EGNOS SYSTEM TEST BED

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Outline

- Introduction

- ESTB programmatic and main highlights

- ESTB-MTB system architecture overview

- ESTB Operations Overview
    - Organization
    - ESTB SIS availability

- ESTB Expansion concept

- Performances monitoring: Integrity, Accuracy

- Conclusions

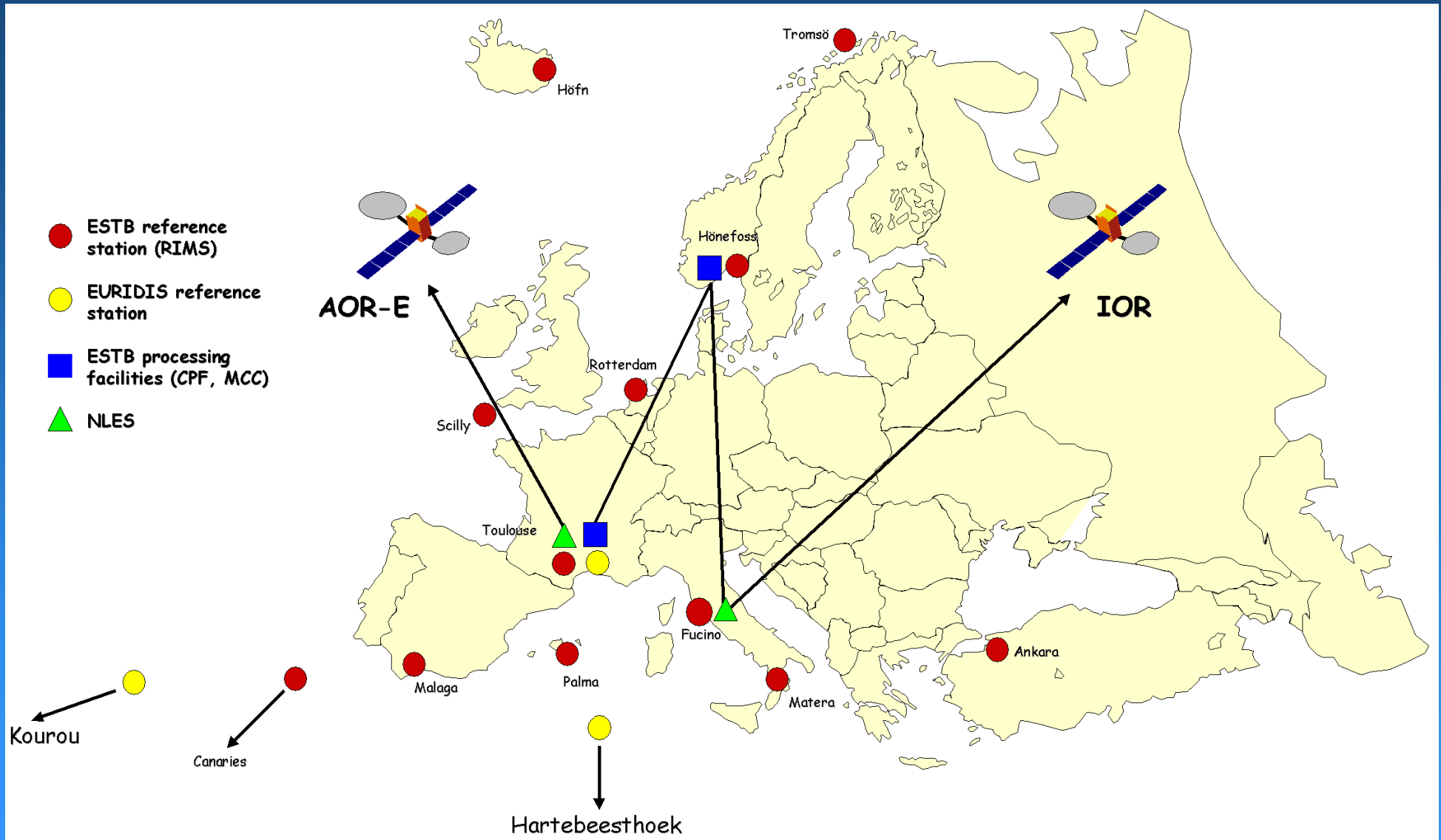*EGNOS Project Office*

Introduction

- ESTB is an EGNOS Prototype:
    - Complete end to end system
    - Functionally representative of EGNOS system
    - It provides a service on most of Europe
- ESTB SIS available since February 2000
- ESTB SIS is being and will continue to be used to:
    - Analyse specific GNSS system design and performance aspects and optimisations
    - Serve as a prototype platform to prepare future EGNOS operations
    - support GNSS applications and services demonstration, promotion and development
    - Help User Communities to get progressively aware and familiarised with forthcoming new GNSS services
- European GNSS services have started with the ESTB

ESTB Global Overview

Legend:
- 🔴 ESTB reference station (RIMS)
- 🟡 EURIDIS reference station
- 🟦 ESTB processing facilities (CPF, MCC)
- 🔺 NLES

Tromsö, Höfn, Hönefoss, AOR-E, IOR, Rotterdam, Scilly, Toulouse, Malaga, Palma, Fucino, Matera, Ankara, Kourou, Canaries, Hartebeesthoek

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Y2002 main highlights (1)

- Technical

  - ESTB signal upgraded to latest international standard (RTCA DO-229C)

  - ESTB signal transmission available available via 2 geostationnary satellites (AOR-E and IOR)

  - ESTB corrections available via internet (SISNeT)

  - 2 new RIMS stations connected to the network

  - Service availability continues improving

  - Positioning accuracy has been improved to lower than 1 meter

  - Service expansion beyond Europe has been demonstrated

Y2002 Main highlights (2)

- User support and Demonstrations

  - Helpdesk has processed about 300 questions and requests

  - General information to Users keeps improving (newsletter, WEB, etc…)

  - Many demonstrations of GNSS benefits and potential new applications have continued to occur

Perspective for Y2003 (1)

- Programmatic
  - Framework for extending ESTB operations beyond mid-2003 and until availability of stable EGNOS Operational SIS under discussion
    - Objective: ensure seamless availability of GNSS signal to User Community
    - User support lobbying welcome to facilitate the process
  - GEO satellite baseline constellation to evolve during Y2003:
    - AOR-E to be decomissioned from ESTB around mid 2003
    - IOR satellite to be moved by INMARSAT over Pacific towards end-2003
    - ESTB transmission to progressively move to either INMARSAT 4F1 or ARTEMIS (TBC)
    - Users will be informed in due time
    - SISNeT transmission will continue

Perspective for Y2003 (2)

- Support to GNSS Service Introduction
  - ESTB will remain in Y2003 the only stable European GNSS signal
  - Use of ESTB to support GNSS services preparation will be intensified (EC Galileo Pilot Projects, ESA ARTES 5 initiateives and others…)
  - Demonstration of GNSS services outside Europe will further develop in Y2003 (Africa, South America, China…)

ESTB strategy wrt to MT0/2 (1)

- MT0 declares whether the system is in test mode or in operational mode

- ESTB is currently fully in line with International signal and messages standards

- Standards however do allow a more elaborated use of MT0:

    - System in test mode
    - System operational but for non safety application
    - System operational for safety applications

- WAAS has adopted this "elaborated"version of MT0

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ESTB strategy wrt to MT0/2 (2)

- Several receiver manufacturers can interpret the 2 versions of MT0

- Some have chosen to interpret only the one selected by WAAS and this creates incompatibilities with the ESTB signal

- ESTB has evolved and allows to broadcast either of the 2 solutions

- ESA intention is to switch to "WAAS" mode on 16th December 2002 provided:
  - Confirmation that full compatibility with e.g. GARMIN receivers is restored
  - No major impact on on-going or planned demonstration is identified
  - Users are invited to take the opportunity of the tests planned in November to check compatibility and make their opinion known to ESA as soon as possible

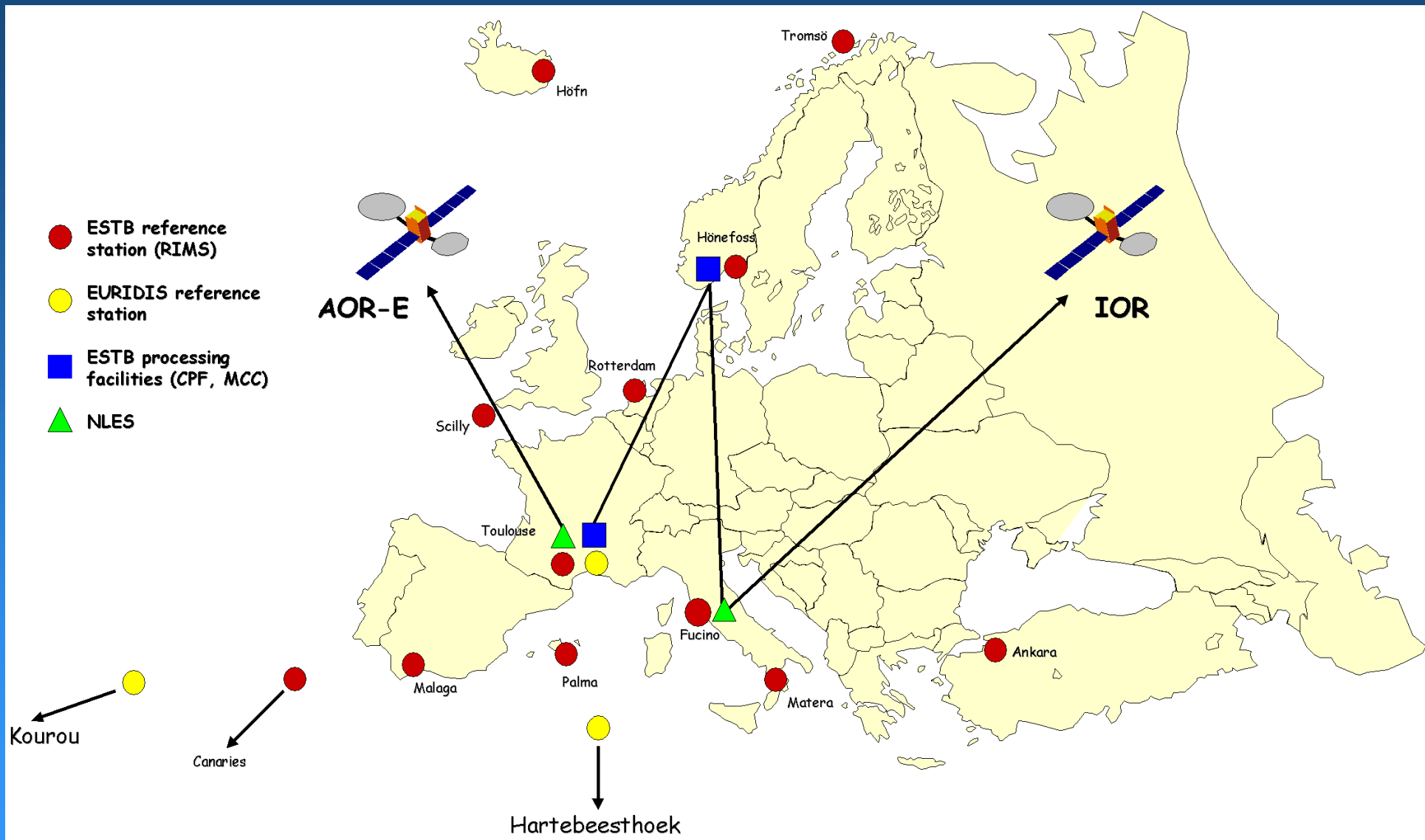# ESTB strategy wrt to MT0/2 (3)

Proposed schedule:

- 25-26 November, test with MT0/2 on PRN 120

- Week 48-47: feedback from users and impact analysis
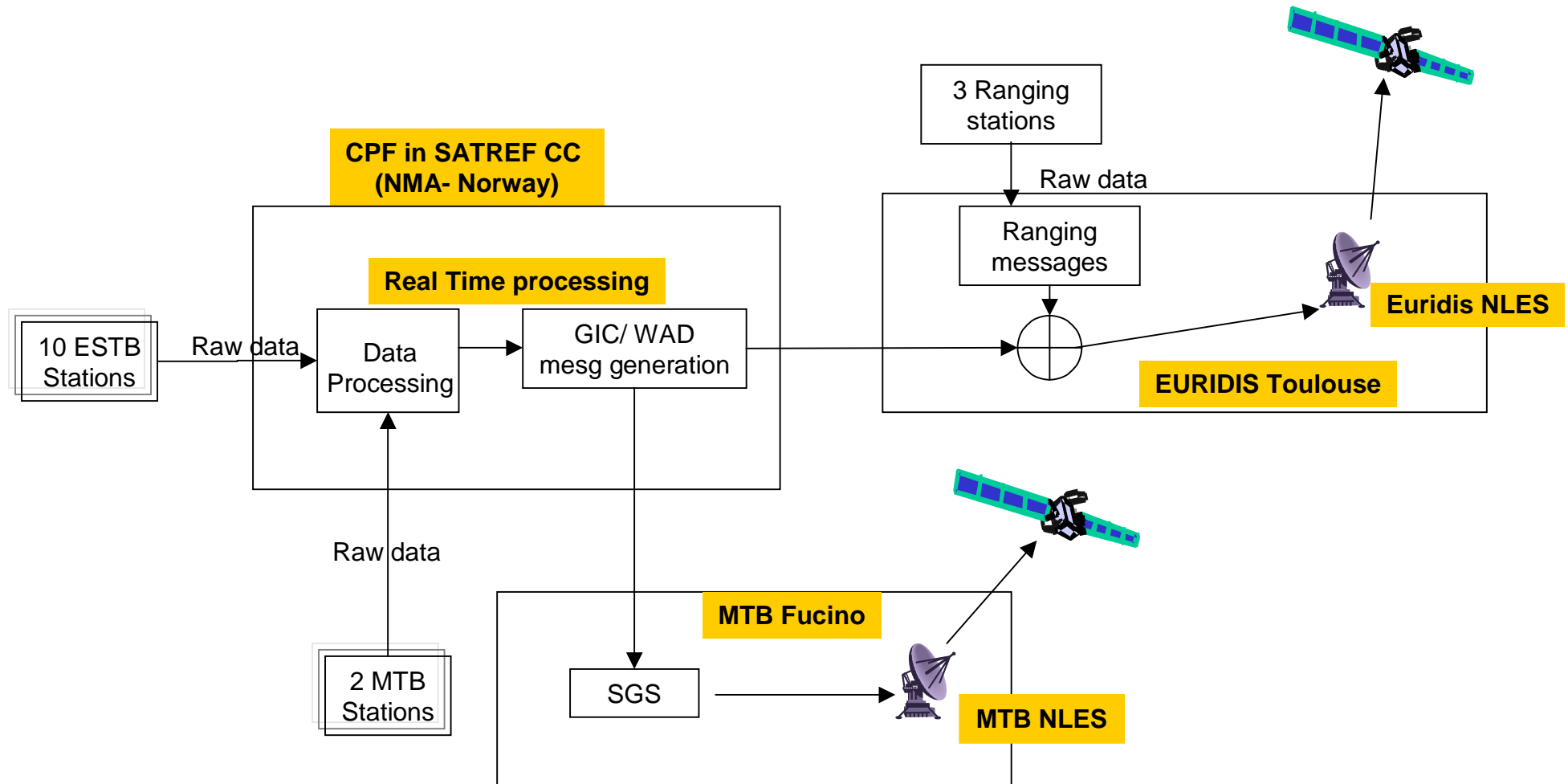
- Week 51: MT0/2 switch on ESTB SIS PRN 131

ESTB system architecture overview

Ground Segment outlines

Legend:
- **ESTB reference station (RIMS)** — red circle
- **EURIDIS reference station** — yellow circle
- **ESTB processing facilities (CPF, MCC)** — blue square
- **NLES** — green triangle

Map labels: Höfn, Tromsö, Hönefoss, AOR-E, IOR, Rotterdam, Scilly, Toulouse, Fucino, Ankara, Malaga, Palma, Matera, Kourou, Canaries, Hartebeesthoek

ESTB-MTB FUNCTIONAL ARCHITECTURE

3 Ranging stations

CPF in SATREF CC (NMA- Norway)

Raw data

Real Time processing

10 ESTB Stations

Raw data

Data Processing

GIC/ WAD mesg generation

Ranging messages

Euridis NLES

EURIDIS Toulouse

Raw data

2 MTB Stations

MTB Fucino

SGS

MTB NLES

Sites location

Malaga RS (Spain)

Tromsoe RS (Norway)

Main Processing Facilities

**ESTB CPF
NMA - Honefoss**

**Euridis CMT and
ESTB MCC
CNES - Toulouse**

ESTB Operations overview

ESTB improvements in Y2002

- Aussaguel NLES: automate restart processing of the SIS
- CPF :
    - highest mode (all corrections+ integrity) set-up automatically without SIS interruptions
    - iono algo correction in May 2002 (accuracy improved)
- SIS standard upgrade:
    - DO229B + MT0/2
    - +GEO corrections+MT17
- RIMS: antennas geographical positions recomputed
- MTB-CPF connection: now stable with SIS on IOR + 2 RIMS connected to CPF (September 2002)

GIC/WAD SIS availability

Target SIS availability with corrections: 95%
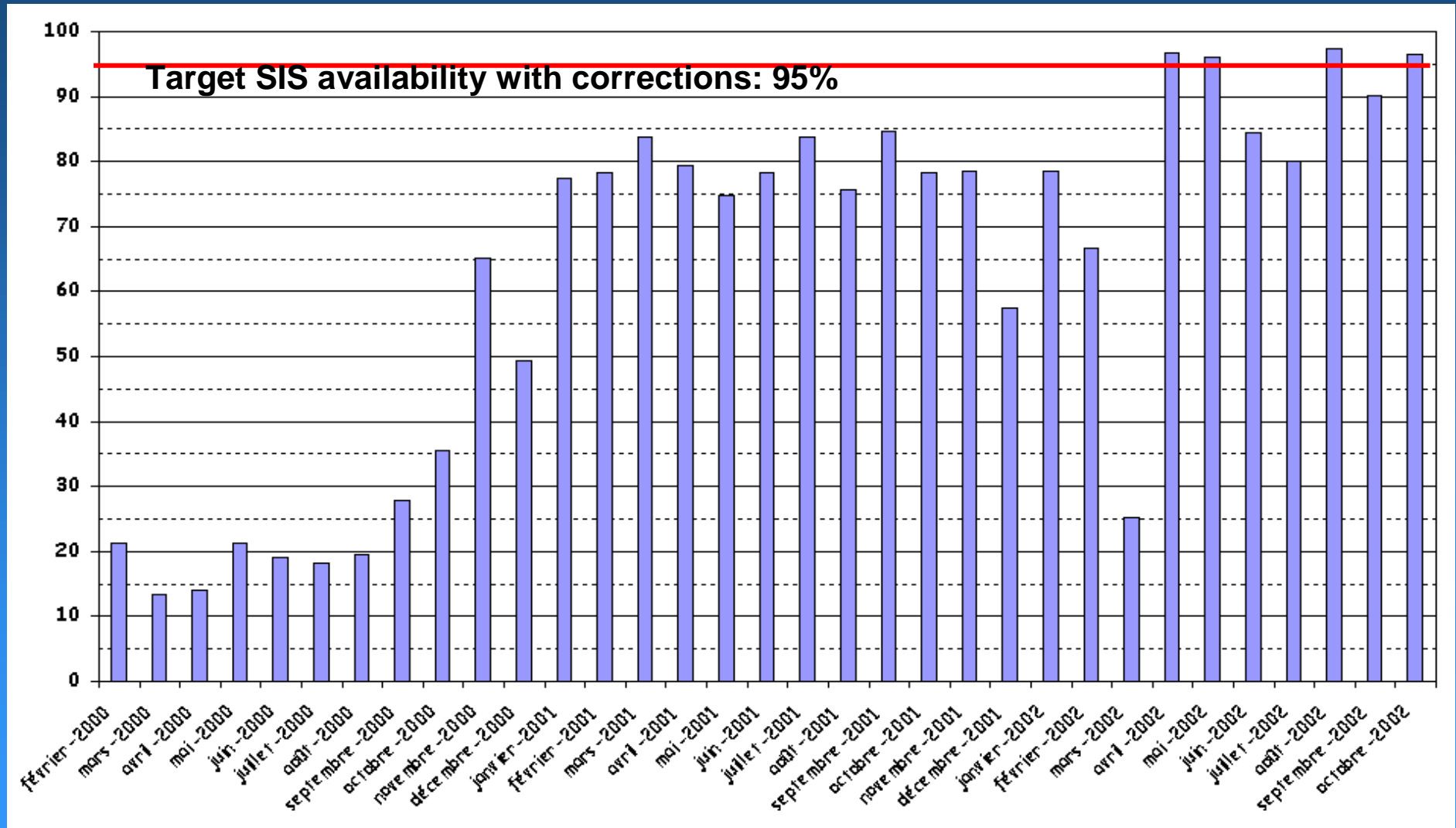
SIS status information

- Forecast schedule for AOR-E and IOR SIS on:

    - www.esa.int/ESTB

- Daily e-mail from ESTB MCC

- ESTB Helpdesk available for Specific question at

    - estb@esa.int

ESTB Expansion mode

Expansion service concepts

2 modes available with ESTB

✔ **Extension of ECAC area (adjacent areas)**
- **limited area**
- **homogenous service**

✔ **Real Expansion (remote areas**
- **second service area**
- **remote location**
- **Design changes**
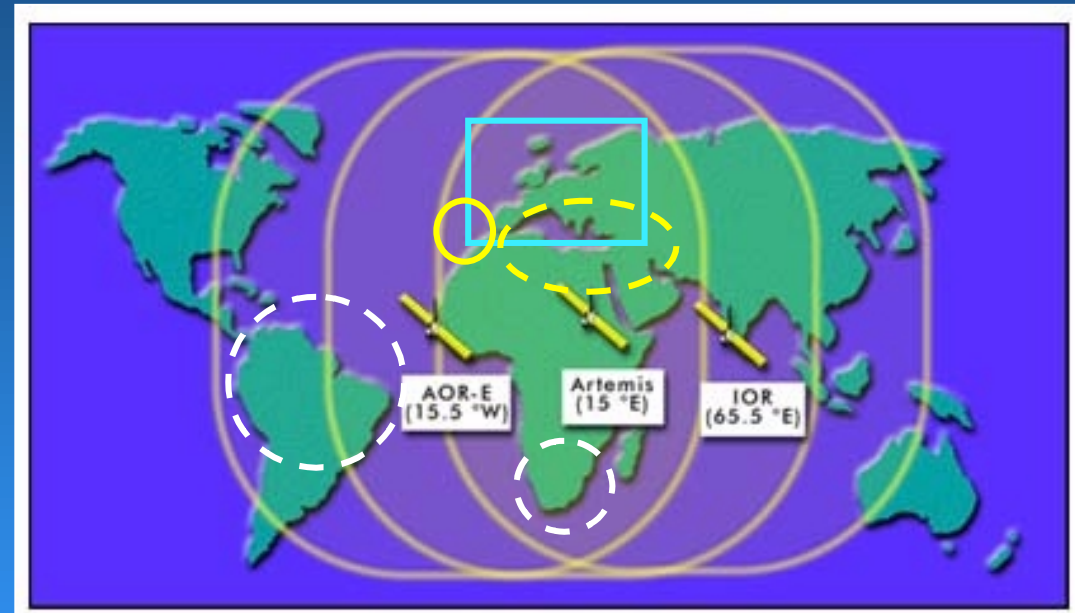
REAL expansion Service mode

- Integrity is achieved through MT27 (DO229A):
    - MT 27 provide an increment of UDRE specific to the expansion area
    - UDREI increment is a configurable parameter of the system

- Position accuracy is achieved by:
    - Addition of a new iono grid over the expansion area
    - GIVE and GIVD provided on expansion area with MT18 and MT26

Performances monitoring: accuracy, integrity
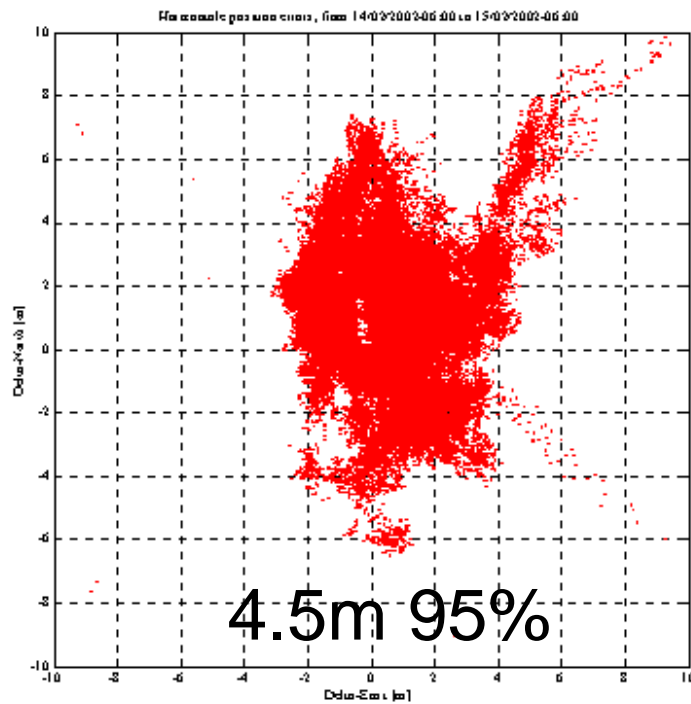
Typical ESTB Performances in Toulouse

- ESTB Accuracy availability(95%)
    - Horizontal accuracy: 1.5m
    - Vertical accuracy: 2.5 m
- ESTB service availability:
    - APV1: 99.4% (VAL=50m)
    - APV2: 97.4% (VAL=20m)
- Over ESTB Service area (Leeds, Barcelona, Delft)
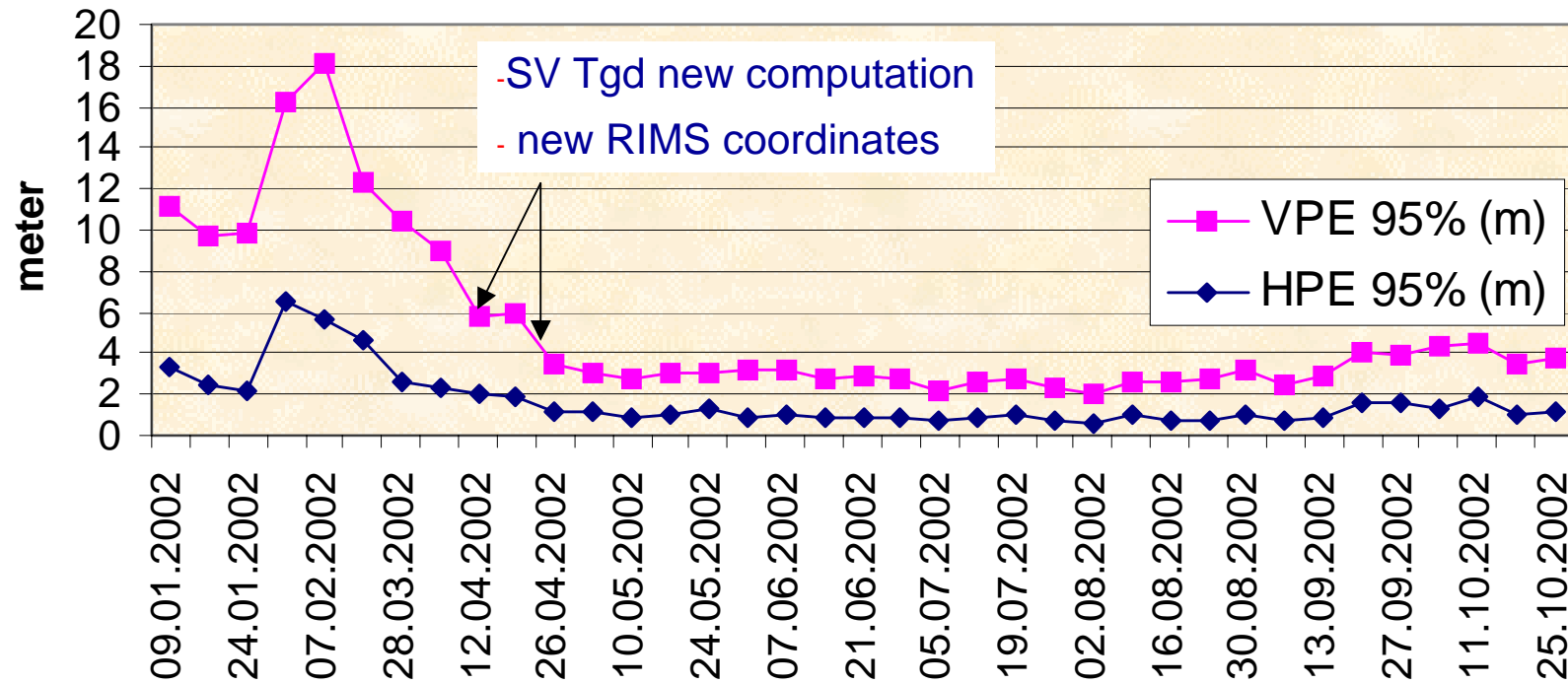   - Same range of values

Accuracy in Toulouse
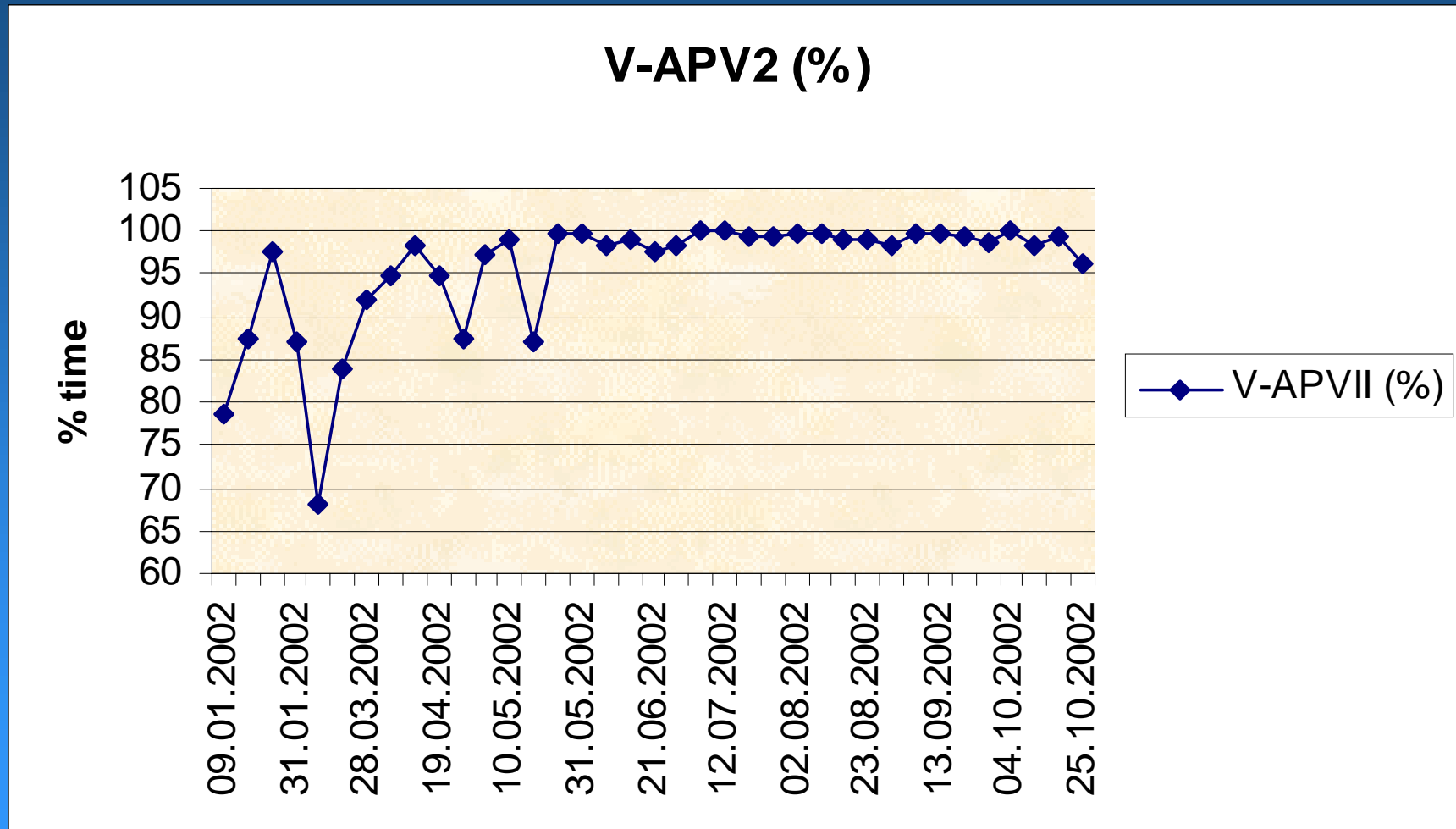
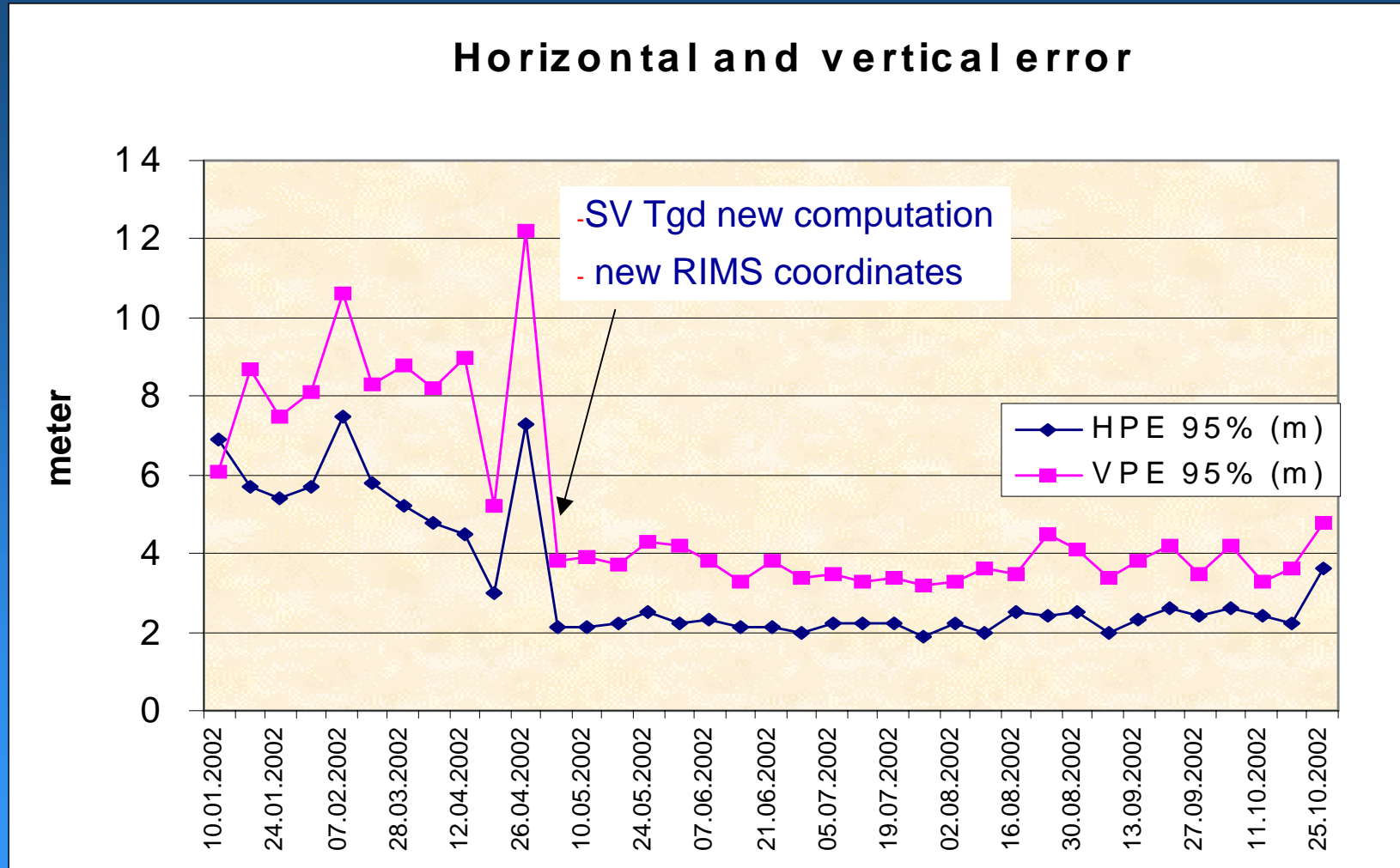14 Feb. 02   2 Aug. 02

4.5m 95%   1.5m, 95%

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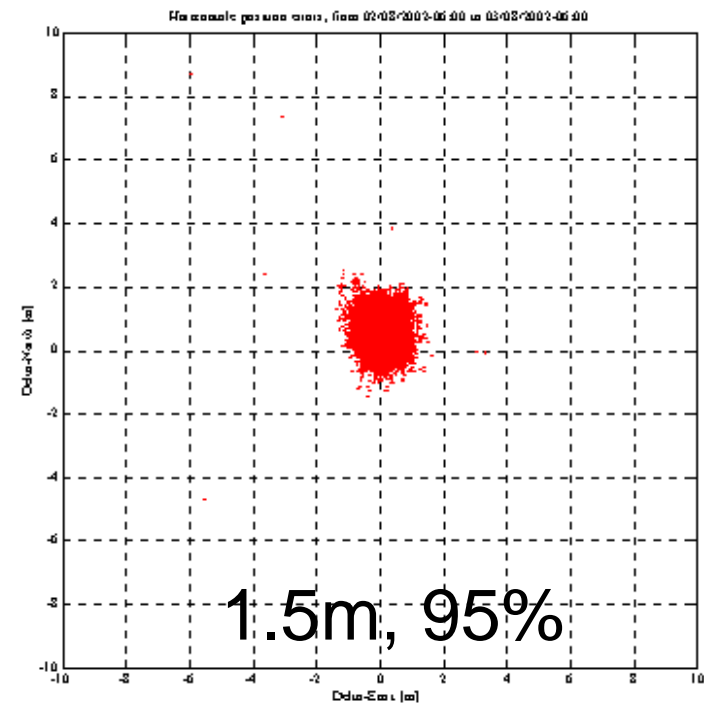
Accuracy monitored at Toulouse by CNES

Vertical and horizontal errors

- SV Tgd new computation
- new RIMS coordinates

VPE 95% (m)
HPE 95% (m)

APV2 service availability in Toulouse

V-APV2 (%)

Accuracy monitored at Leeds by I3F

Horizontal and vertical error

- SV Tgd new computation
- new RIMS coordinates

HPE 95% (m)
VPE 95% (m)

MIDAN results during validation configuration
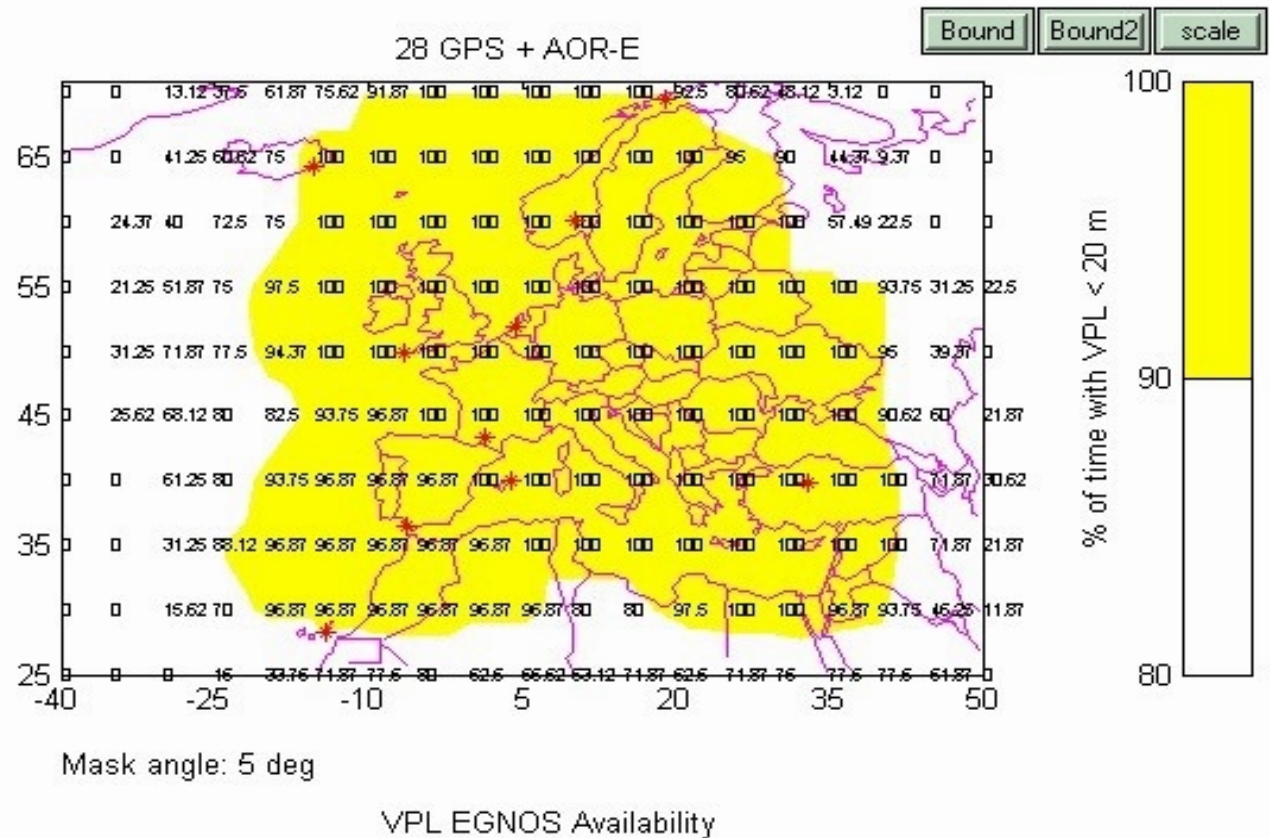
MIDAN iono GRID
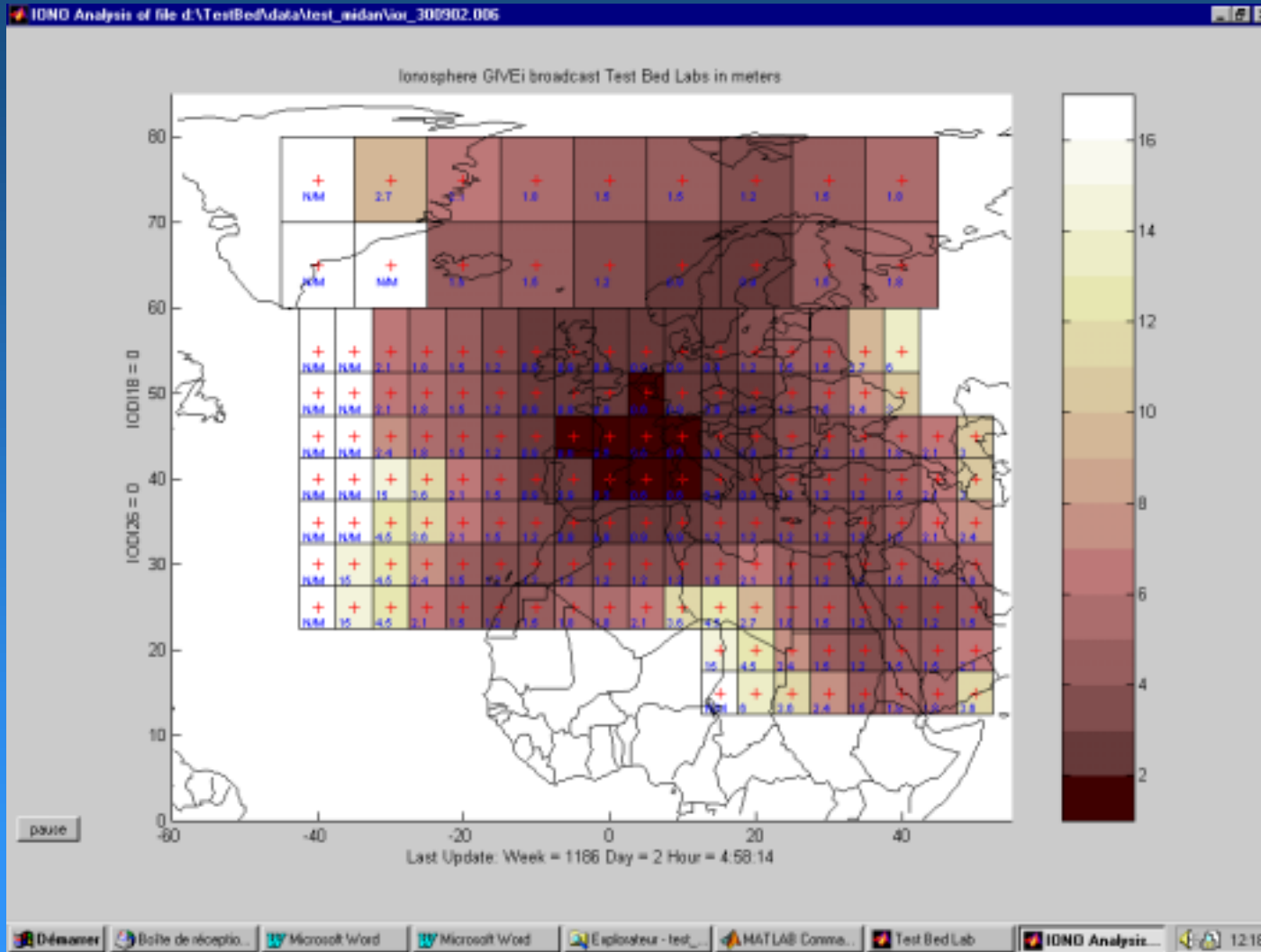
ESA is involved in other trials that will help to grow the market for EGNOS services and products

- ESTB trials using expansion mode:

  - MIDAN demonstration in the Middle East (3 additional stations), October 2002

  - Static tests in China (3 additional stations), mid 2003

  - Flight trials in Senegal, ASECNA (December 2002),

  - Multi-modal demonstrations in South America, March 2003

Summary

- EGNOS IS REAL NOW!

- EGNOS system prototype (ESTB) is operational, and performances are very promising for EGNOS AOC

- ESTB used as support for data collection, Industrials tests, demonstrations and preparation of operational validation