

Extension of EGNOS to the development of GNSS services in Africa

CGSIC meeting

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Vincent Gabaglio

Application section, GISS



European
Commission



European Concerns on GPS

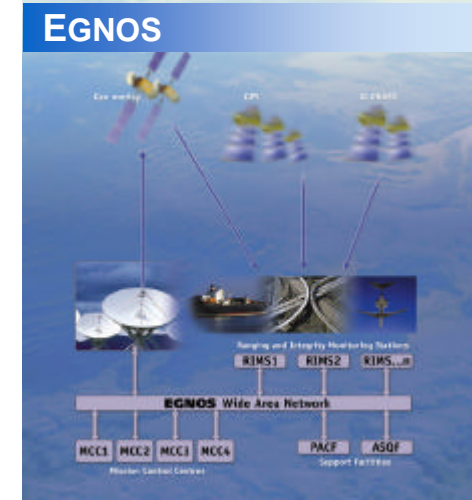
- For many applications, user requirements are met only partially:
 - Availability
 - Accuracy
 - Integrity
 - Continuity
- GPS/GLONASS not under full civil control
 - Liability in case of System failure (Integrity?)
 - Concern for certification of GPS & GLONASS equipment



The European Strategy

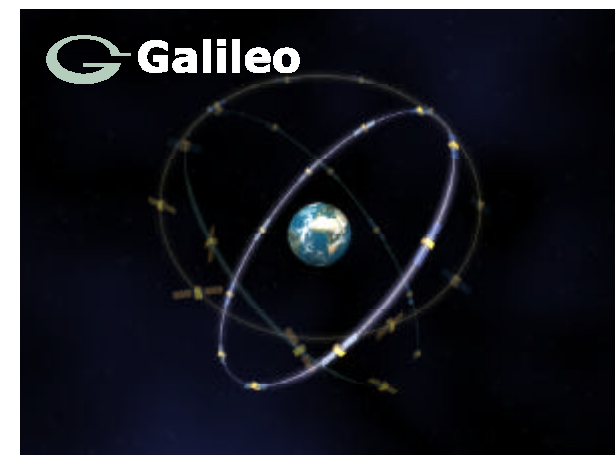
Step 1: EGNOS to provide civil complement to military GPS (and GLONASS), into operations in 2004

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

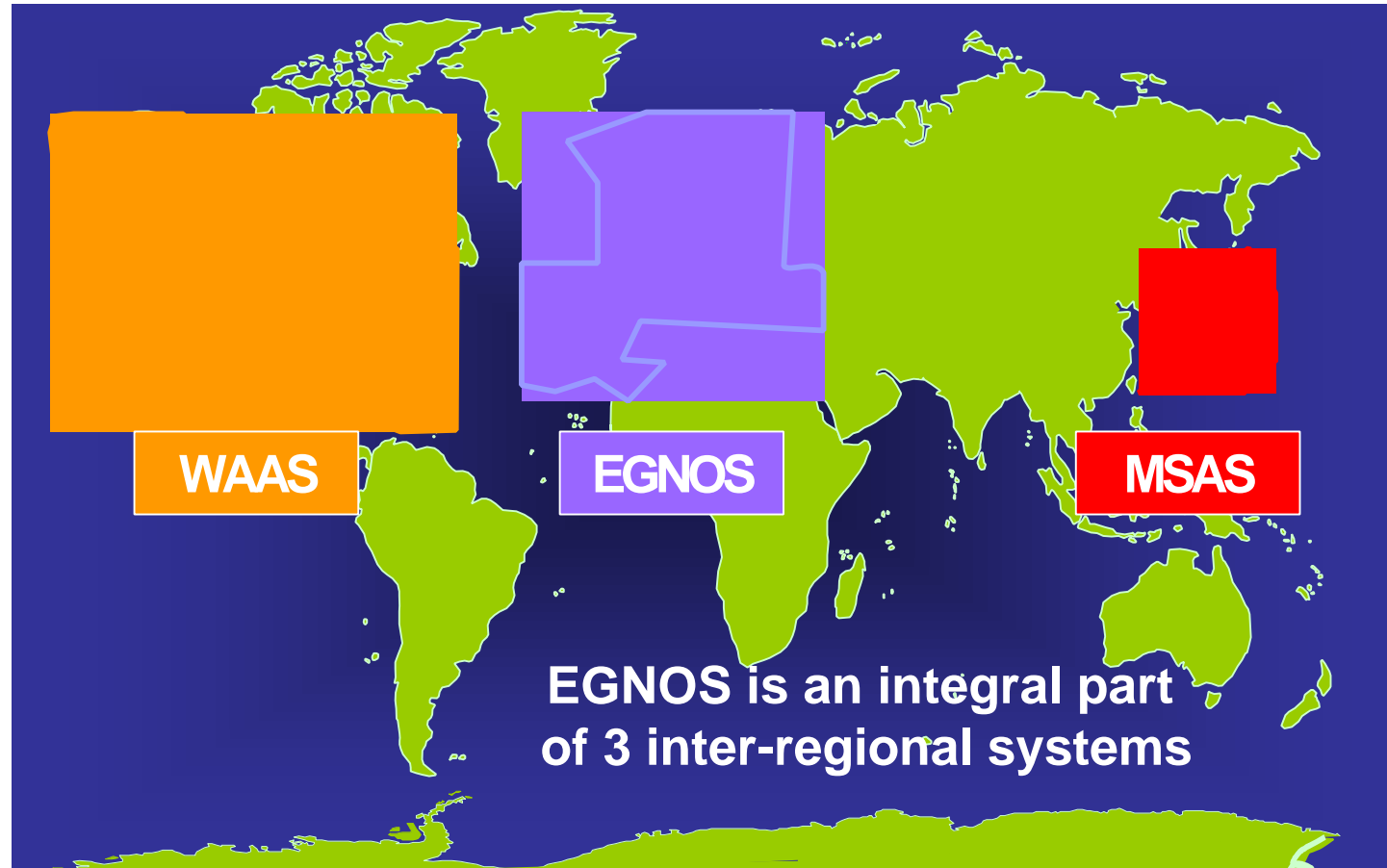


Step 2: GALILEO is to achieve European sovereignty through dedicated system under civil control: into operations by 2008

GALILEO is an initiative of the European Commission and ESA



SBAS system: Interoperability requirement



EGNOS Functionalities

- **RANGING: GPS-like pseudoranges**
- **INTEGRITY: broadcast of GPS Integrity messages**
- **WIDE AREA DIFFERENTIAL: broadcast of GPS differential corrections valid over full Service Area**



Multimodal Performance Objectives

Civil Aviation:

- Primary means of navigation down to Precision Approach with Vertical Accuracy of 7.7 meters

Maritime:

- Specified to be better than 4 meters in European Coastal waters
- Expected performance around 1 meter horizontal accuracy

Land Applications:

- Specified to be better than 4 meters in continental Europe
- Expected performance around 1 meter horizontal accuracy



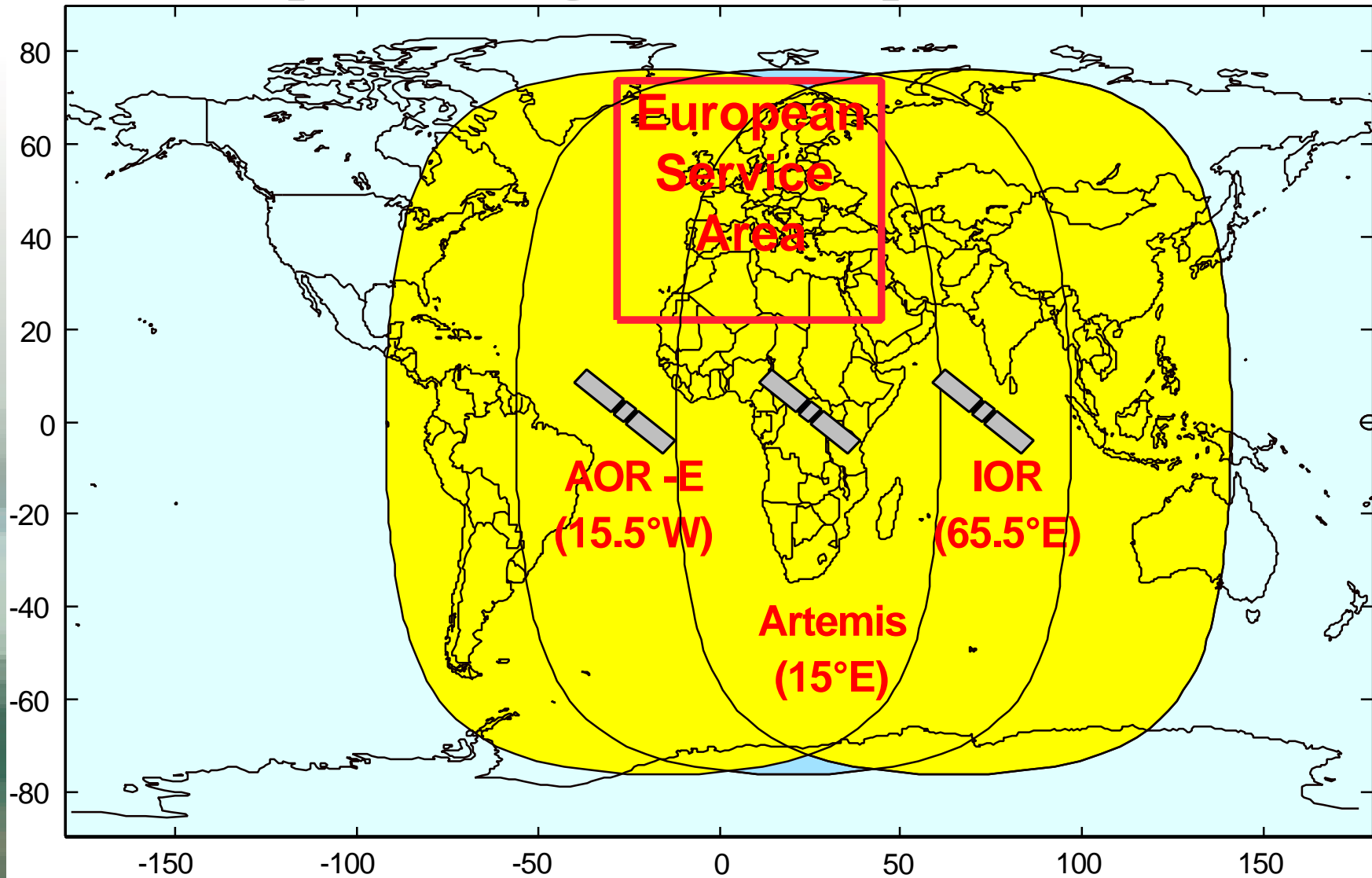
Benefits to Civil Aviation

- By means of EGNOS, Precision Approach Operations (APV 2 and APV 1) achievable on every runway
- Thanks to Integrity of EGNOS vertical guidance, better protection against CFIT accidents
- Thanks to SBAS APV1 performance, suppression of all Non Precision Approach (NPA) procedures
- New SBAS APV1 service opening the door to new feeder routes between secondary and international airports
- New APV1 procedures suppressing the need of CAT-1 service for many runways



EGNOS GEO Satellites

Triple Coverage over Europe and Africa



European
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European GNSS Cooperation with Africa

- **Provision of GNSS is a specific objective in the transport policy strategy of the EU-ACP Partnership Agreement (Cotonou), covering EGNOS/GALILEO**
- **Various studies have been financed by EC on the benefits of developing GNSS-based services in Africa**
- **EC and ESA have started to support the AFI GNSS test bed implementation according to the ICAO plan**
- **EC is assessing request from AFCAC to finance an AFI-wide pre-operational GNSS SBAS system**
- **EC and ESA are open to further support all phases of ICAO AFI GNSS strategy, including development of the African GALILEO regional component**



EGNOS for Africa

- The ICAO Africa and Indian Ocean (AFI) Regional Implementation Plan includes a GNSS strategy plan
- The Plan adopted by AFI States contains:
 - An initial phase (2002-2005) for the implementation of an AFI GNSS test bed as an extension of the EGNOS test bed
 - The conditional deployment of an operational system relying upon EGNOS components, in order to meet APV-I capabilities (Non Precision Approach with Vertical Guidance) before 2008
 - The long term development of GNSS-based CAT-1 capabilities (Precision Approach), relying also on the availability of a second satellite constellation (e.g. GALILEO)



Cost Benefit Analyses

- Two ICAO CBA studies related to the introduction of GNSS in AFI carried out with EC support
- Quantitative/ qualitative benefits and cost saving for the region identified (safety, maintenance, operations) in all transport sector, with focus on aviation
- Eurocontrol has detailed and confirmed the positive outcome through an independent internal study
- The current PWC/ESYS CBA for EGNOS is also identifying and quantifying benefits for Africa in other application sectors besides aviation



Current PWC-ESYS CBA study

Identified Benefits from EGNOS for Africa

- **Maritime:** increased efficiency in port operations resulting from GNSS due to the reliability of the survey information
- **Rail:** fail-safe satellite positioning systems are being developed for trains, to be used as train control system for Low Density Traffic Lines. The primary benefit is that the cost of trackside equipment is substantially reduced.
- **Road:** Decrease distance travelled (decrease of fuel costs); Decrease time of journey; Increase safety for users.
- **Other Professional users:** civil engineering, survey, geodesy...



EGNOS initiatives within ICAO/AFI

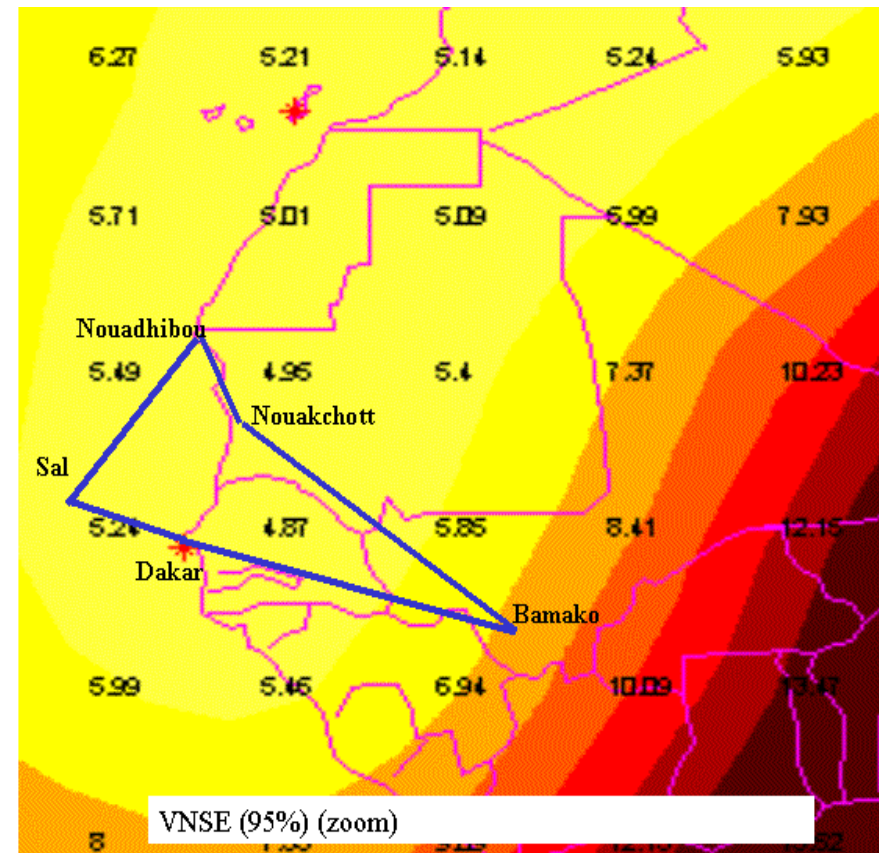
- RIMS station installed in Dakar → flight trials in first quarter of 2003
- Test Bed follow-on with 4 mobile RIMS in the whole AFI region, according to ICAO plan (2003-2004)
- Pre-operational SBAS Test Bed → request for funds from AFCAC under assessment at EC
- AFI long term strategy also compatible with GALILEO regional augmentations



Initial AFI trials

Dakar – February 2003

- ASECNA, ESA, EC, Eurocontrol, DGAC and AENA collaboration:
- Successful installation of a EGNOS test reference station in Dakar (July 2002)
- Carrying out trials to evaluate the performance of the EGNOS signal over West Africa
- Performing flight demo at five airports, using a AT42 test aircraft equipped with a EGNOS test receiver



EGNOS Trial in Dakar

- ASECNA airplane is now EGNOS equipped (receivers and guidance)
- Tests of the equipment have been made in Bordeaux (18-22 November)
- Demonstration is planned in Dakar at beginning of February
- Tests in other airport are planned during February and March.



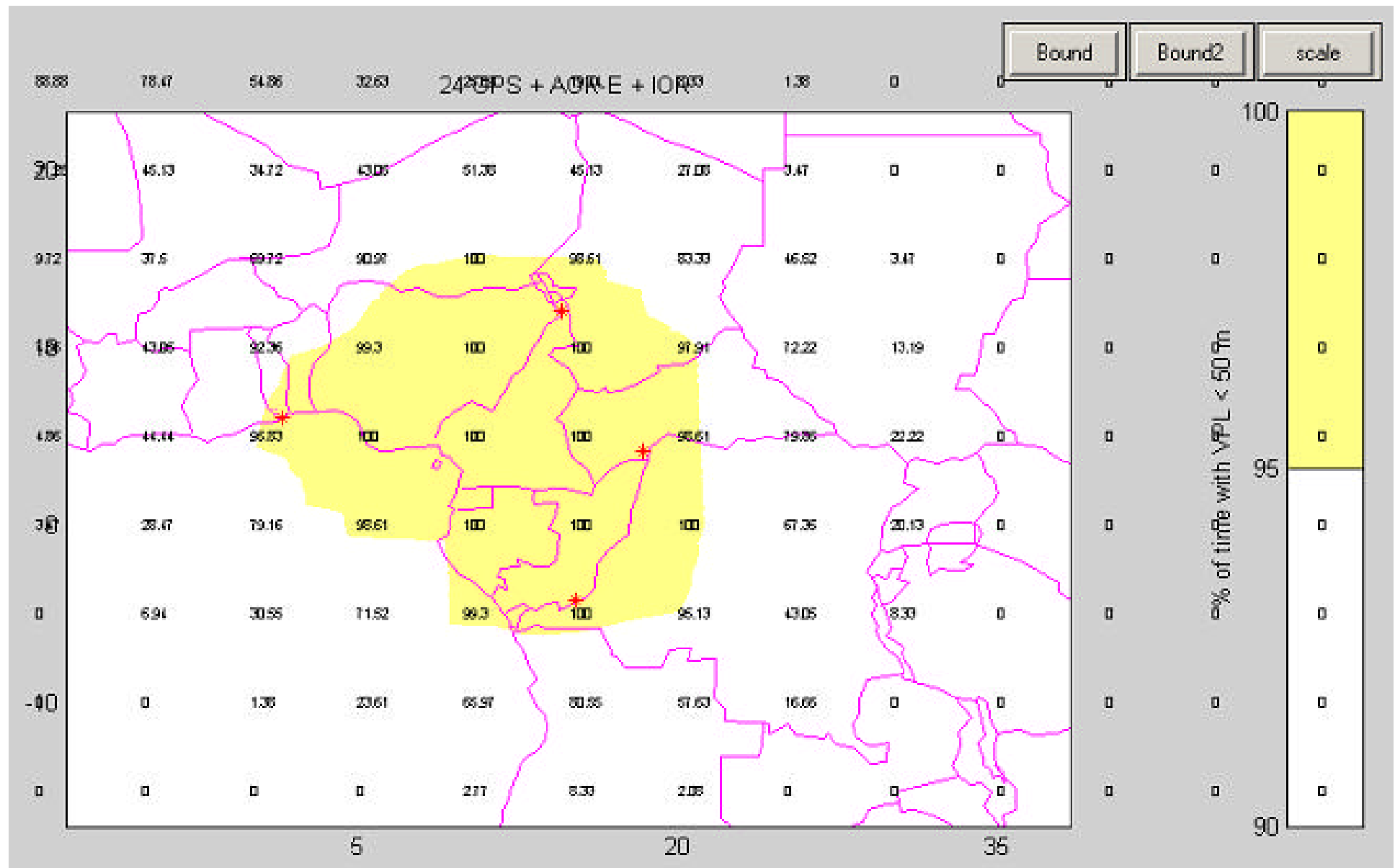
Next step:

AFI Test Bed in Central Africa

- Implementation of a Test Bed in central Africa, in line with the ICAO Strategy (Phase I).
- 4 RIMS (owned by European Commission and ENAV) will be installed by ESA and ASECNA in:
 - Bangui
 - N'djamena
 - Brazzaville
 - Lomé
- Technical cooperation agreement between European partners and ASECNA.
- Flight test will be performed in the area, with demonstration in Yaoundé



First simulation result



Other EGNOS initiatives within ICAO

- **CAR/SAM:**

- Three mobile ESTB RIMS will be deployed in the Caribbean area (first half of 2003)
- European support to training and elaboration of GNSS regional plan (ICAO – GREPECAS Framework)

- **MID:**

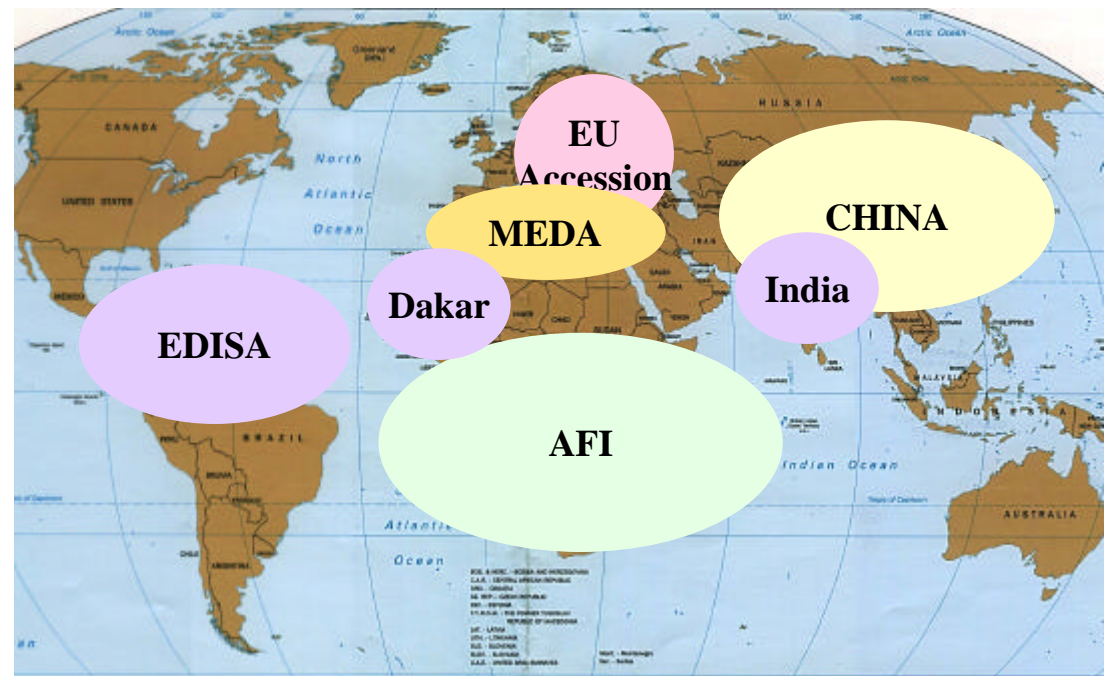
- Cairo PA flight trials, Oct. 2002 → portable RIMS stations installed by ENAV(Italy) in Cairo, Bahrein, Jeddah
- Related Planned Activities in the Mediterranean:
 - » Implementation of MEDA GNSS training center
 - » Demo/Trials for other GNSS applications



International co-operation initiatives

Planned EGNOS test bed trials:

- EU Accession Countries
- MEDA
- EDISA
- AFI Test Bed
- Dakar
- Chinese Test Bed
- India



Conclusions

- Test bed trials have started in Africa in 2002:
 - Dakar Station (July)
 - Cairo trials (October)
- SBAS APV-1 procedures need to be timely considered and developed for the whole AFI region
- Implementation of an EGNOS Test Bed in Central Africa is planned for first part of 2003
- Implementation in other region (zone B and C) is under consolidation.
- All the initiative are in line with the ICAO Regional plan.
- EGNOS in Africa will also be beneficial for other users community (maritime, rail, ...)



**For more information,
please visit the following Web Sites:**



www.galileo-pgm.org

www.esa.int/navigation

Back-up slides



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Aviation Performance Requirements

	Accuracy (H) 95%	Accuracy (V) 95%	Integrity	Time to alert	Continuity	Availability	Associated RNP type(s)
En-route	2.0 NM	N/A	$1 \cdot 10^{-7}/h$	5 min.	$1 \cdot 10^{-4}/h$ to $1 \cdot 10^{-8}/h$	0.99 to 0.99999	20 to 10
En-route, Terminal	0.4 NM	N/A	$1 \cdot 10^{-7}/h$	15 s	$1 \cdot 10^{-4}/h$ to $1 \cdot 10^{-8}/h$	0.999 to 0.99999	5 to 1
Initial approach, Non-precision approach, Departure	220 m	N/A	$1 \cdot 10^{-7}/h$	10 s	$1 \cdot 10^{-4}/h$ to $1 \cdot 10^{-8}/h$	0.99 to 0.99999	0.5 to 0.3
Instrument approach with vertical guidance APV-1	220 m	20 m	$1 \cdot 2 \cdot 10^{-7}$ per approach	10 s	$1 \cdot 8 \cdot 10^{-6}$ in any 15 s	0.99 to 0.99999	0.3/125
APV -2 and CAT I Precision approach	16.0 m	7.7 m to 4.0 m	$1 \cdot 2 \cdot 10^{-7}$ per approach	6 s	$1 \cdot 8 \cdot 10^{-6}$ in any 15 s	0.99 to 0.99999	0.03/50 to 0.02/40



Architecture

