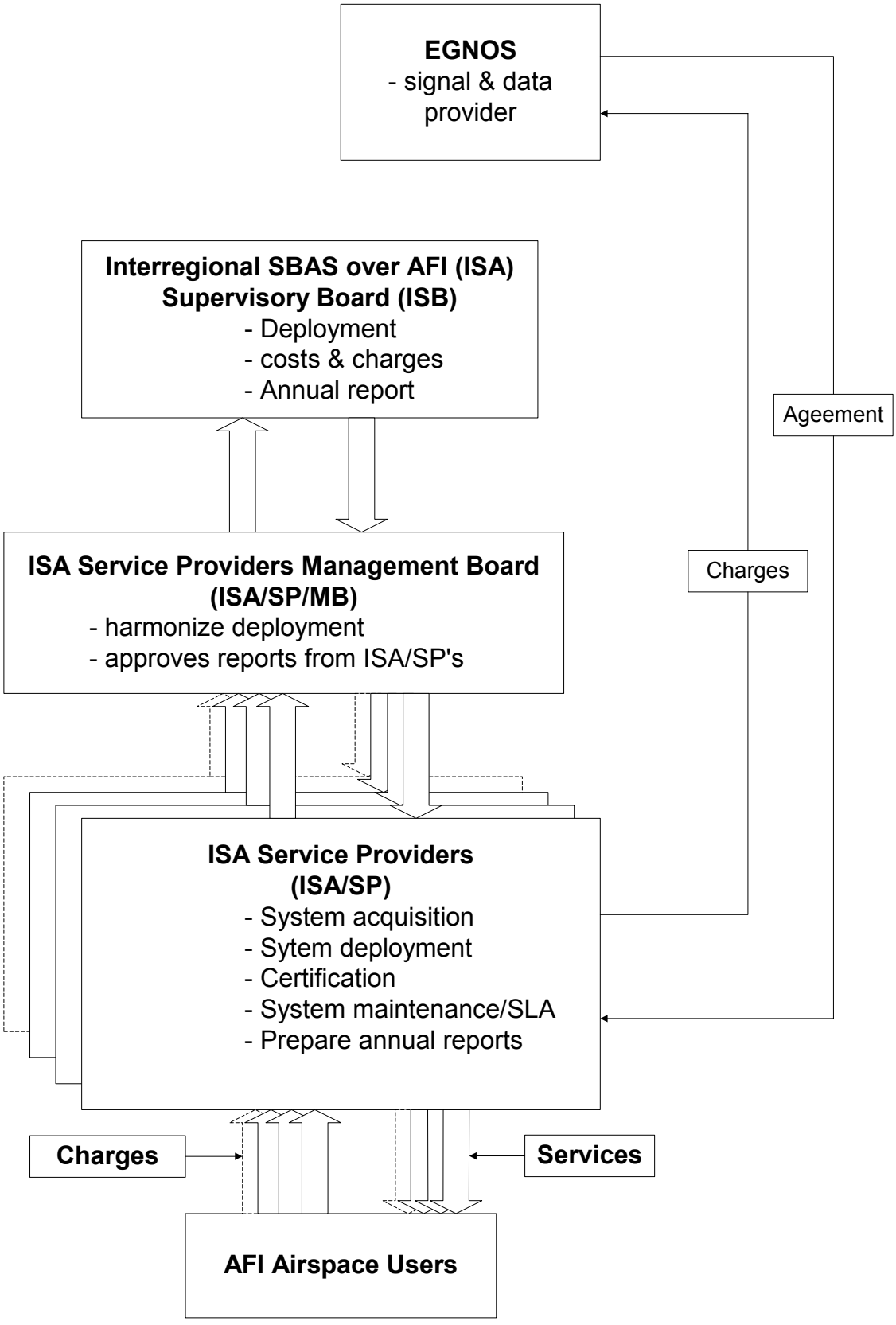
Potential EGNOS & ISA framework (Europe & Africa): option2



Appendix C


EGNOS & ISA
- signal & data provider
Charges
Services
European & African Service Provider (E&ISA/SP)
- System acquisition
- Sytem deployment
- Certification
- System maintenance/SLA
Sub system including new sites in AFI
Charges
Services
European and African Airspace Users

Appendix D


EGNOS
- signal & data provider
Interregional SBAS over AFI (ISA) Supervisory Board (ISB)
- Deployment
- costs & charges
- Annual report
Ageement
ISA Service Providers Management Board (ISA/SP/MB)
- harmonize deployment
- approves reports from ISA/SP's
Charges
ISA Service Providers (ISA/SP)
- System acquisition
- Sytem deployment
- Certification
- System maintenance/SLA
- Prepare annual reports
Charges
Services
AFI Airspace Users

APPENDIX J

CIVIL AVIATION PERFORMANCE REQUIREMENTS

FOR ISA

(INTERREGIONAL SBAS OVER AFI)

AFI GNSS STRATEGY PHASE 2

~~TN01~~Requirement Document 01

Version 0.3

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

DISTRIBUTION LIST

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 when cost beneficial.

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.
- ~~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.

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~~
Horizontal (95 %)	2 NM (3.7 Km)	← 0.4 NM (0.74 Km) →		220 m (720 ft)	←	16 m (52 ft)	→
Vertical (95 %)	N.A.				20 m (66 ft)	~~8 m (26 ft)~~	~~6 m to 4.0 m (20 ft to 13 ft)~~
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) →		
VAL	← NA. →				50 m (164 ft)	~~20 m (66 ft)~~	~~15 m to 10 m (50 ft to 33 ft)~~

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)~~(2)~~Insert~~ See N~~n~~ote 5 of Table 3.7.2.4-1 in SARPs (Annex 10, Volume I, page 42G)

*: Jean-Pierre Dupont to contact Eurocontrol on this value and advise GNSS/TF members

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 [See Eurocontrol for review of whole paragraph, J.-P]**

~~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 and RNP 0.02/40, a non-continuity event shall be considered as having the capability to lead to a **major event**, whatever the duration of the event~~.
For APV-1, (*text to be added*)

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

AFI FIRs AREA

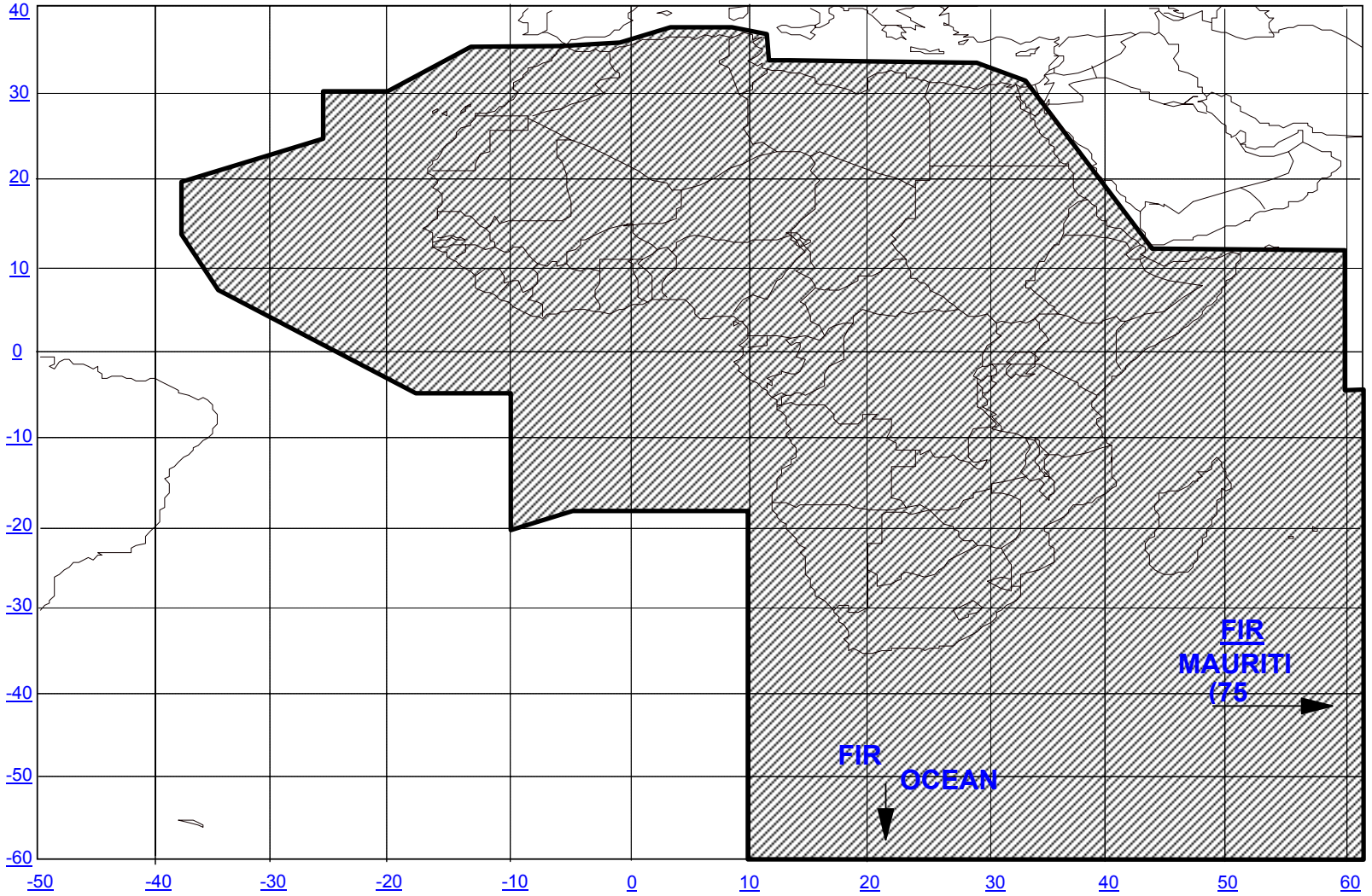


Figure 1

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 when cost beneficial.

~~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)~~a) ~~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*

* Figures to be reviewed through consultations with Eurocontrol

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)	RNP 10	RNP 5 To RNP 2	RNP1	RNP 0.3	RNP 0.3/125	RNP 0.03/50	RNP 0.02/40
Accuracy 95% H *	2 NM	← 0.4 NM →		220 m	220 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 m (H) 50 m (V)	40 m (H) 20 m (V)	40 m (H) 10 m (V)
Time to Aler	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~~

~~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

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~~rea~~s~~

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)

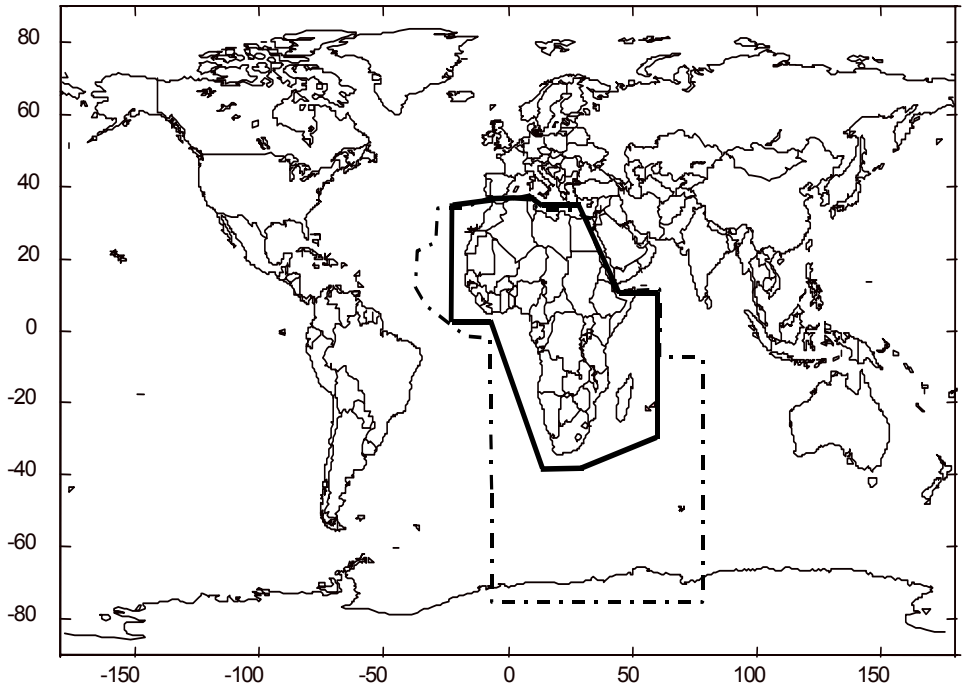


Figure 1: AFI Land masses and adjacent islands

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)~~

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. • 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	Q4 2004
4	Follow up and assist if required the trials on the Test Bed in Zones A, B and C	GNSS/TF	On-going
5	Development of action plan for Implementation of the AFI SBAS	ASECNA	Next Meeting
6	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
7	Identify and address European funding options	Galileo JU	Next Meeting

Item	Description	Responsibility	Target Date
8	Cost/benefits analysis for operational SBAS system	ASECNA* (ESA, IATA)	Next Meeting
9	Simulations, planning and identification of sites for RIMS of the AFI Testy Bed (ASTB)	ESA, GNSS/TF	31 August 2004
10	Simulations, planning and identification of sites for RIMS of the operational SBAS system	ESA	Next Meeting
11	Establish the COM Working Group	ICAO, States	Next Meeting
12	Review the report of the COM Working Group	GNSS/TF	Next Meeting
13	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, Nigeria, South Africa, Tunisia, ASECNA, IATA, ICAO

APPENDIX L

INTERNATIONAL CIVIL AVIATION ORGANIZATION

SECOND MEETING OF THE AFI GNSS IMPLEMENTATION TASK FORCE

(GNSS/I/TF/2)

(Johannesburg, 22-23 June 2004)

List of Papers

IP N°	Title	Agenda Item	Presented by
1	Information Bulletin		Secretariat
2	List of Papers		Secretariat
3	Information on the work of the Navigation Systems Panel (NSP)	1	Secretariat
4	Status information on GPS, GLONASS, GALILEO, WAAS, EGNOS, MSAS, GAGAN, LAAS and GBAS	1	Secretariat
5	GNSS SBAS Trials in the CAR/SAM Region	1	Secretariat
6	SBAS EGNOS Trials in the CAR Region	1	Secretariat
7	GNSS implementation in the ASIA/PAC Region	1	Secretariat
8	Follow-up on AN-Conf/11 Recommendations	1	Secretariat
9	EGNOS Test Bed avionics	3	ASECNA
WP N°			
1	Draft Agenda	Opening Session	Secretariat
2	EGNOS Test Bed in Eastern Africa (Zone C)	2	Secretariat
3	Civil Aviation Requirements for AFI SBAS	5	Secretariat
4	Review of the results of the survey on the implementation of Basic GNSS in the AFI Region	6	Secretariat
5	Terms of reference, work programme and composition of the AFI GNSS Implementation Task Force	7	Secretariat
6	Zone A trials results (ppt)	2	ESA and ASECNA
7	PANS-OPS GNSS Workshop	8	Secretariat
8	Institutional arrangements: the AFI SBAS as a multinational air navigation facility/service	4	Secretariat
9	Implementation of the EGNOS Test Bed in Area B	2 & 3	South Africa
10	Conceptual issues relative to institutional framework, funding and cost recovery arrangements of SBAS over the AFI Region	4	South Africa
11	ISA funding options (ppt)	4	Galileo Joint Undertaking
12	African GNSS Service Implementation (ppt)	4	Galileo Joint Undertaking

IP N°	Title	Agenda Item	Presented by
13	ISA – Inter-regional SBAS for Africa – APV-I Service Service/Preliminary Results (ppt)	3 and 4	ESA
14	ESTB AFI RIMS Network (ppt)	3	ESA
