



EGNOS/Galileo CO-OPERATION INITIATIVES WITH AFRICA

**Alexandre Steciw
(GJU Senior Advisor)**



The European strategy in satellite navigation

Step 1: EGNOS to provide civil complement to military GPS (and GLONASS), into initial operations from early 2006



EGNOS is an initiative of the European Commission, Eurocontrol and ESA

Step 2: GALILEO is to achieve European sovereignty and service guarantees through dedicated system under civil control.



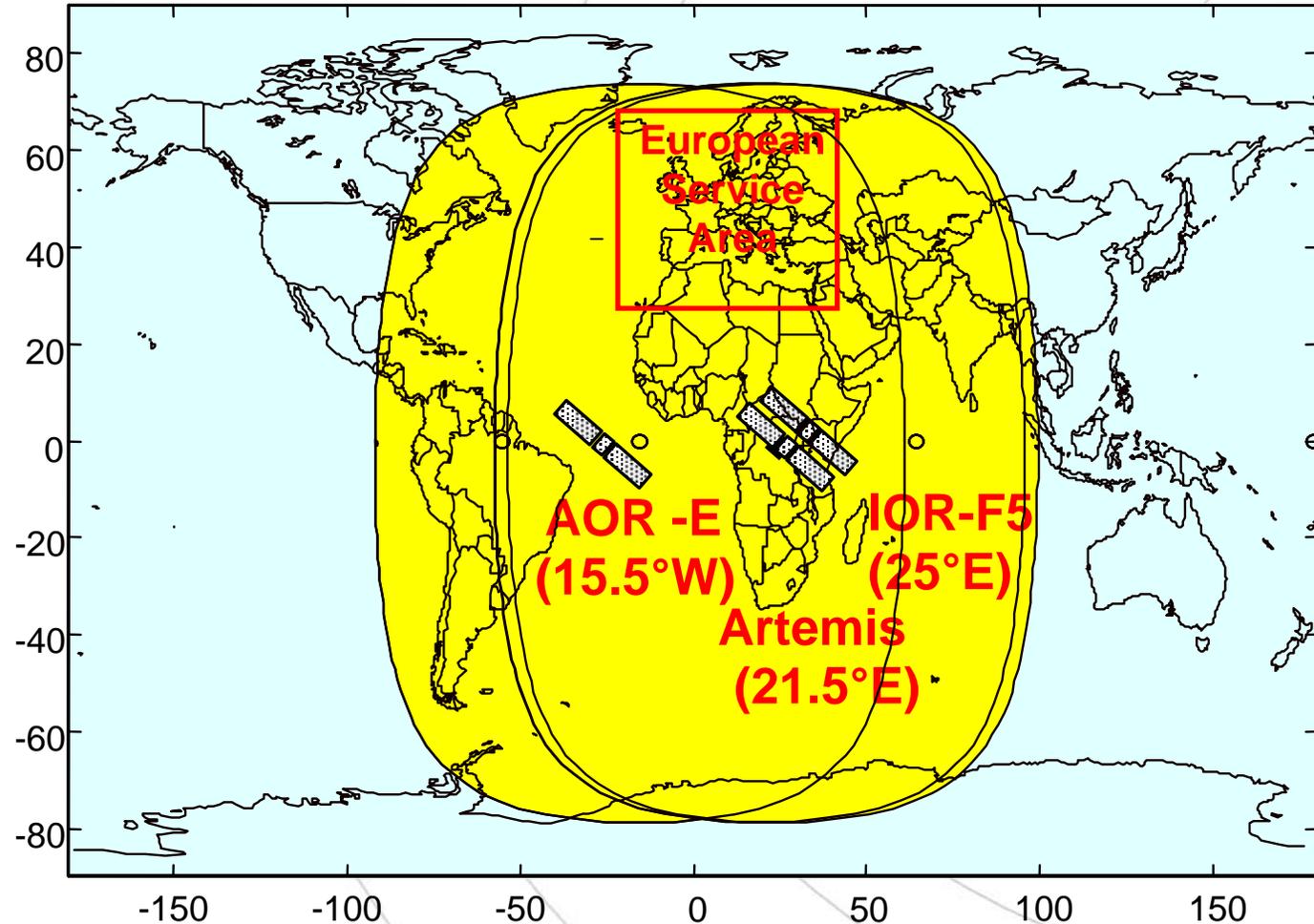
GALILEO is an initiative of the European Commission and ESA

EGNOS and Galileo are the European contributions to the global ICAO strategy on GNSS



EGNOS

- ▶ EGNOS is an augmentation of the GPS signals – i.e. the addition of correction data (upgrading of EGNOS to augment Galileo is under study)
- ▶ As such it offers a higher accuracy and reliability than GPS alone
- ▶ A key aspect for safety of life applications is integrity – i.e. a warning of system malfunction that will reach the user within 6 s
- ▶ Across Europe, 34 monitoring stations monitor the GPS constellation. A control centre collects this data and broadcasts the integrity message to users via geostationary satellites.



Africa's vicinity to Europe means that EGNOS coverage can be extended at marginal cost

- Lies within the footprint of the geostationary satellites
- Can make use of the European control centre for data processing and uploading to these satellites

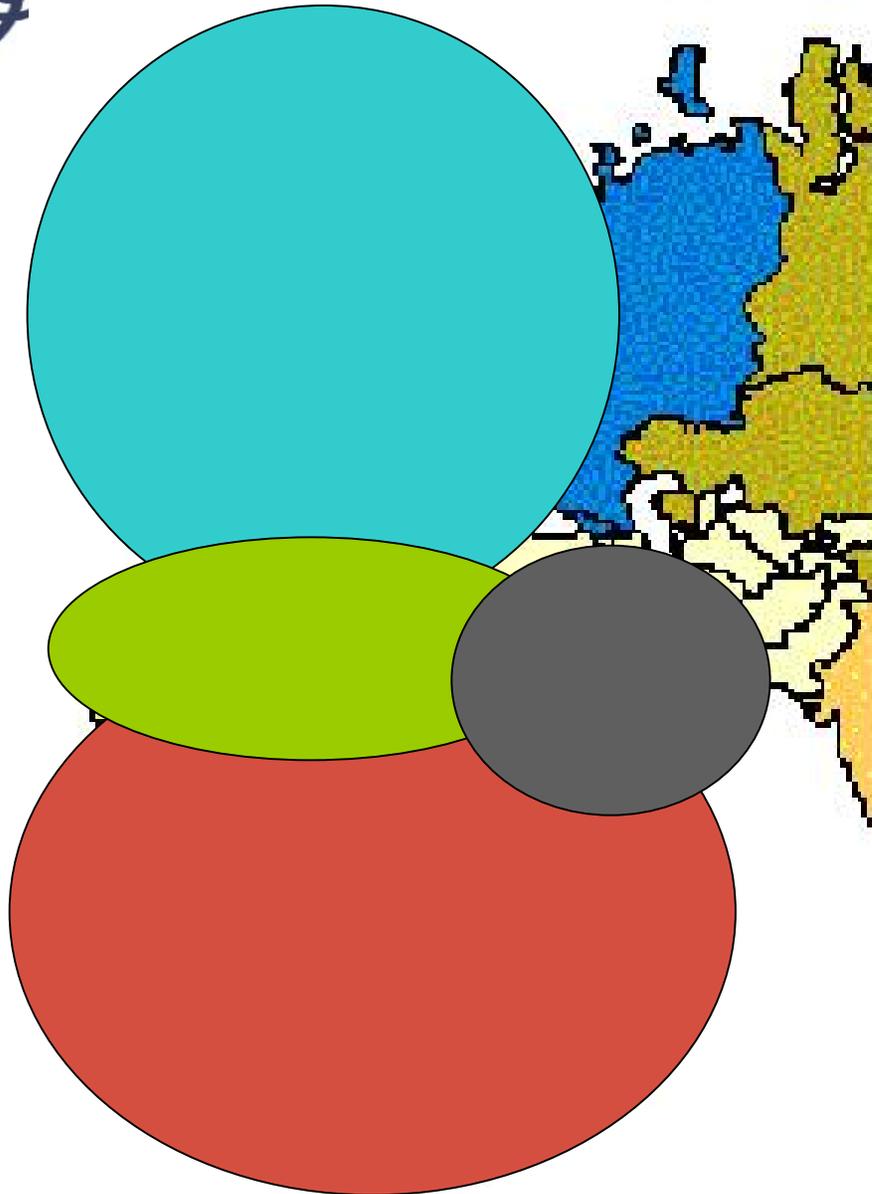


CO-OPERATION ON GNSS WITH AFRICA

- *Demonstrations already took place in co-operation with ASECNA for air navigation and SPOORNET for train control, using the EGNOS testbed in AFRICA*
- *Some other applications would also justify live demonstrations, in particular the provision of emergency messages through SBAS . A concept named ALIVE (Alert Interface Via EGNOS) is being promoted by ESA*



Co-operation between Europe and Africa on GNSS



○ Interlinked GNSS SBAS systems

- ✓ EGNOS over Europe
- ✓ Extension to MEDA region
- ✓ Regional hub in Middle East
- ✓ Inter-regional SBAS for AFI (ISA) for sub-Saharan Africa



Policy Context Co-operation between Europe and Africa on GNSS

- The policy context for the GNSS service implementation over Africa has developed taking into account three major elements:
 - ✓ International Civil Aviation Organisation (ICAO) GNSS policy
 - ✓ EU Development policy (Cotonou agreement) and the Euro-Mediterranean Partnership
 - ✓ European GNSS strategy
 - ✓ Need for a multimodal approach

- Africa's vicinity means that EGNOS coverage can be extended at marginal cost:
 - ✓ Within the footprint of the geostationary satellites
 - ✓ Use of the European control centre for data processing and uploading to these satellites



EGNOS and Galileo services for Aviation

Applications:

- ▶ En-route navigation
- ▶ Terminal Area navigation
- ▶ Approach and landing
- ▶ Support to Airports Surface Movement Guidance



ICAO Standards:

- ✓ EGNOS compliant with ICAO (International Civil Aviation Organisation) SARPS (Standards and Recommended Practices)
- ✓ Galileo ICAO SARPS under development



ICAO GNSS strategy for Africa

Through ICAO's AFI Planning and Implementation Regional Group (APIRG), the AFI States decided on a GNSS Regional Strategy in 2001 (at APIRG/13)

- ✓ based on a three phase implementation plan
- ✓ this was updated by the APIRG GNSS Implementation Task Force in 2005
- ✓ further supported by APIRG/15 (Sept 2005)

Includes completed EGNOS testbed trials

Assumes ISA implementation

Based on ISA and Galileo

ICAO AFI GNSS Strategy				
	Phase I		Phase II	Phase III
Time scale	2000 - 2005		2006 - 2011	2012 - 2017
Certification	Basic GNSS	Basic GNSS	from en route to APV-1	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



What ISA means for Africa

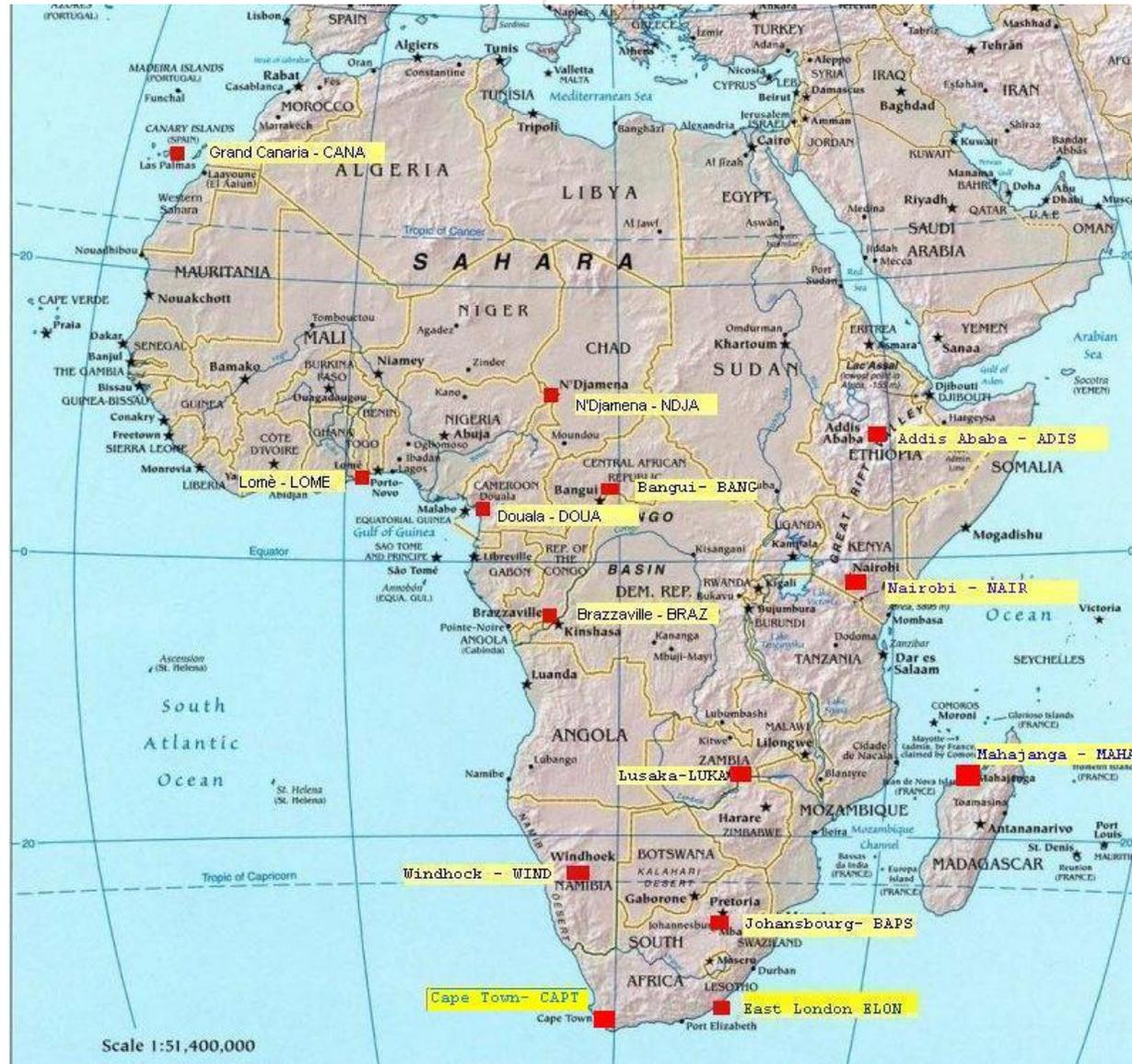
Main benefits for civil aviation

- ✓ Approach with vertical guidance replacing non-precision approaches at all airports
- ✓ Reliance on satellite-based navigation, reducing the cost and maintenance of ground-based navigation aids
- ✓ Improved harmonisation and safety across the AFI region.
- ✓ A reduction in the number of aircraft landing accidents on runways not currently equipped with operational instrument landing systems
- ✓ Cost savings through avoided diversions

Other benefits

- ✓ Strengthened regional economic integration and cooperation through the development of a Africa-wide institutional framework
- ✓ Increased safety in transport operations (also for rail and maritime) in a cost-effective way
- ✓ Possibility of implementing the ALIVE concept

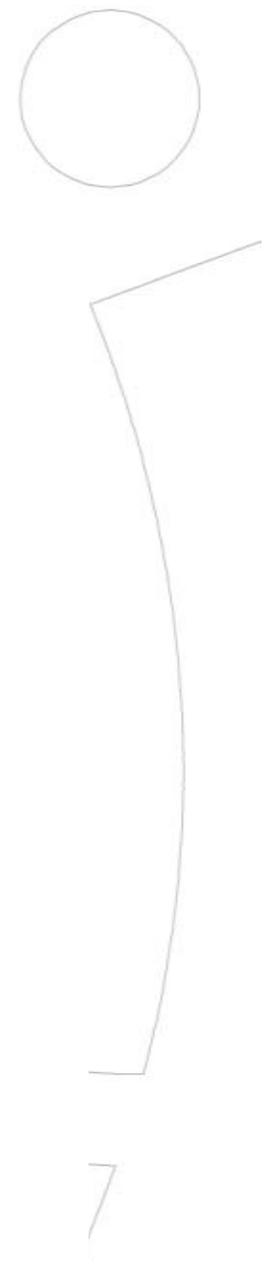
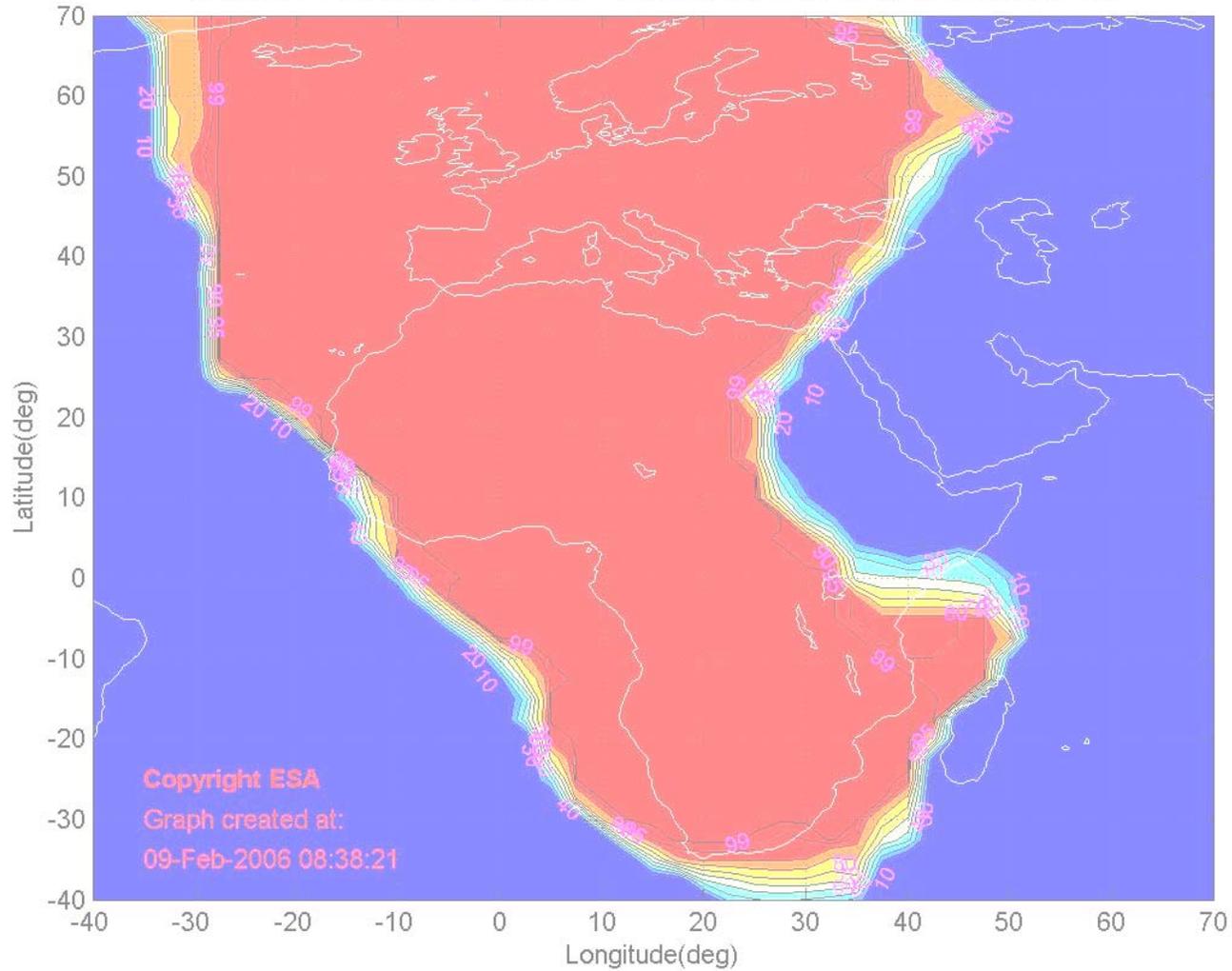
ESTB RIMS in Africa





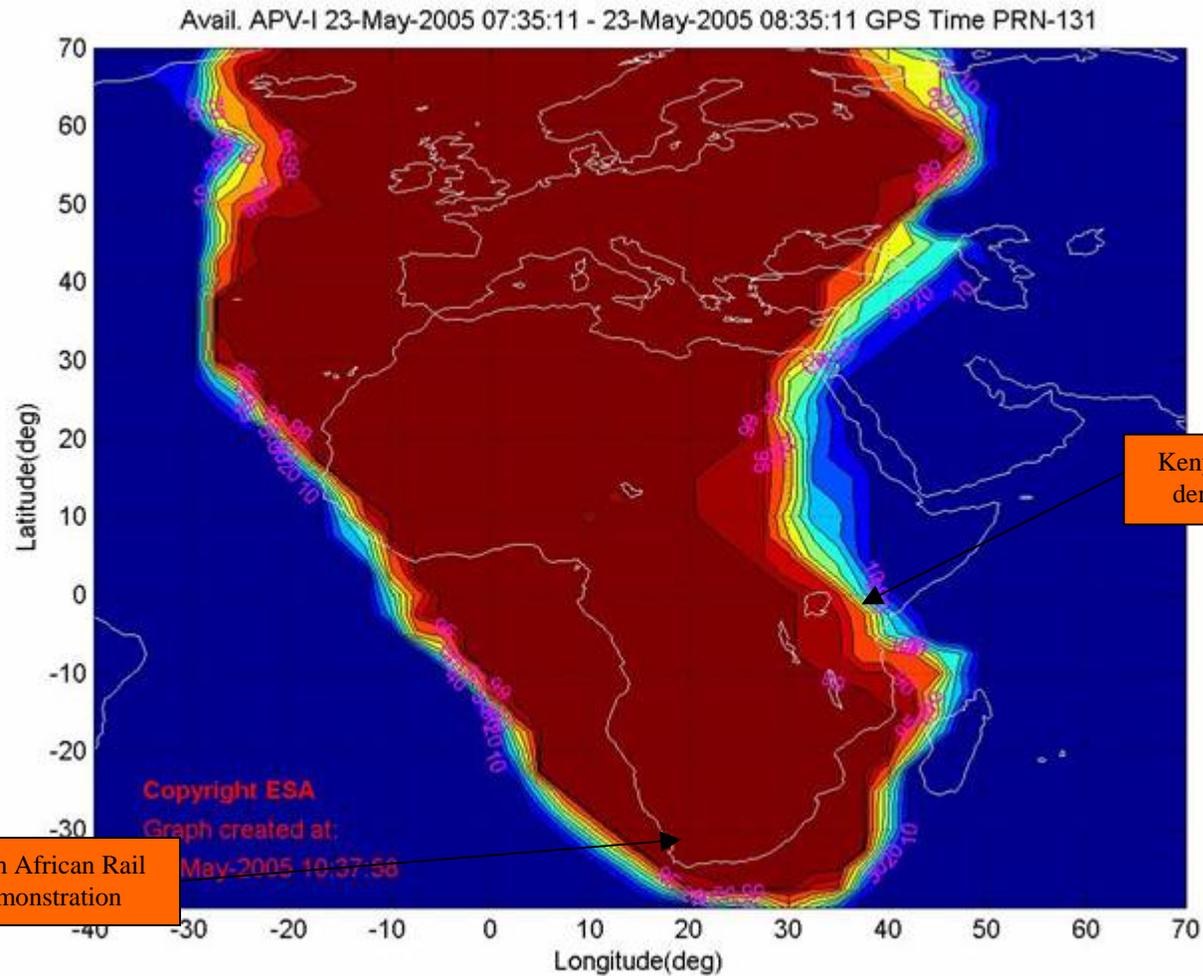
ESTB Coverage in Africa (9 Feb 2006)

Avail. APV-I 09-Feb-2006 06:35:24 - 09-Feb-2006 07:35:24 GPS Time PRN-120





EGNOS STB Coverage



South African Rail demonstration

Kenyan Aviation demonstration

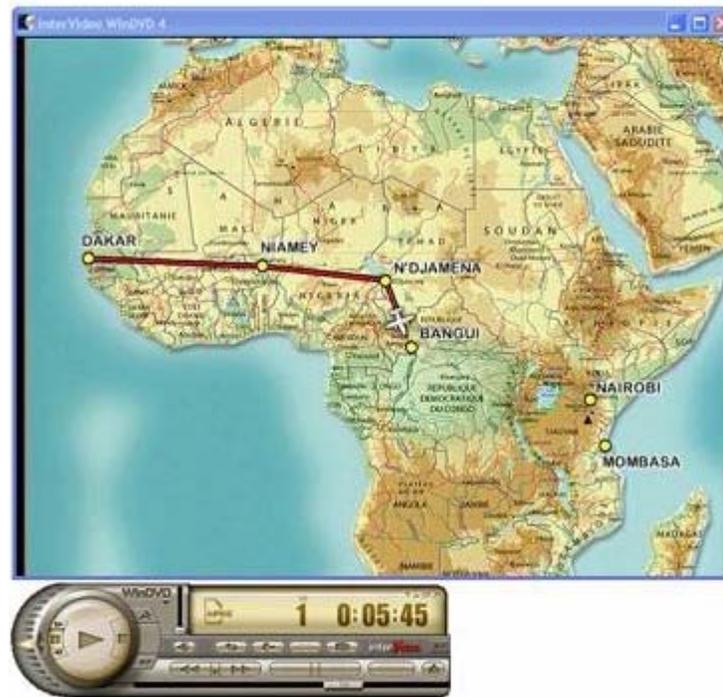


ASECNA demonstration

*Crossing Africa using EGNOS over one week
Demo day on May 19th 2005, in Nairobi (Kenya)*



Media examples



[Link to film](#)

AFRICA

An ATR 42 flew across the widest part of Africa—from Dakar, Senegal, to Mombasa, Kenya—in the most ambitious test to date using the European Geostationary Navigation Overlay Service (Egnos). Conducted by the European Space Agency and Agence Pour la Securite de la Navigation Aerienne en Afrique et a Madagascar, the 20-hr. flight used a Thales Avionics Egnos receiver to gather upgraded GPS data through a roof-mounted antenna. The flight demonstrated the Egnos extension over Africa, relying on the Egnos testbed signal broadcast through Inmarsat IOR-E.

Aviation Week dated May 30th 2005



Weblinks

<http://www.satexpo.it/en/news-new.php/9?c=55715&f=n>

<http://www.talksatellite.com/EMEAedd139.htm>

http://www.eurekalert.org/pub_releases/2005-05/esa-caw051305.php

<http://www.eurekalert.org/features/kids/2005-05/esa-foa051705.php>

http://www.rin.org.uk/pooled/articles/BF_NEWSART/view.asp?Q=BF_NEWSART_159655

http://www.globalpositioningsystems.co.uk/news_article.php?article_id=244&PHPSESSID=7925b3223d987ff3fddcf081c8ba6bef

[http://science.monstersandcritics.com/news/article_1002704.php/First trans-African flight with EGNOS a success](http://science.monstersandcritics.com/news/article_1002704.php/First_trans-African_flight_with_EGNOS_a_success)

<http://www.bnsc.gov.uk/default.aspx?nid=5290>

<http://www.spacedaily.com/news/gps-euro-05e.html>

<http://www.spacedaily.com/news/gps-euro-05h.html>

http://www.innovations-report.de/html/berichte/verkehr_logistik/bericht-16795.html

http://www.gisdevelopment.net/news/viewn.asp?id=GIS:N_uljewsmkbc

<http://www.blackanthem.com/scitech/2005051307.html>

http://www.spacenewsfeed.co.uk/2005/15May2005_10.html

<http://www.mercatorpark.de/unternehmen/?company=43&content=full&article=315&mpsid=b42829aa336498febc832a44570bcd5>

<http://www.eu-digest.com/2005/05/esa-crossing-africa-with-egnos.html>

<http://www.isdefe.es/webisdefe.nsf/0/7513c1909abcae86c125700d0028beb3?OpenDocument>

<http://eu.spaceref.com/news/viewpr.html?pid=16959>



African weblinks

West Africa News (link to Space Daily)

<http://cgi.wn.com/?SearchString=EGNOS&language=Any+Language&template=westafricanews%2Findex.txt&action=search&first=0>

Madagascar News (link to Space Daily)

<http://cgi.wn.com/?template=worldnews%2Fsearch.txt&action=search&first=0&SearchString=EGNOS>

Fly South

<http://www.flysouth.co.za/index.htm>

Flights Cameroon (link to Science daily)

<http://www.cyberhoods.com/country/info.asp-guide-Flights-state-Cameroon>

Tanzania Media (Space Daily)

<http://cgi.wn.com/?SearchString=EGNOS&language=Any+Language&template=tanzaniamedia%2Findex.txt&action=search&first=0>

Africa Time (Congo in French)

http://www.africatime.com/maroc/nouv_pana.asp?no_nouvelle=190506&no_categorie=3

Kenya Times & Kenya Industry (powered by World News)

<http://archive.wn.com/2005/05/16/1400/kenyatimes/>



EGNOS Testbed demonstrations

A demonstration of the use of EGNOS for advanced rail traffic management, especially on low-density rail lines

- Took place in Gauteng, South Africa on 24 November 2005
- Undertaken with collaboration of Spoornet, South Africa



The demo highlighted the capabilities that will be provided by the planned operational extension of EGNOS for Africa (ISA), and gave the participants a glimpse at future technologies in rail control systems



Objectives and audience

- *To demonstrate use of EGNOS for advanced rail traffic management, especially on low-density rail lines*
- *EGNOS-based positioning technology can provide performances powerful enough to allow self-standing train location determination, without the need for trackside infrastructure.*
- *Undertaken with collaboration of Spoornet, South Africa*
- *Involved the Technology Division of Spoornet, but also aimed at other railway and port operators in Southern Africa*
- *First demonstration of its kind in South Africa*



INTEGRAL Overview

- *INTEGRAL is a prototype mobile GPS/EGNOS telematics system*
- *Provides train position, velocity and heading for rail applications*
- *Developed by Keyser-Threde, Bombardier and IFEN*
- *Aimed mainly at safety-critical (train control and signalling), but also for non-safety critical applications (passenger info and fleet management)*



INTEGRAL Overview

Main Features of Positioning Components

GNSS I

- high absolute accuracy, signal integrity enhanced by EGNOS
- signal obscuration, multi-path

Odometer

- high availability, good relative accuracy
- relative measurement, drift, slip/slide

Inertial Sensor

- high availability, contact-less measurement
- relative measurement, drift

Route Map

- base for coordinates transformation, reference for integrity monitoring
- not standardized



GPS



Odometer



Route Map



Inertial Sensor



Position/Velocity



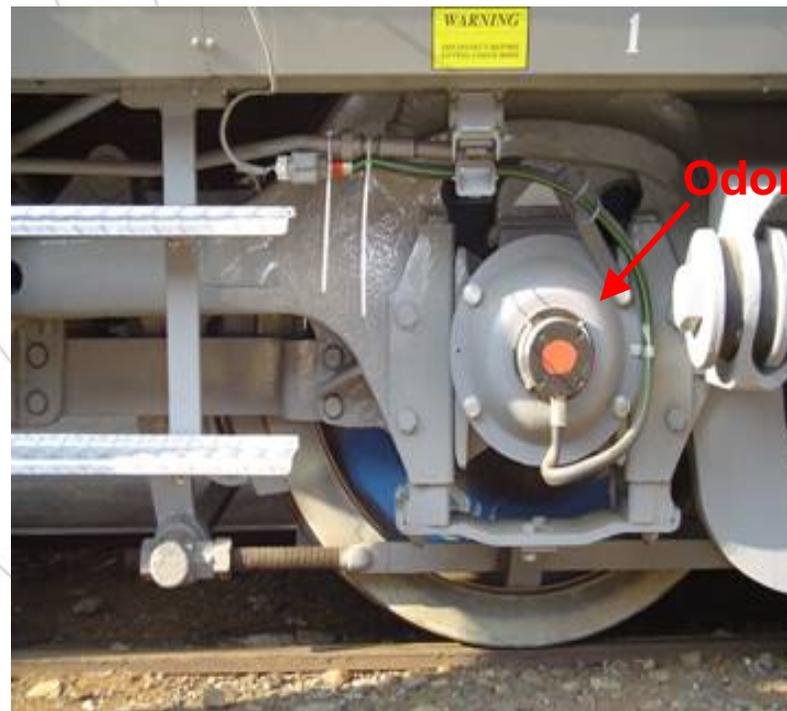
Demonstration Location

- *Demonstration Site at the National Exhibition Centre Sports Facilities (NASREC) Station, near Johannesburg, South Africa.*
- *A low priority separated track, i.e. without regular traffic and so no disruption.*
- *Preceded by presentations at a Golf Club near the Station.*





Demonstration Unit Interfaces



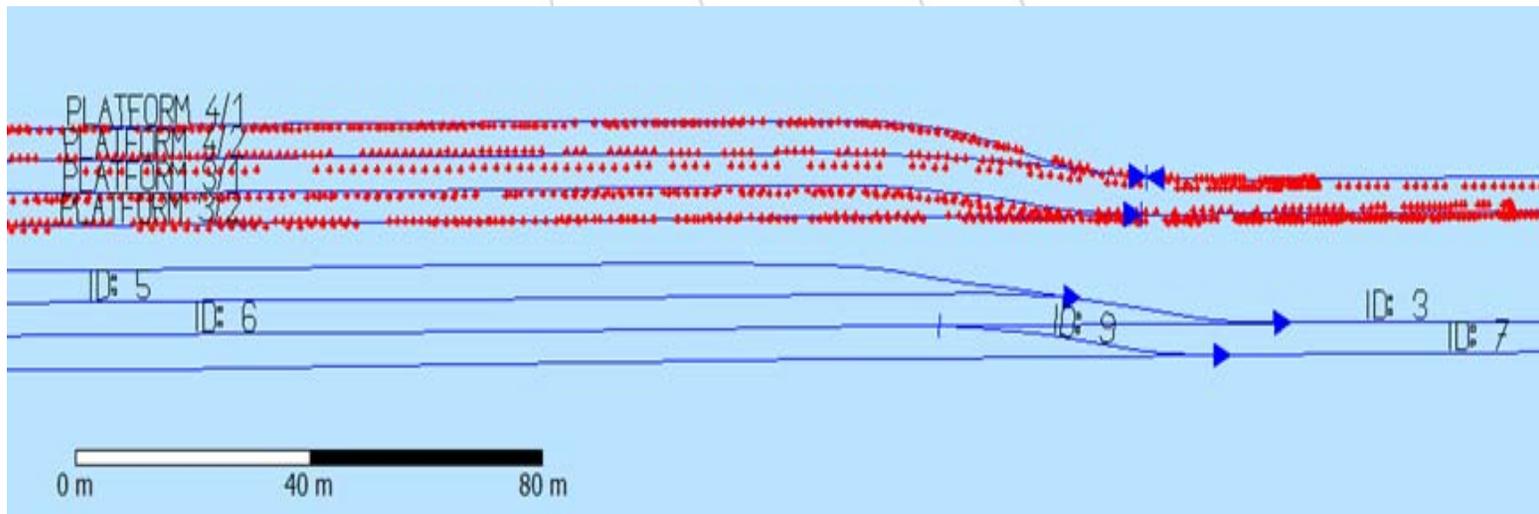


Participation

- *Around 40 persons attended the demonstration with representation from*
 - *Spoornet*
 - *Metrorail (commuter rail company)*
 - *E-Freight (logistics company)*
 - *Alstrom ZA*
 - *Swaziland Railways*
 - *Southern African Rail Association*
 - *National Ports Authority, ZA*
 - *Air Traffic Navigation Services (ATNS) company, South Africa.*

Demonstration Results

- *During the runs, all tracks were correctly detect after points (switches).*
- *The trace of GPS/EGNOS positioning to the respective tracks is clearly shown in the following figure:*



Note: Challenging track with many points (switches) as the tracks split to the west (left).



Conclusions

- *The INTEGRAIL ZA rail demonstration of 24 November 2005 went extremely well and attendance was more than expected.*
- *The selected train scenario showed the benefits of EGNOS based navigation for railway traffic management and signaling regarding position/velocity determination.*
- *Successful demonstration on the complex NASREC rail line which showed the ability of INTEGRAIL to clearly distinguish between the many sets of parallel tracks. This is particularly challenging for safety related applications.*
- *An article of the demonstration appeared in the Jan 06 issue of "Inside GNSS" magazine and on ESA, KT and ESSP web sites.*

The demo highlighted the capabilities that will be provided by the planned operational extension of EGNOS for Africa (ISA), and gave the participants a glimpse at future technologies in rail control systems



Lessons learnt

- *Pre-testing in location of the INTEGRAIL system was very demanding – two trips were needed to solve technical problems*
- *This rail demo has opened up opportunities in other transport sectors – NPA requested further information on the use of EGNOS in the maritime domain*
- *Complemented by the Rail business case study also undertaken for ZA and involving Spoornt*



European Geostationary Navigation Overlay Service

Provision of emergency communication messages through SBAS: The ESA ALIVE proposal

*Prepared by: J.Ventura – Traveset, A.R. Marthur, European Space Agency,
Hans-Peter Plag, Univ. of Nevada, USA*



European Space Agency

Disasters

- *Disasters could be of various types*

- *Natural disasters:*

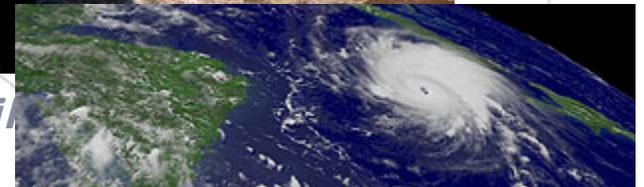
- *earthquakes, volcanic eruptions, tsunamis etc.*
 - *Land slides, rock avalanches, etc.*
 - *Tornadoes, hurricanes, wild fires etc.*

- *Biological disasters:*

- *Plagues, epidemics etc.*

- *Technological disasters:*

- *War related, terrorism, chemical and oil*





What is ALIVE?

- *ALIVE is the **AL**ert **I**nterface **V**ia **E**GNOS for Disaster Prevention and Mitigation.*
- *It acts as an interface between the various Disaster Management Centers and the users in distress.*
- *This is motivated by the obvious principle that disaster prevention, mitigation and preparedness are better than mere disaster response.*
- *It provides the users in distress with useful information about the possible oncoming of the calamity, ways to avoid it, various rescue measures to be taken etc.*

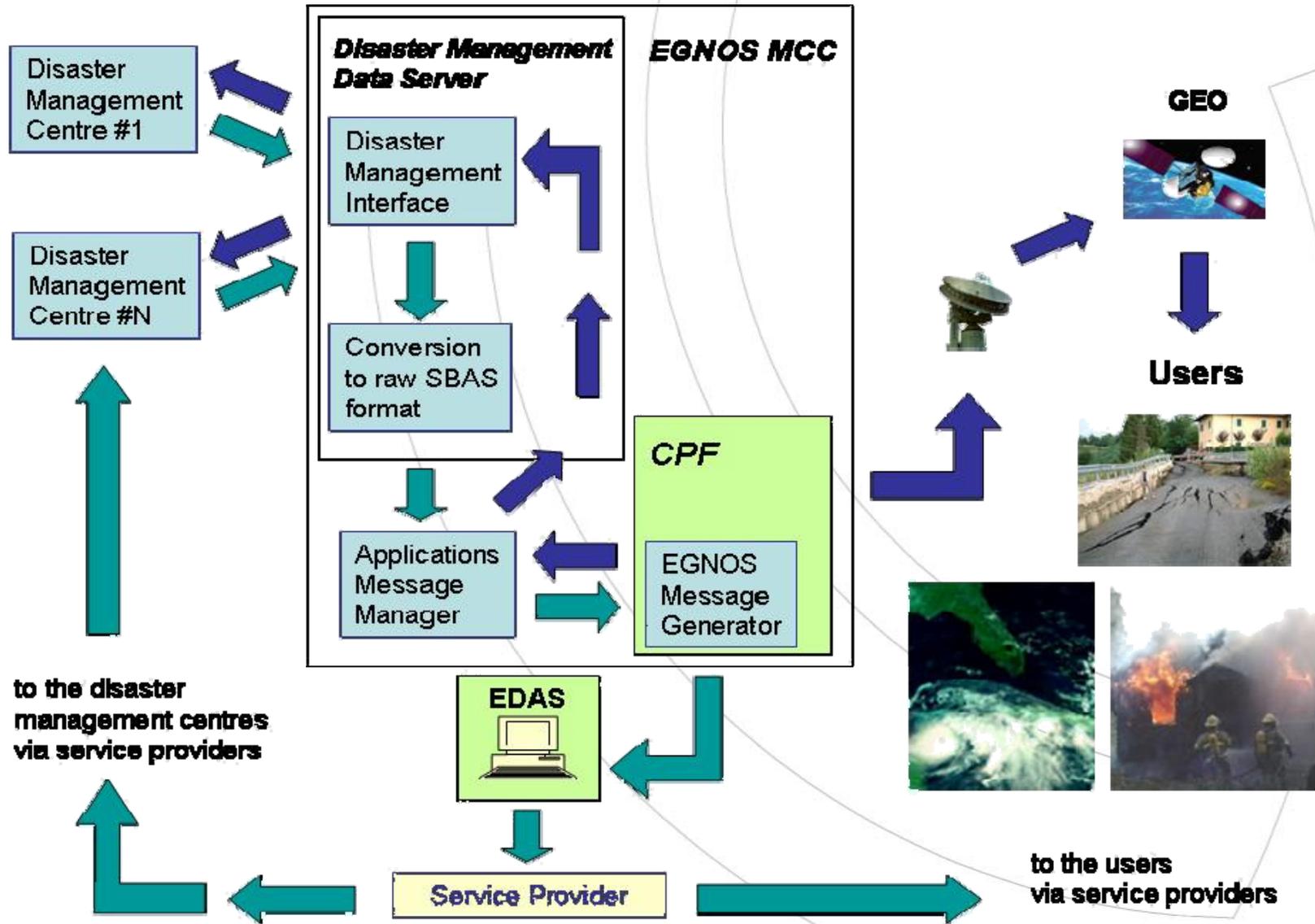


Why SBAS may help?

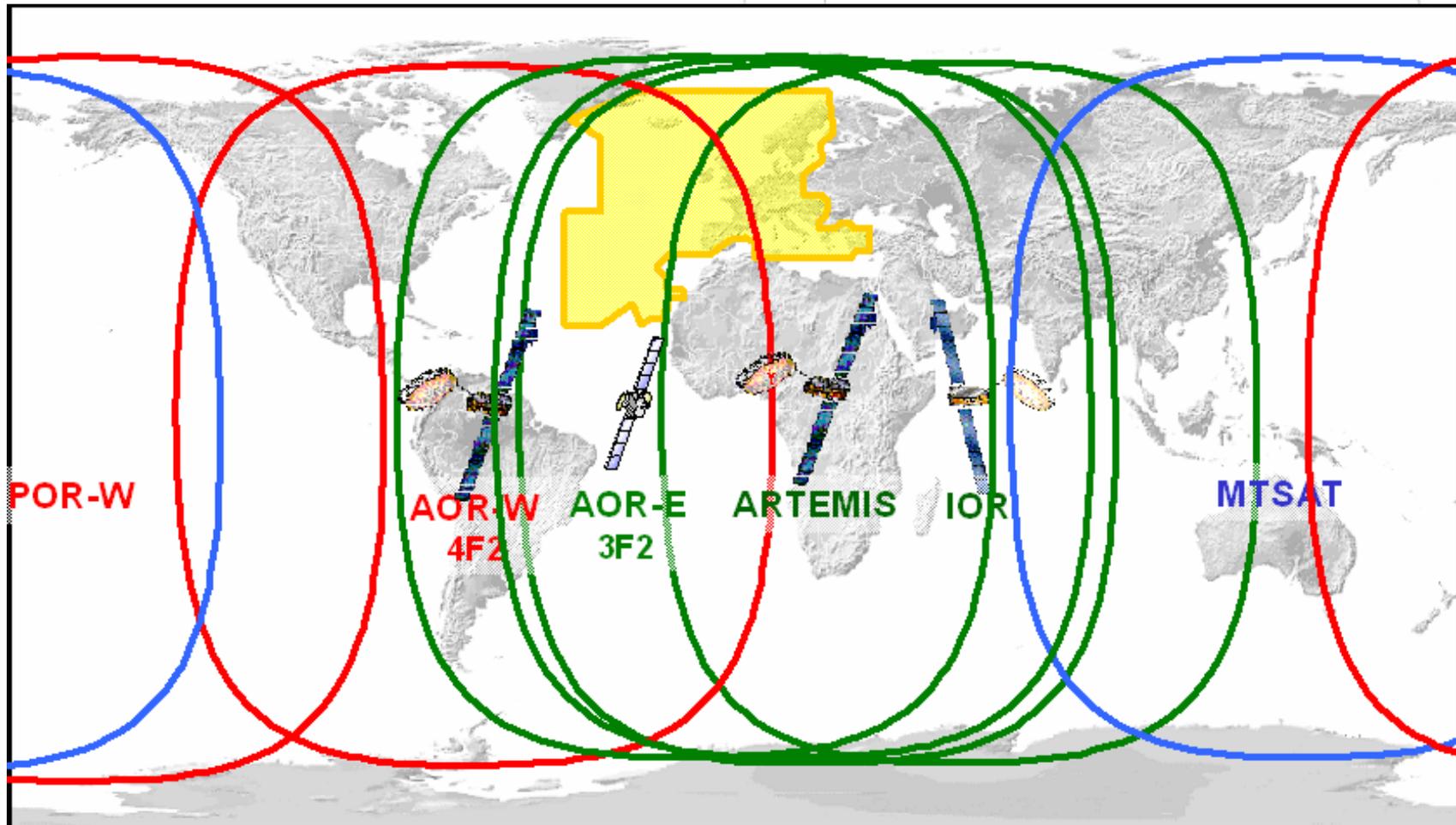
- **SBAS receivers get alert message and also have their position simultaneously.** Only users concerned need to act;
- **Unique worldwide standard:** All SBAS receivers are identical;
- **SBAS operated with all guarantees:** Safety of Life, Institutional control, 24hour non Stop; confirmation message is broadcast in time.
- Can be implemented in very short term: **pragmatic approach;**
- **Works in places with no infrastructure** or where infrastructure is not operational
- **Potential Global coverage** with all other SBAS;
- **Excellent feedback** received from concerned International related organizations. Real interest expressed. A possible good answer to a well know problem.



ALIVE Architectural Concept



World Wide Coverage





Implementation Path

- *The New Service Message has to be standardised.*
- *The receiver units capable of receiving these messages, via SBAS messages, have to be developed.*
- *The Interface of the SBAS ground segment with the disaster management has to be developed.*
- *Look for other SBAS interest aiming at making a global proposal*
- *Implement these services in SBASs.*

Summary

- *Disaster prevention, mitigation and preparedness are better than disaster response.*
 - *SBAS System can provide message broadcast capability as a means for disaster warnings*
- *ESA defined the ALIVE concept (Alert Interface Via EGNOS)*
 - *Concept applicable also for other critical communication messages (SAR Return link, Information to Avionic users, etc).*
- *ALIVE concept being promoted at relevant European and United Nations agencies, relevant NGOs and EC levels*
 - *Very positive welcome to be continued*





CONCLUSIONS

- *ESTB enabled the demonstration of SBAS applications in Africa , in particular air navigation and train control.*
- *Other demonstrations of SBAS applications would be useful: ALIVE, maritime..*
- *ESTB operations are in the process of being stopped*
- *Those willing to use ESTB for further live trials and plan the introduction of SBAS in Africa should expressed their interest urgently.ESA could possibly help obtaining financial support from relevant EU institutions.*