

# Handheld Internet-Based EGNOS Receiver

**The First Product of  
the ESA *SISNET* Technology**



Félix Torán-Martí, Dr. Javier Ventura-Traveset (1) and Dr. Ruizhi Chen (2).  
(1) EGNOS Project Office, Toulouse (France). (2) Finnish Geodetic Institute, Masala (Finland)  
GNSS 2003, 23<sup>rd</sup> of April, Graz (Austria)

# PRESENTATION OUTLINE

---



Introduction



Overview of the SISNET Platform



Current Status



SISNeT Developments

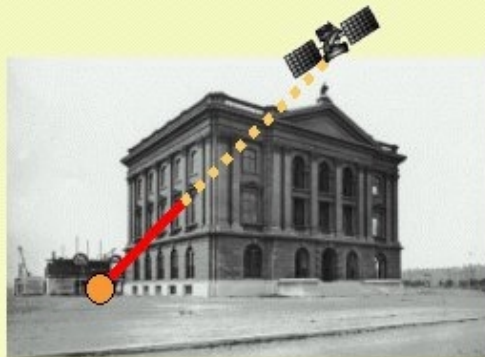


Conclusions

# INTRODUCTION (I)

Broadcast of EGNOS messages through GEO is a very efficient strategy for many users. Yet, some users:

- may also wish transmission through other means (or combination with other navigation systems) to avoid potential GEO blocking (e.g. land mobile users in cities)
- may be interested in EGNOS real-time information for scientific/technical/educational purposes without wishing to invest on a receiver (e.g. IONO map of Europe, EGNOS performance monitoring, etc)



## INTRODUCTION (II)

---

- ESA ARTES-5 (ASTE) program: covers both the combination of EGNOS with other sensors and integration of EGNOS and terrestrial regional networks
- ESA SISNET Project aims at complementing the ASTE initiatives by **providing the EGNOS test bed signal through the Internet in real-time**

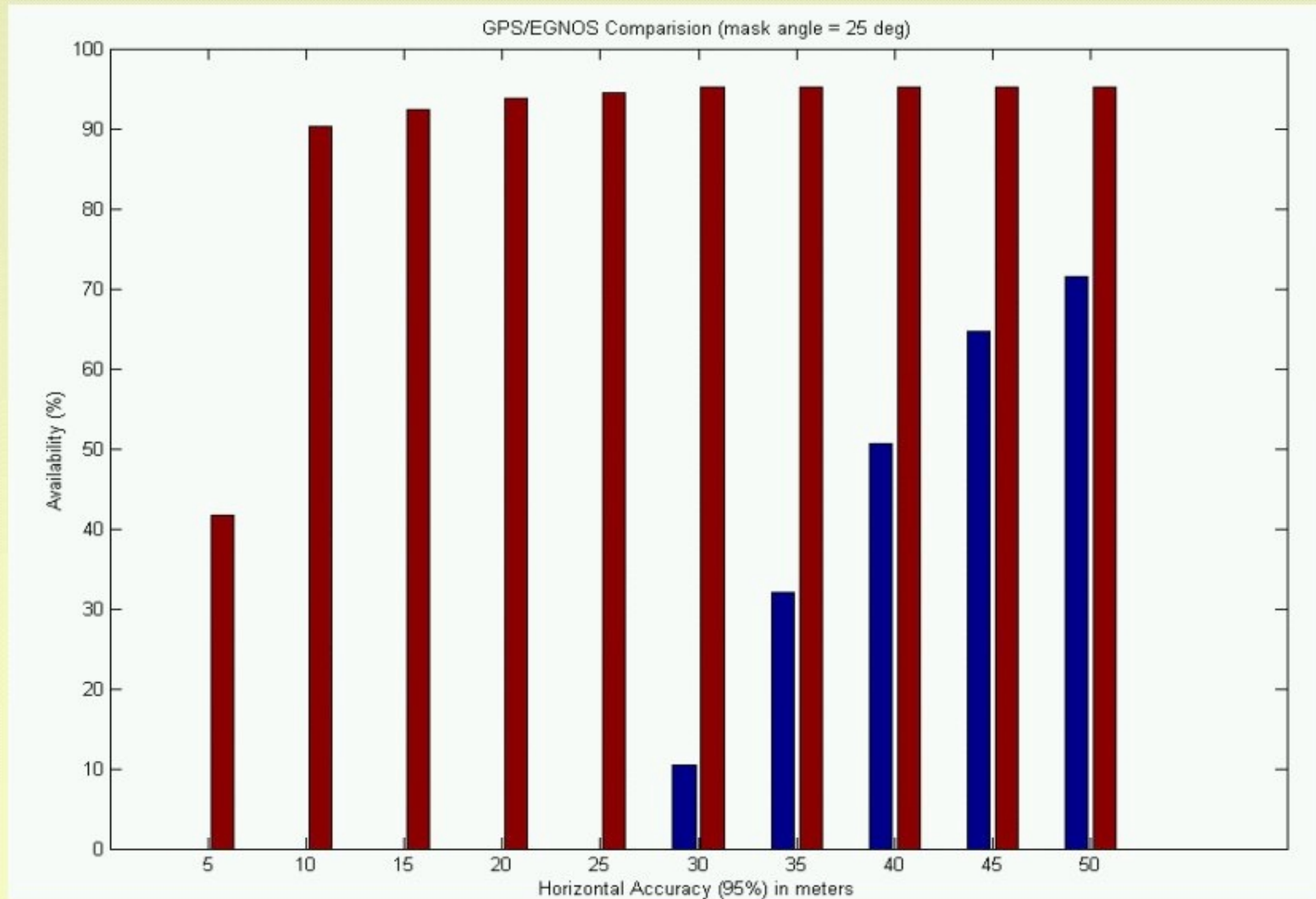
## INTRODUCTION (III)

---

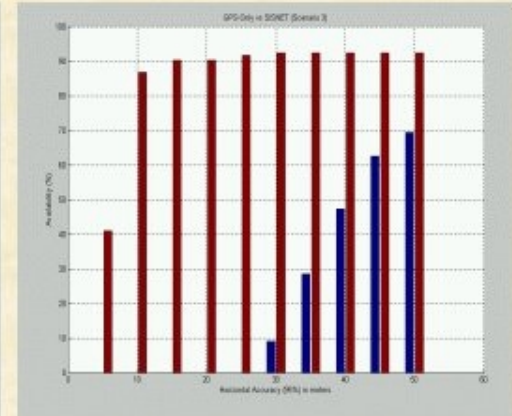
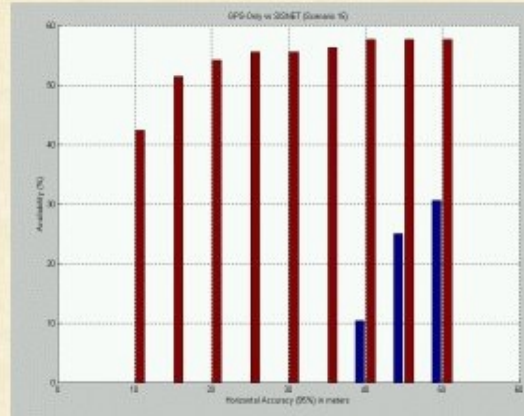
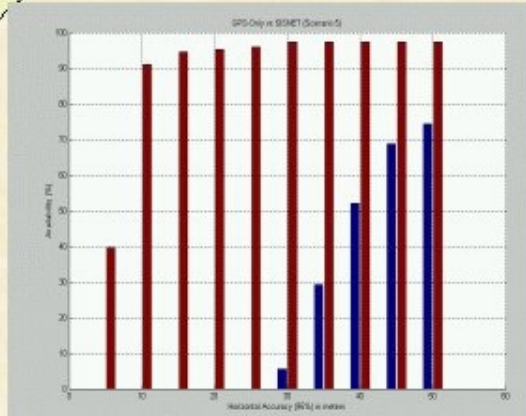
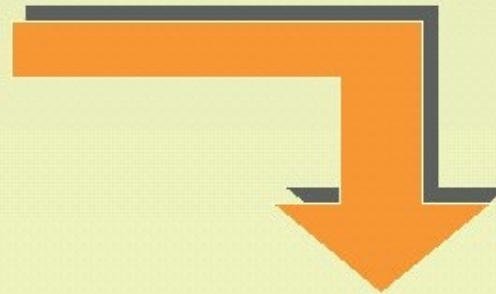
### SISNET Advantages:

- Allows acquiring the GEO signals, even under low visibility of GEO (e.g. urban canyons or high latitudes);
- A simple connection to the Internet provides a virtual EGNOS receiver;
- The transfer rate is appropriate for use with GSM or GPRS (EGNOS message: 250 bps, SISNET: less than 800 bps).

# INTRODUCTION (IV)



# INTRODUCTION (V)



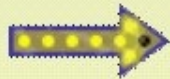
**Reference:** "EGNOS Performances in Urban Areas Using the ESA SISNeT Technology: Advanced Modelling of User Masking Effects." Available through <http://www.esa.int/navigation/sisnet>

# PRESENTATION OUTLINE

---



Introduction



Overview of the SISNET Platform



Current Status



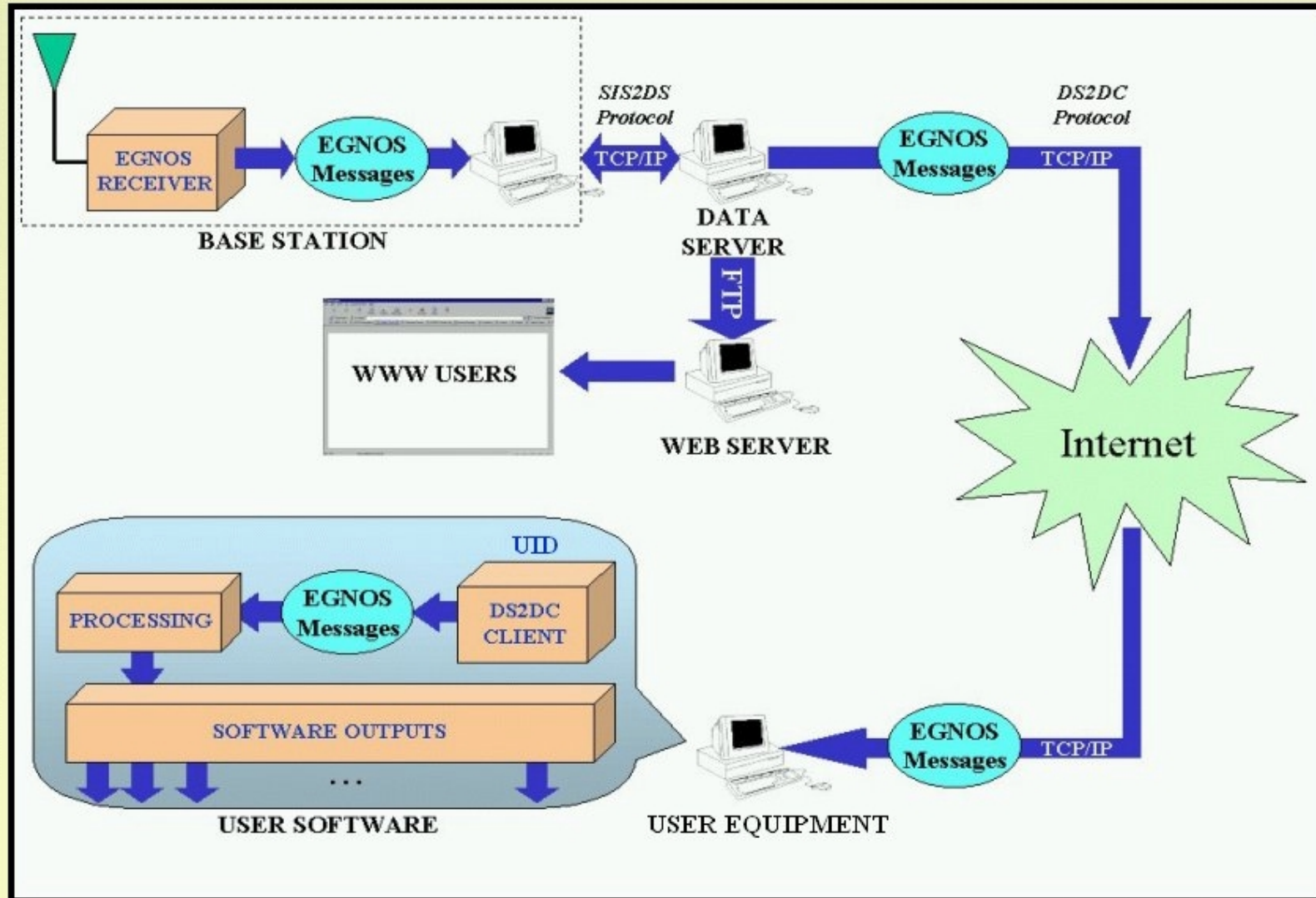
SISNeT Developments



Conclusions

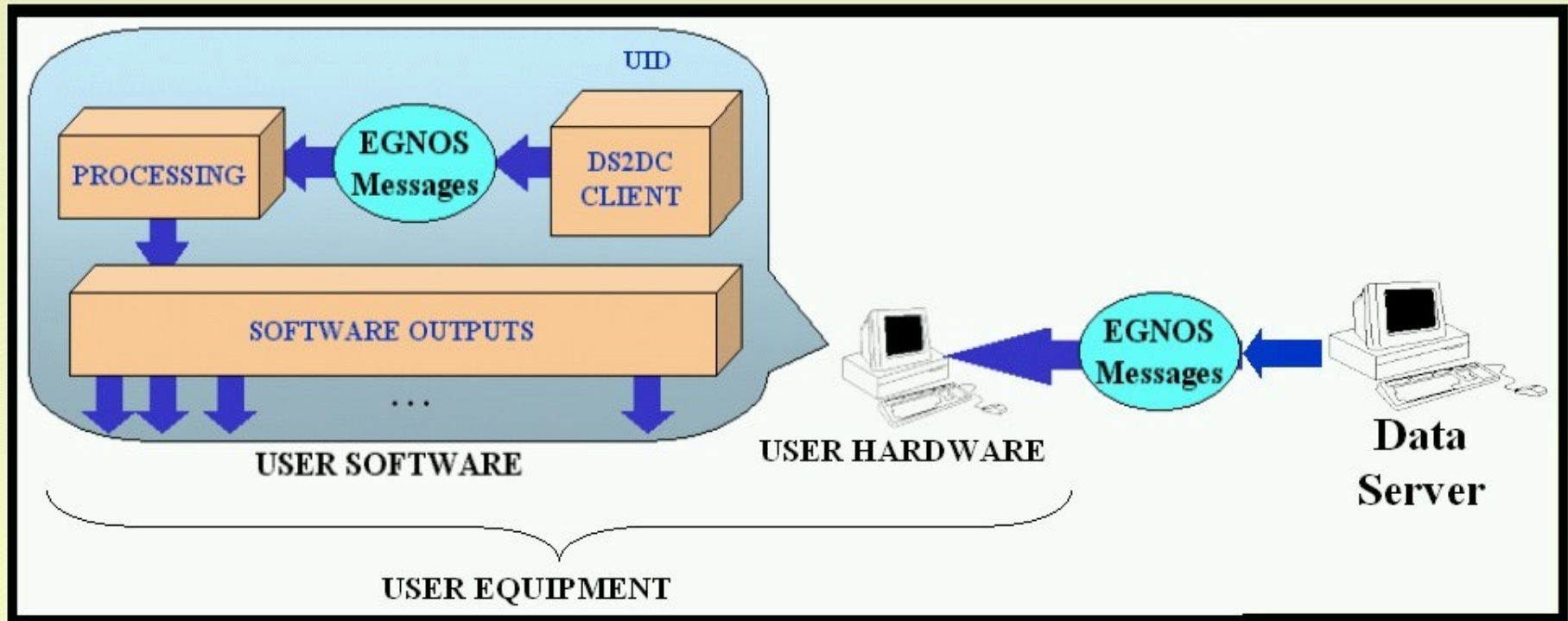


# ARCHITECTURE OF SISNET





# USER APPLICATION SOFTWARE ARCHITECTURE



# PRESENTATION OUTLINE

---



Introduction



Overview of the SISNET Platform



Current Status

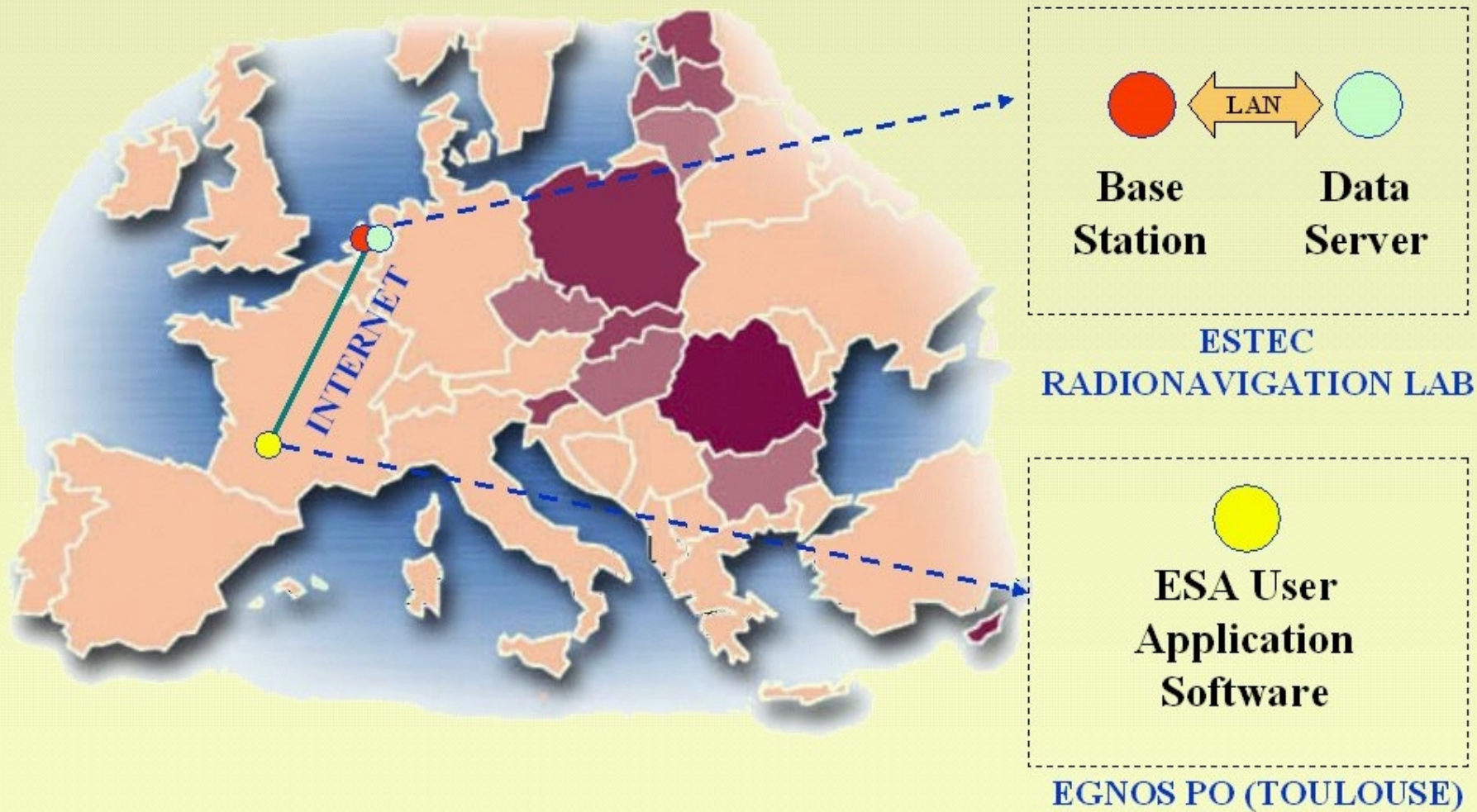


SISNeT Developments

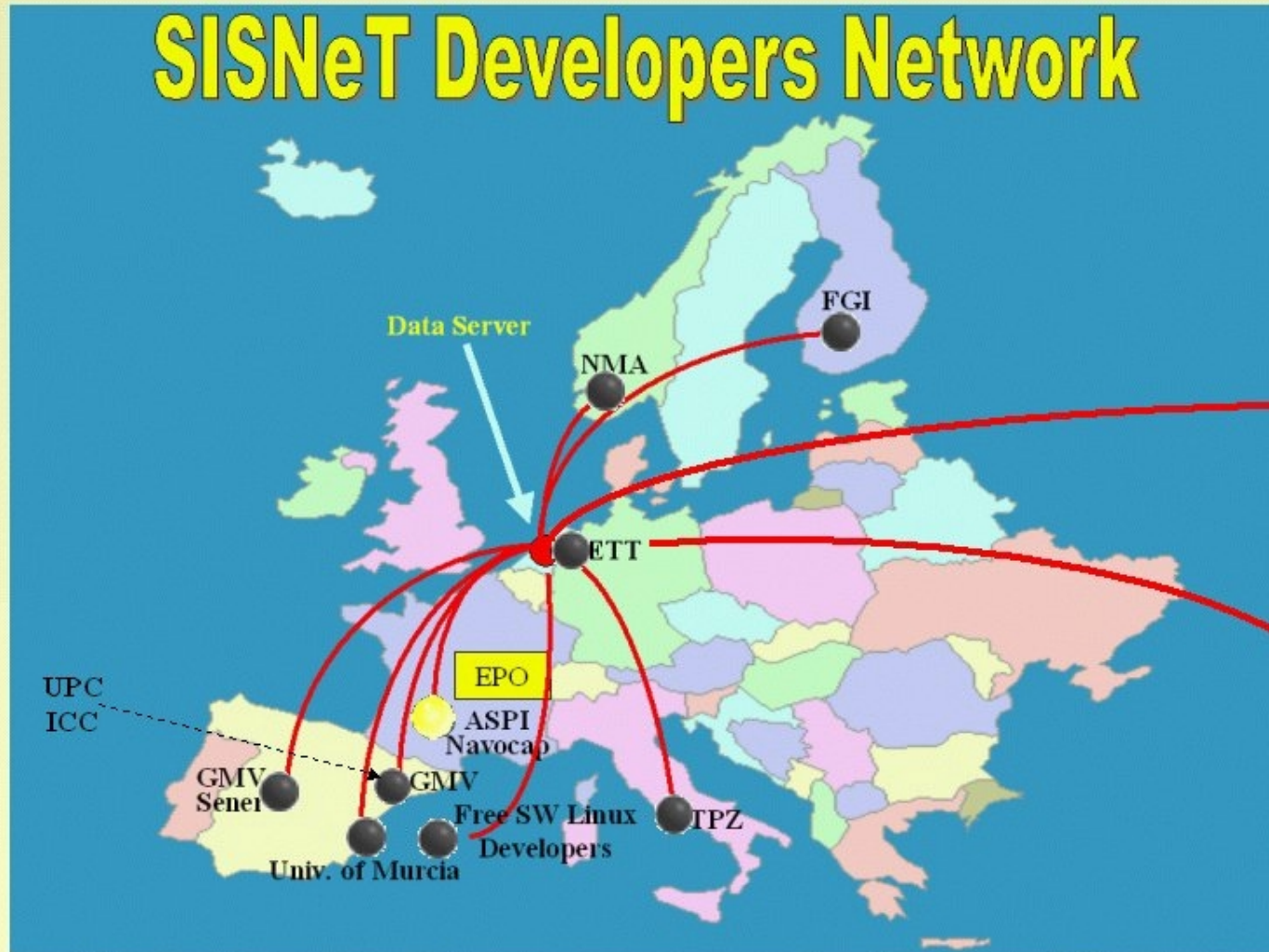


Conclusions

# LOCATION OF KEY SISNET COMPONENTS



# SISNeT Developer Network



## SISNeT Developers Network

**India**

**Accord Soft**

**Russia**

**Indep. Researchers**

Network continuously grows: new users in Germany, UK, etc.

# New Version 3.0 of SISNeT (I)

---

## The Major Change:

- Separators (CRLF) added at the end of commands sent to the DS, as well as in commands coming from the data server.
- Advantages:
  - This is a key step for asynchronous operation;
  - Macro-commands can be sent to the Data Server;
  - Helps considerably in message decoding;
  - Avoids problems: TCP/IP can break long messages into parts: separators are necessary.
  - Interaction via telnet

# New Version 3.0 of SISNeT (II)

---

Drawback of using separators: this change is not backwards compatible.

## **The rational behind this change:**

- Addition of separators was an idea originated by users.
- Polling conducted by ESA: users agree with using separators.
- At this time, users have full control on receivers source code.
- Changes to implement are very simple.
- Receivers developed under ESA contract: will be compatible with version 3.0 very soon.
- Transition to version 3.0 will be smooth. Current version will co-exist with v3.0 during a week.

# New Version 3.0 of SISNeT (III)

---

## More improvements:

- Quick initialisation of SBAS receivers in about 30 seconds (using GSM).
- New macro-command: Authentication + quick initialisation (asynchronous, using CRLF separators).
- Possibility to obtain last broadcast messages on demand.
- ESA experiments reveal that loosing 30% of messages implies loosing about 0.5 meter accuracy.
- It is possible to request fast / slow / ionospheric corrections periodically, not waiting for them. **Optimisation of bandwidth usage.**



# PRESENTATION OUTLINE

---



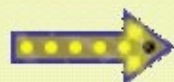
Introduction



Overview of the SISNET Platform



Current Status



SISNeT Developments



Conclusions

# INDUSTRIAL DEVELOPMENTS

---

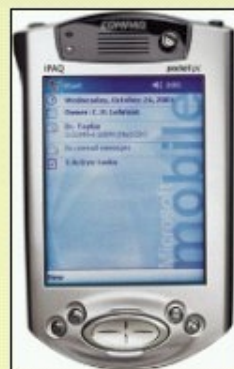
Several SISNeT-based industrial activities currently ongoing.  
Objectives cover:

- Development of an integrated SISNeT receiver (including GPS receiver + GSM/GPRS Internet link);
- Demo of SISNeT receivers embedded into cars;
- Lab. Software: real-time / offline processing of the ESTB signal;
- Study of SISNeT network improvements (security and performance);
- **SISNeT handheld receiver based on a PDA;**
- SISNeT Technology for Urban buses (Toulouse)
- SISNeT Technology for Blind Pedestrians

# SISNeT Handheld Receiver Architecture

## SOFTWARE

- High performance navigation algorithms;
- Driver: connection with GIS applications;
- Smart algorithms: take the most of EGNOS and GPS;



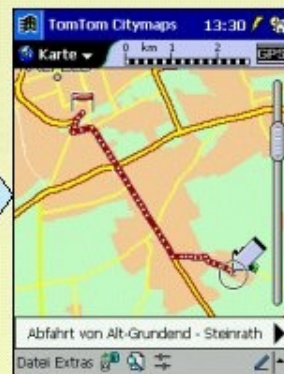
POCKET PC 2002 OS



GPS Receiver Card

Corrected co-ordinates

DRIVER



ALMOST ANY GIS / LBS APPLICATION CAN WORK WITH SISNeT-CORRECTED CO-ORDINATES!!!



GPRS MODEM

**SISNET**

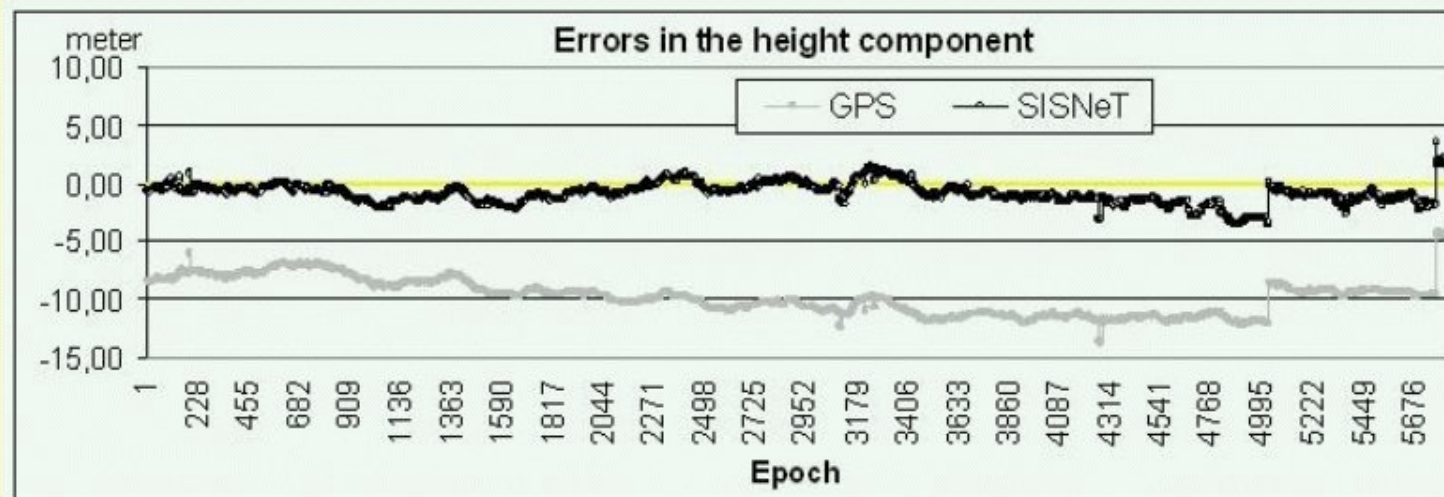
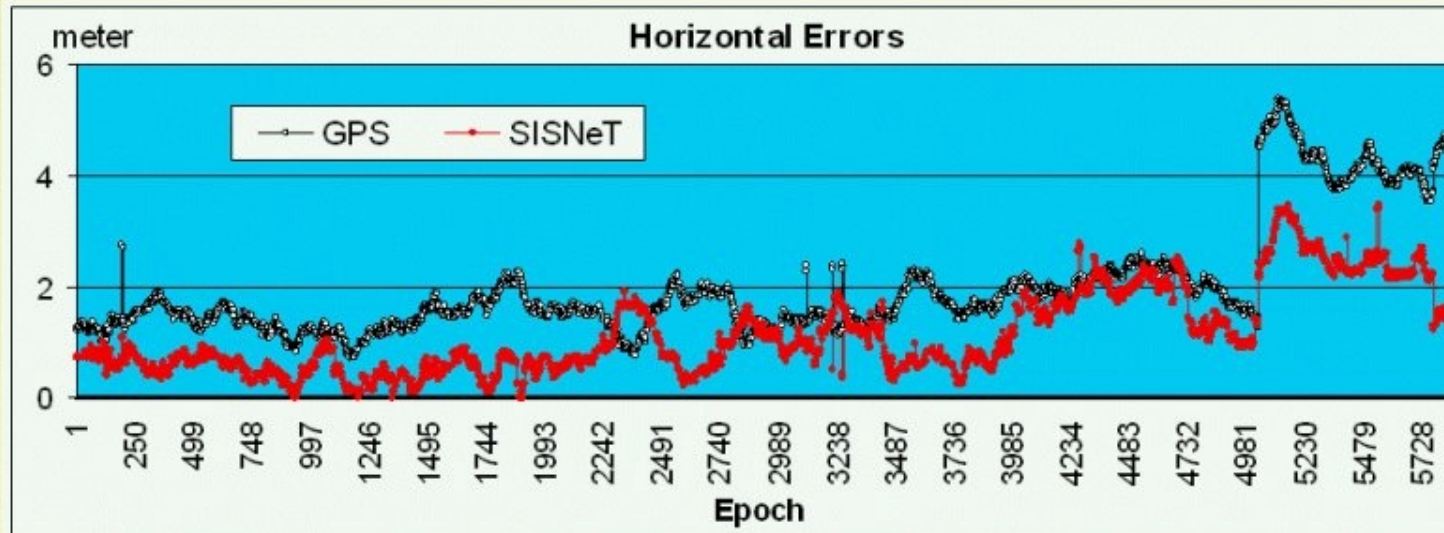


# TESTS IN FINLAND: GPS ANTENNA ON FGI CAR



GPS  
antenna

# STATIC TEST RESULTS

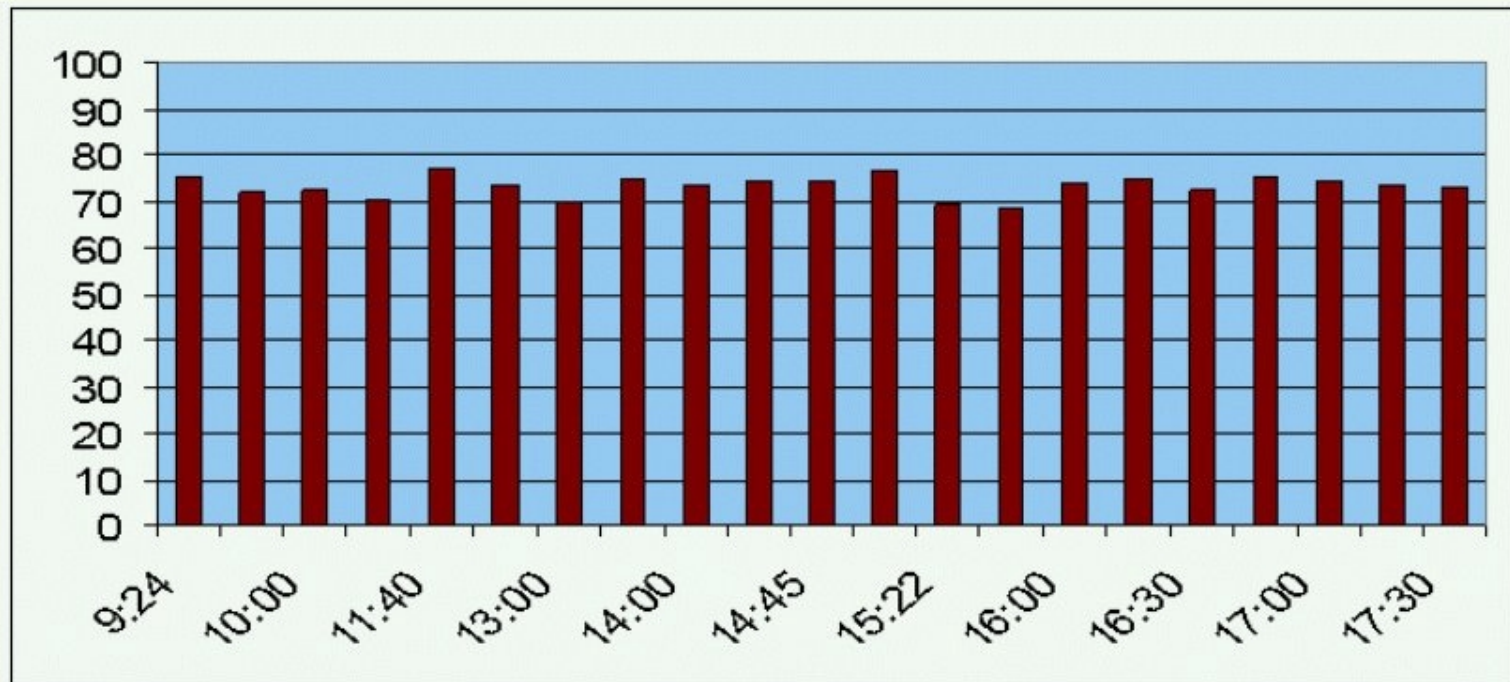


# DYNAMIC TEST OVERVIEW



- Driving path: 50 km
- Driving time: 40 min.
- Maximum speed: 110 km/h

# DYNAMIC TEST RESULTS



- Connection speed: 9.6 kbps
- Average performance: 70%

**Impact of losing 30% of the messages: about 0.5 m**



# Recent Achievement: SISNeT Receiver Based on a Mobile Phone (Pocket PC OS)



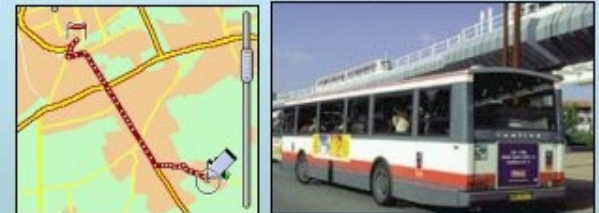
# ESA CONTRACT WITH NAVOCAP (Toulouse) SISNeT for Urban Buses

## STEP 1: Handheld Receiver Development



BASED ON "NETPAD" PDA (WinCE.NET)

## STEP 2: Dynamic Tests



SEMVAT LINE 2 WILL BE USED

## STEP 3: Recommendations for integration of SISNeT into urban buses



### OBJECTIVE:

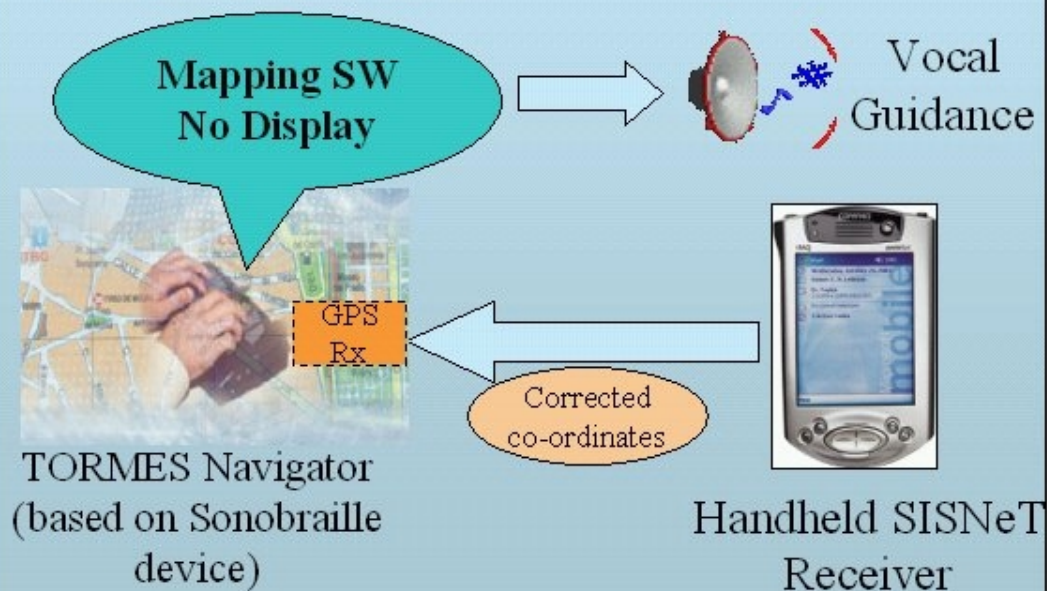
Taking into account the results of dynamic tests, recommend an strategy to integrate the SISNeT information into urban buses typical environment (UHF, TDMA, limited bandwidth,...)

# SISNET - PROJECT (BLIND PEDESTRIANS)

## 1. Detailed definition

### Objectives

- Detailed definition of tests;
- Test platform integration;



## 2. Tests and Conclusions

### Objectives

- Execution of two parallel tests using the TORMES platform:
  - GPS-only
  - SISNeT
- Analysis of results and conclusions;



# PRESENTATION OUTLINE

---



Introduction



Overview of the SISNET Platform



Current Status



SISNeT Developments



Conclusions

# SUMMARY

---

- SISNET allows the access to the ESTB signal through the Internet;
- The SISNeT services are available since February 2002 through an authentication protocol;
- **A specific SISNET User Interface Document (UID) is already available for anyone wishing to develop SISNET-based user applications.**
- Several SISNeT-based industrial activities ongoing, showing promising results. This presentation has focused on the first product of the SISNeT technology: a PDA-based handheld SISNeT receiver.
- The combination of EGNOS and the Internet can open a large amount of applications for Satellite Navigation.

### SISNeT

[About SISNeT »](#)

[SISNeT Overview »](#)

[SISNeT User Interface Document »](#)

[ESTB Real Time Monitoring through Internet »](#)

[Publications »](#)

[FAQ »](#)

[Downloads »](#)

[Contact SISNeT team »](#)

[Disclaimer »](#)

### Search

### Advanced Search



SISNeT is a new technology that combines the powerful capabilities of satellite navigation and the Internet. The highly accurate navigation information that comes from the EGNOS (European Geostationary Navigation Overlay Service) Signal-In-Space (SIS) is now available over the Internet and in real time via SISNeT.

Specifically, SISNeT gives access to the wide-area differential corrections and the integrity information of EGNOS. The SISNeT project was undertaken by ESA during the second half of 2001. In August 2001, the first prototype of the system was set-up, and the SISNeT concept was successfully validated. Since February 2002, the system has been pre-operational, broadcasting an EGNOS-like signal through the Internet, as generated by the EGNOS System Test Bed (ESTB).

Any user with access to the Internet (usually through wireless networks - GSM or GPRS) can access EGNOS through SISNeT, irrespective of the GEO visibility conditions. No EGNOS receiver is needed.

### Related links

- » [EGNOS](#)
- » [ESTB](#)
- » [List of acronyms](#)

**More Info at [www.esa.int/sisnet](http://www.esa.int/sisnet)**

## RELATED ESA PRESS RELEASES

---

***“Navigate via the Web with the SISNeT receiver,”*** ESA Press Release, 6 September 2002, available at

[http://www.esa.int/export/esaSA/ESAW0OZPD4D\\_navigation\\_0.html](http://www.esa.int/export/esaSA/ESAW0OZPD4D_navigation_0.html)

***“Toulouse bus test-drives European satellite navigation,”*** ESA Press Release, 14 February 2003, available at

[http://www.esa.int/export/esaSA/SEM4HZ1A6BD\\_navigation\\_0.html](http://www.esa.int/export/esaSA/SEM4HZ1A6BD_navigation_0.html)

***“Space technology to help the blind,”*** ESA Press Release, 30 December 2003, available at

[http://www.esa.int/export/esaSA/SEM4HZ1A6BD\\_navigation\\_0.html](http://www.esa.int/export/esaSA/SEM4HZ1A6BD_navigation_0.html)

# REFERENCES (I)

---

- [1] Gauthier L., Michel P., Ventura-Traveset J. and Benedicto J., "EGNOS: the first step of the European contribution to the Global Navigation Satellite System," *ESA Bulletin*, No. 105, February 2001.
- [2] Secretan H., Ventura-Traveset J., Toran-Marti F., Solari G. and Basker S., "EGNOS System Test Bed Evolution and Utilisation," *ION GPS 2001*, Sept. 2001, Salt Lake City, USA. Awarded as best paper presentation in the area of SBAS systems.
- [3] Secretan H., Ventura-Traveset J., Toran-Marti F., Solari G. and Basker S., "EGNOS System Test Bed Evolution and Utilisation," *NAVITEC Conference*, Noordwijk (The Netherlands), December 2001. Available at <http://www.esa.int/sisnet>
- [4] European Space Agency, *EGNOS System Test Bed Website*, <http://www.esa.int/navigation/estb>
- [5] Toran-Marti F., Ventura-Traveset J. and de Mateo J.C., "Satellite Navigation and the Internet: Introducing SISNET Technology," *Dr. Dobb's Journal*, March 2002. Highlighted as featured article, available online at <http://www.ddj.com/documents/s=4069/ddj0203a/0203a.htm>
- [6] Toran-Marti F., Ventura-Traveset J. and de Mateo JC, "The ESA SISNeT Technology: Real-Time Access to the EGNOS Services through Wireless Networks and the Internet," *ION GPS 2002*, Portland, USA, September 2002.
- [7] Toran-Marti F. and Ventura-Traveset J. "The ESA SISNET Project: Real-Time Access to the EGNOS Services across the Internet," *2<sup>nd</sup> ESA ESTB Workshop*, Nice (France), November 2001. Available at <http://www.esa.int/sisnet>
- [8] Toran-Marti F., Ventura-Traveset J. and de Mateo JC, "Internet-based Satellite Navigation receivers using EGNOS: the ESA SISNET project," *ESA Workshop on Satellite Navigation User Equipment Technologies (NAVITEC)*, Noordwijk (The Netherlands), December 2001. Available at <http://www.esa.int/sisnet>



## REFERENCES (II)

---

- [9] European Space Agency, "SISNET: Making EGNOS Available Over the Internet," *ESTB News*, ESA Newsletter, Issue 2, page 4, September 2001. Available at <http://www.esa.int/estb>
- [10] European Space Agency, "SISNeT: Enhancing EGNOS for Land-Mobile Users," *ESTB News*, ESA Newsletter, Volume 2, Issue 1, page 1, May 2002. Available at <http://www.esa.int/estb>
- [11] Toran-Marti F., Ventura-Traveset J. and de Mateo JC. "The ESA SISNET Project: Real-Time EGNOS Services through the Internet," *ESA Journal Preparing for the Future*, January 2002. Available at <http://esapub.esrin.esa.it/pff/pffv12n1.htm>
- [12] Toran-Marti F., Ventura-Traveset J., and de Mateo JC, "The ESA SISNET Project: Real-Time Access to the EGNOS Services across the Internet," *7th International Workshop on Digital Signal Processing Techniques for Space Communications*, October 2001, Lisbon (Portugal). Available at <http://www.esa.int/sisnet>
- [13] Toran-Marti F. and Ventura-Traveset J. "*SISNeT Brochure*," ESA Brochure, June 2002. Available at <http://www.esa.int/sisnet>
- [14] Toran-Marti F. and Ventura-Traveset J. "*SISNET User Interface Document*," ESA Technical Document, Issue 2, Revision 1, Ref. E-RD-SYS-E31-010. Available at <http://www.esa.int/sisnet>
- [15] Toran-Marti F. and Ventura-Traveset J., "*EGNOS Performances in Urban Areas Using the ESA SISNeT Technology: Advanced Modelling of User Masking Effects*," ESA Technical Note, Ref. E-TN-PFM-E-0029-ESA, April 2002. Available at <http://www.esa.int/sisnet>
- [16] Catalina A., March J., Davila R., Paniagua J., Busnadiago C., Ventura-Traveset J., Toran-Marti F., Fernandez-Coya J.L., Lorente J.L., "Blind Pedestrian Navigator: Operating Features, Performances and EGNOS / SISNET Benefits," *To appear at GNSS 2003, Graz (Austria), 22 – 25 April 2003.*

## REFERENCES (III)

---

- [17] Toran-Martí F., Ventura-Traveset J. and de Mateo JC, "ESPADA 3.0: An innovative EGNOS Simulation Tool Based on Real Data," *ESA Journal preparing for the Future*, January 2002. Available at <http://www.esa.int/sisnet>
- [18] Toran-Martí F., "Advanced Simulation Tool for Satellite Navigation: from Radio Frequency to Positioning Using Real Data." M. Sc. Thesis. Supervised by Dr. Javier Ventura-Traveset (ESA) and Dr. Diego Ramirez (University of Valencia), July 2001.
- [19] European Space Agency, "Navigate via the Web with the SISNeT receiver," ESA Press Release, 6 September 2002, available at [http://www.esa.int/export/esaSA/ESAW00ZPD4D\\_navigation\\_0.html](http://www.esa.int/export/esaSA/ESAW00ZPD4D_navigation_0.html)
- [20] European Space Agency, ESA SISNeT Specialist Website, <http://www.esa.int/sisnet>
- [21] European Space Agency, "Toulouse bus test-drives European satellite navigation," ESA Press Release, 14 February 2003, available at [http://www.esa.int/export/esaSA/SEM4HZ1A6BD\\_navigation\\_0.html](http://www.esa.int/export/esaSA/SEM4HZ1A6BD_navigation_0.html)
- [22] European Space Agency, "Space technology to help the blind," ESA Press Release, 30 December 2003, available at [http://www.esa.int/export/esaSA/SEM4HZ1A6BD\\_navigation\\_0.html](http://www.esa.int/export/esaSA/SEM4HZ1A6BD_navigation_0.html)
- [23] R. Chen, F. Toran-Martí and J. Ventura-Traveset. "Access to the EGNOS Signal In Space Over Mobile-IP," *GPS Solutions* (2003), Vol. 7, No. 1 (in printing.)