Integration of SatCom / SatNav Technologies for Environmental Monitoring and Management of Emergencies

Prof. eng. Raffaela Cefalo

Head, Geodesy and Satellite Navigation Laboratory - GeoSNAV

Department of Civil and Environmental Engineering

UNIVERSITY OF TRIESTE – ITALY

cefalo@dica.units.it

3rd International Committee on GNSS
Pasadena, December 8-12 2008

Research Objectives

- Integration of satellite communication and satellite navigation solutions with space based observing systems for **prevention and management of emergencies**, occurring inside or outside Europe.

- The target of this Activity is the development of a User Platform in order to validate the technological concepts and acknowledge the benefits of an integrated communication/ navigation/observation infrastructure with the users.

Evolutions

- Complementarities of the satellite capabilities with the terrestrial capabilities will be assessed on the basis of a medium to long term view.
- Foreseeable evolution of spaceborne and terrestrial communication and navigation technologies will be taken into account .
- In particular the relevant developments in the GALILEO System.

TAM TAM Project

TAM TAM (Transmission of **A**lert **M**essages **T**hrough SB**A**S for Disaster **M**anagement)

- Evolution and implementation of the ESA ALIVE Concept in GMES (Global Monitoring for Environment and Security)

- Prevision and Management of Emergencies

- Provision of emergency communication messages through SBAS: the ESA ALIVE concept

- **ALIVE is the ALert Interface Via EGNOS for Disaster Prevention and Mitigation.**

- It acts as an interface between the various Disaster Management Centers and the users in distress.

Disaster Prevention

- **Importance of the prevention of disasters**

Various types of disasters:

ESA

Natural disasters:

- Earthquakes, volcanic eruptions, tsumanis, etc.
- Land slides, rock avalanches, etc.
- Tornadoes, hurricanes, wild fires etc.

Disaster Prevention

Anthropic disasters:

- Infrastructures collapses (bridges, buildings, etc.)
- Atmospheric/Earth/Marine dangerous pollutions, biological disasters
- Terroristic attacks, chemical and oil spills, etc.

High Potential Advantages

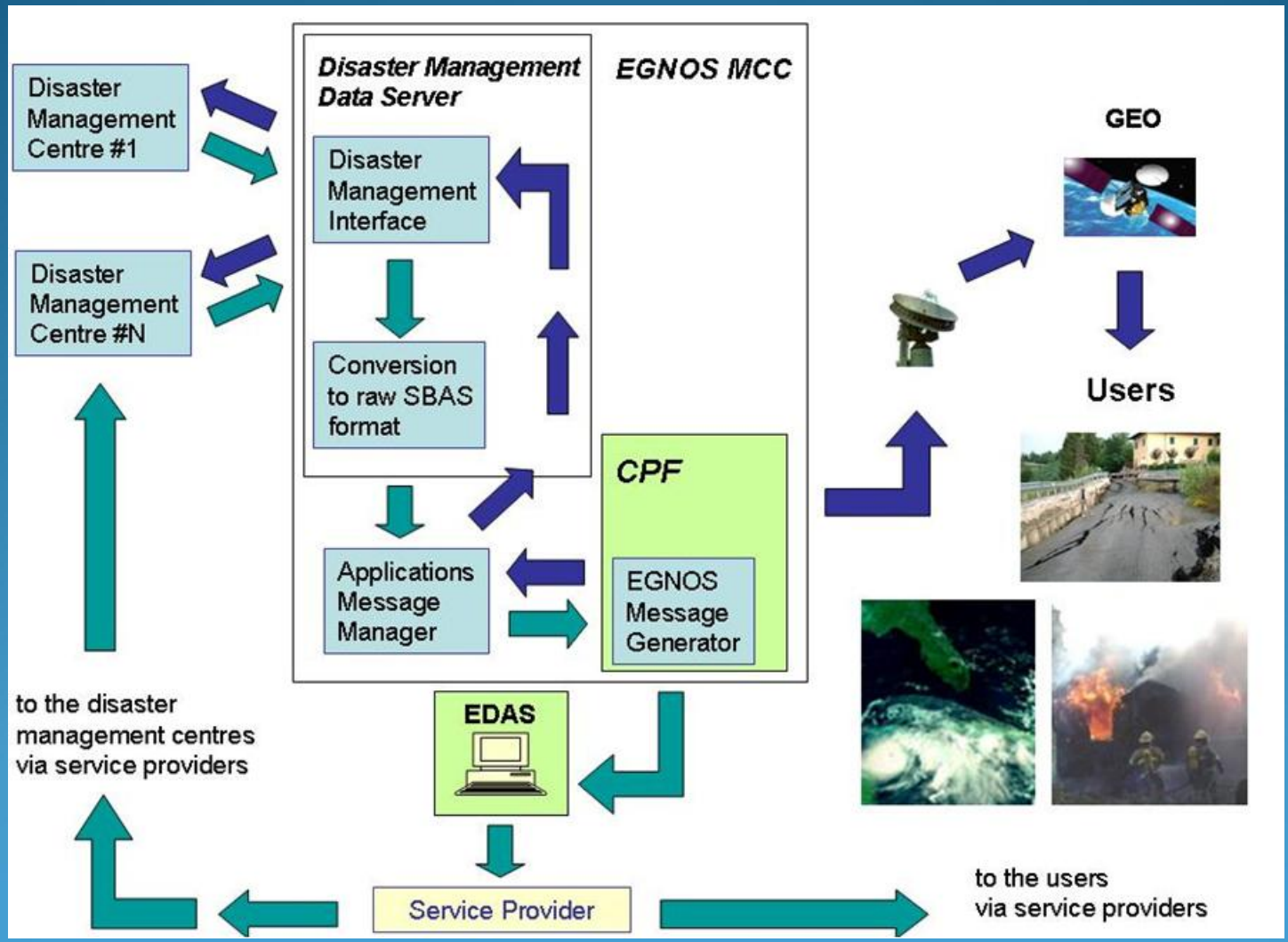
- Works in places with no infrastructure or where infrastructure is not operational

- SBAS receivers get alert message and also have their position simultaneously. Only users concerned need to act;

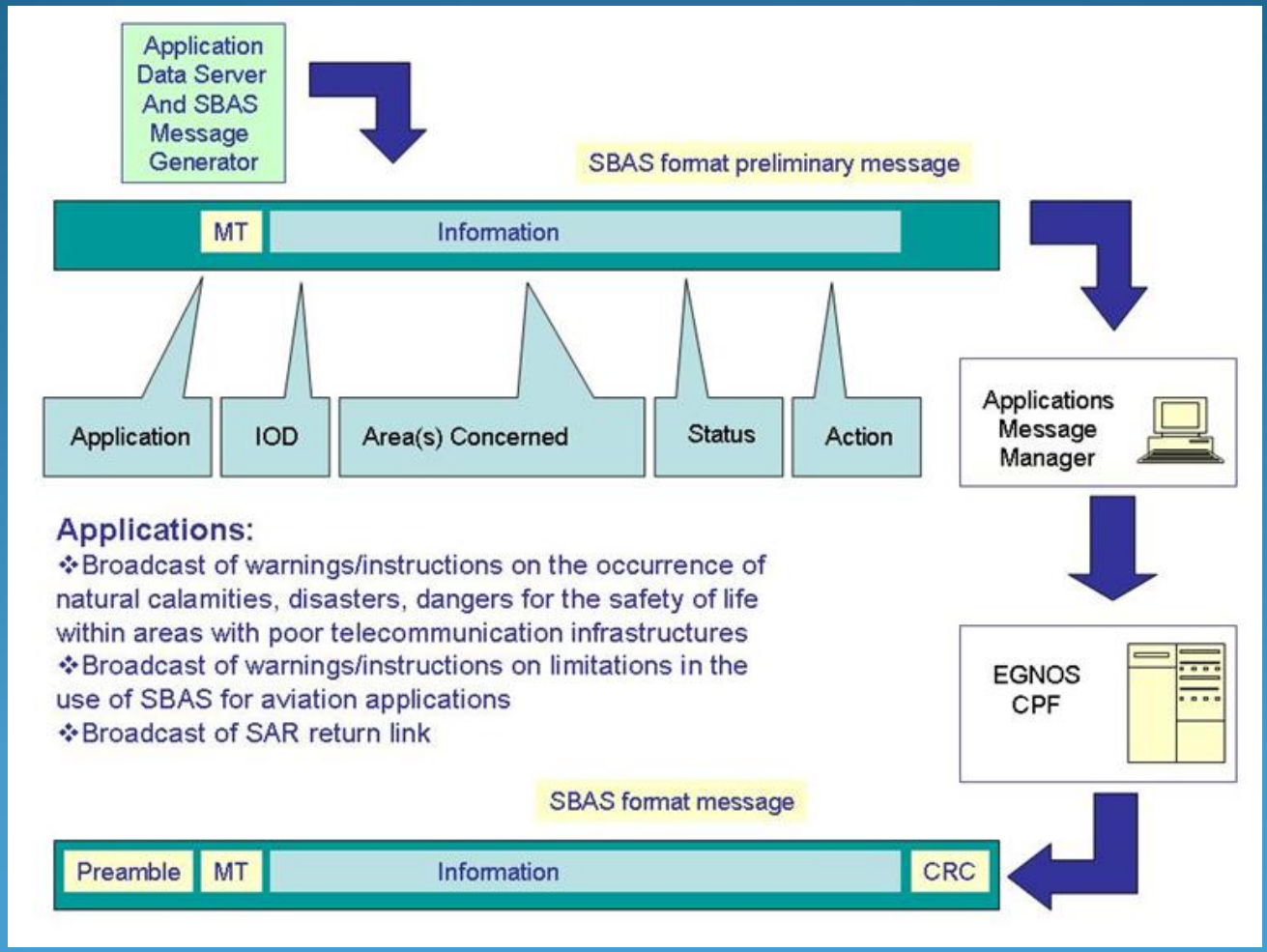
- SBAS operated with all guarantees:

  Safety of Life, Institutional control, 24hour non Stop; in time broadcasting confirmation message.

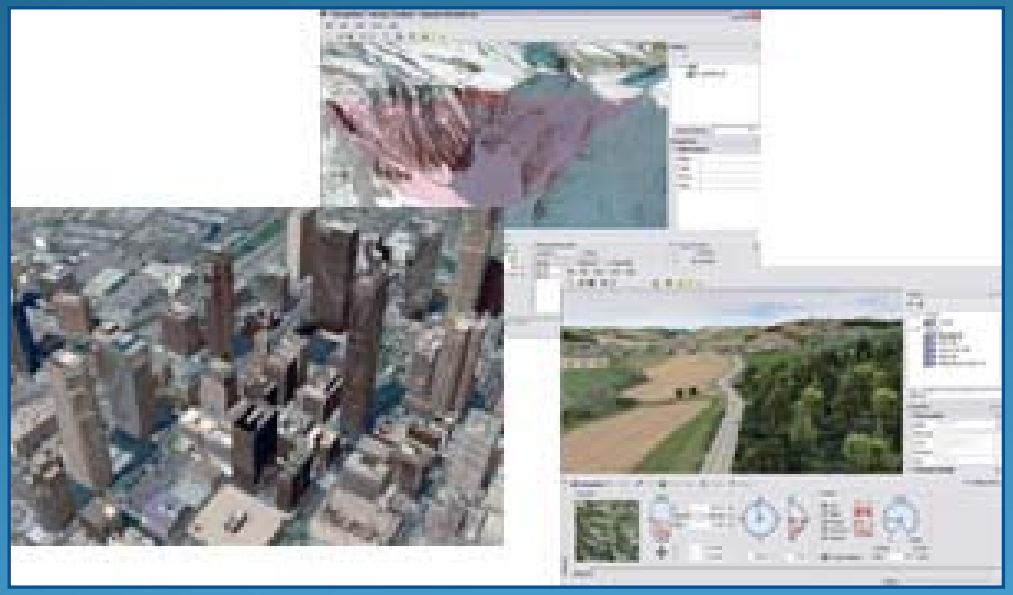
ESA ALIVE Architecture



SBAS format message



3D real time visualization at End User Terminals



http://www.google.com/mobile/default/maps-demo.html

SATNAV Technologies Real time Kinematic Applications

Development and Applications of an Experimental Data Server hosting EGNOS and RTCM / RTK messages

Calderan M., **Cefalo R.**, Montefusco C.

GeoSNAV Laboratory
Department of Civil and Environmental Engineering
University of Trieste, Italy

calderan@iuav.it, cefalo@dica.units.it, cmontefusco@enav.it

Correction Data Generation using EGNOS/SISNeT Tecnology

- *The implementation of the EGNOS Message Server (EMS) and the opportunities offered by the SISNeT (Signal-In-Space through the Internet) technology have encouraged the development of a number of applications within the GNSS users community.*
- *One possible application is to provide GNSS users with the best available correction data for their GPS measurements within the area of operations.*
- *Corrections can be based on: SBAS, RTCM and RTK data.*

Real Time Data transmission

- *The research idea is to make all the correction data available on a Data Server, allowing the GNSS users to access this server through a communication link and download the desired corrections.*
- *In this way GNSS users, depending on the application and on the operation area, can always benefit of the best available corrections.*

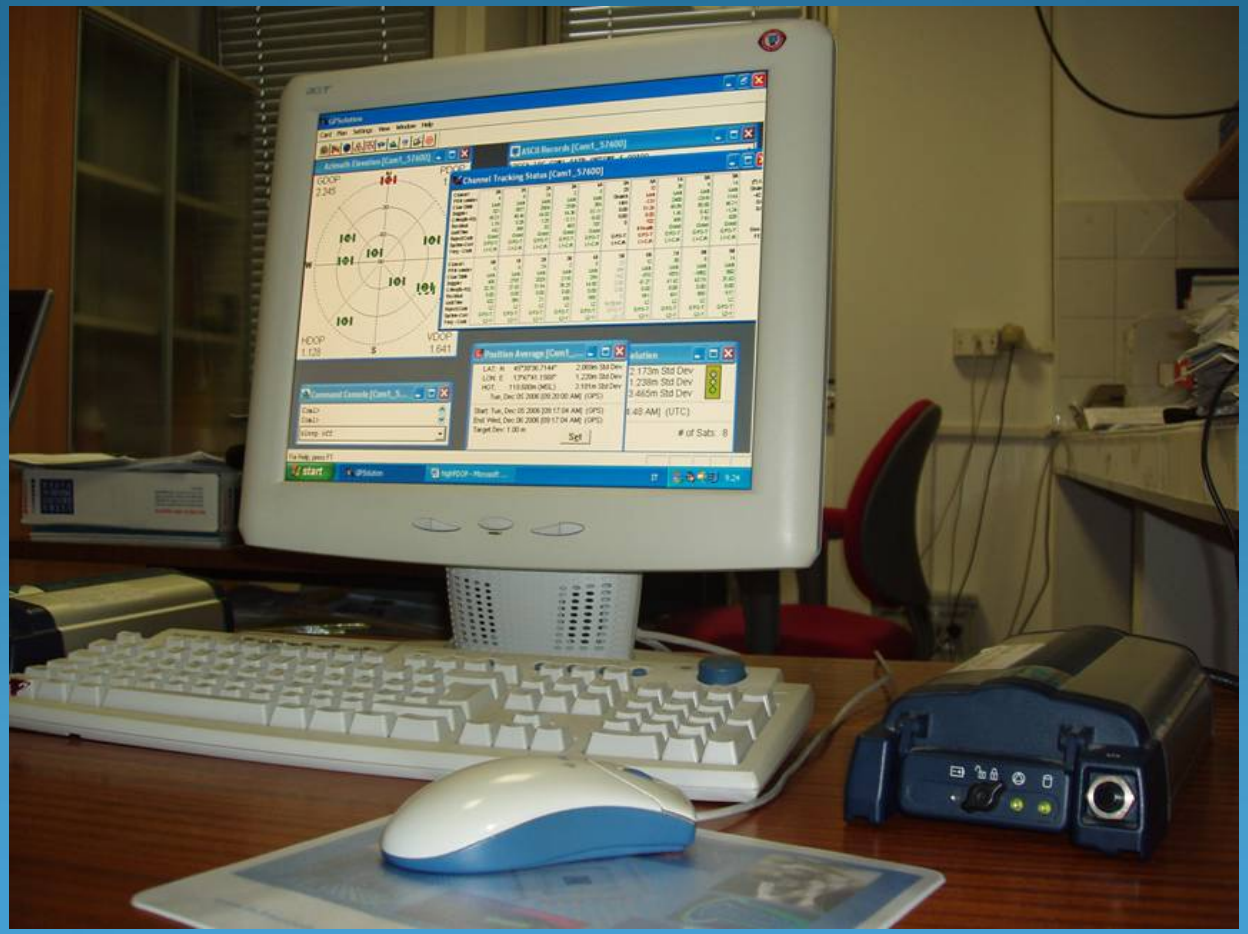
End User Terminals

- *All the corrections available on the Data Server are made accessible via **VPN (Virtual Protected Network)** through the Internet to authorised users equipped with an **integrated GPS/EGNOS/GPRS terminal**.*

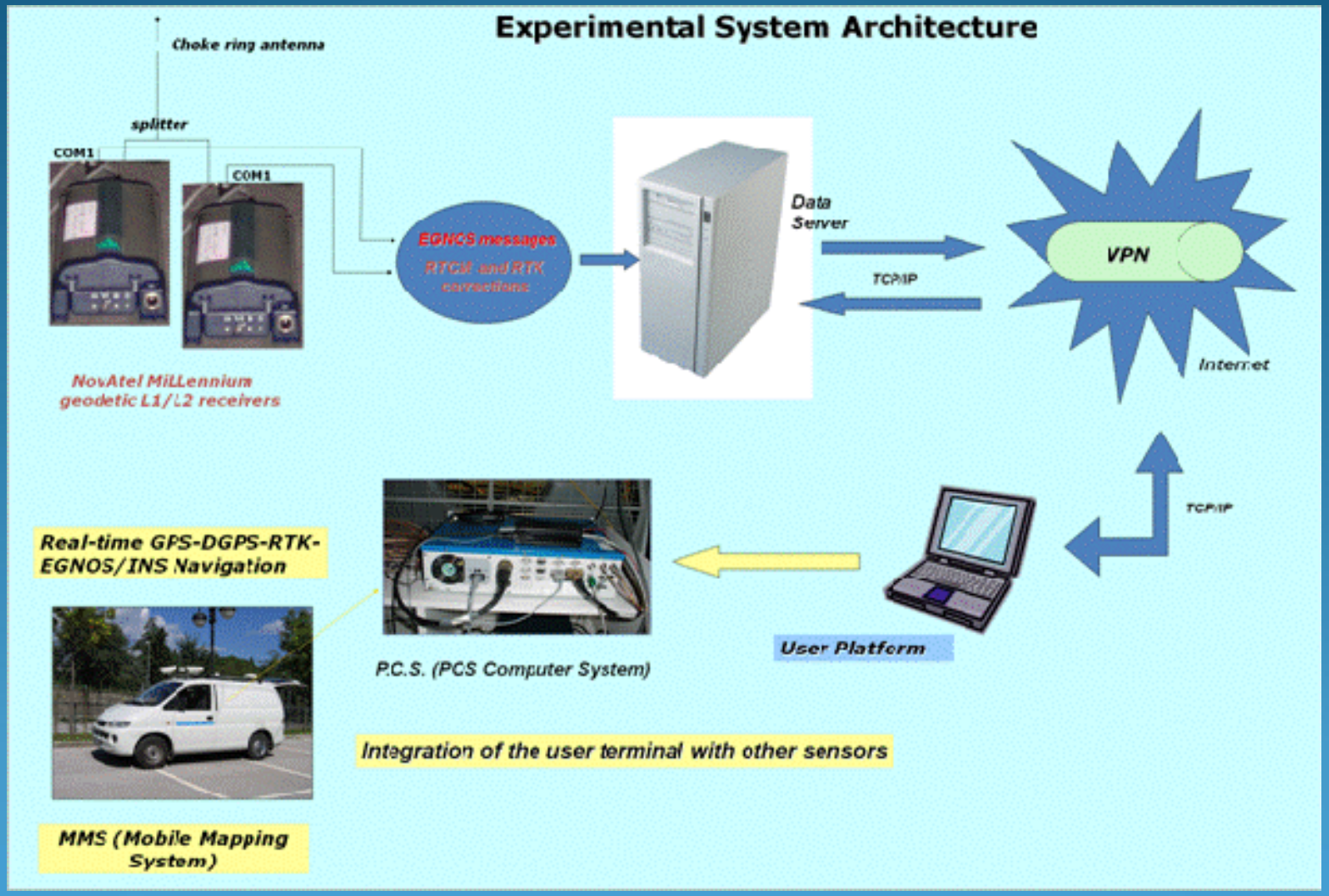
Experimental Data Server

- *An **experimental Data Server making available at the same time EGNOS augmentation messages as well as RTCM and RTK differential corrections**, computed by dedicated receivers located at a known reference position, has been set up at **GeoSNav Laboratory**, Department of Civil Engineering University of Trieste, ITALY.*

The Experimental Local Data Server at GeoSNAV Laboratory



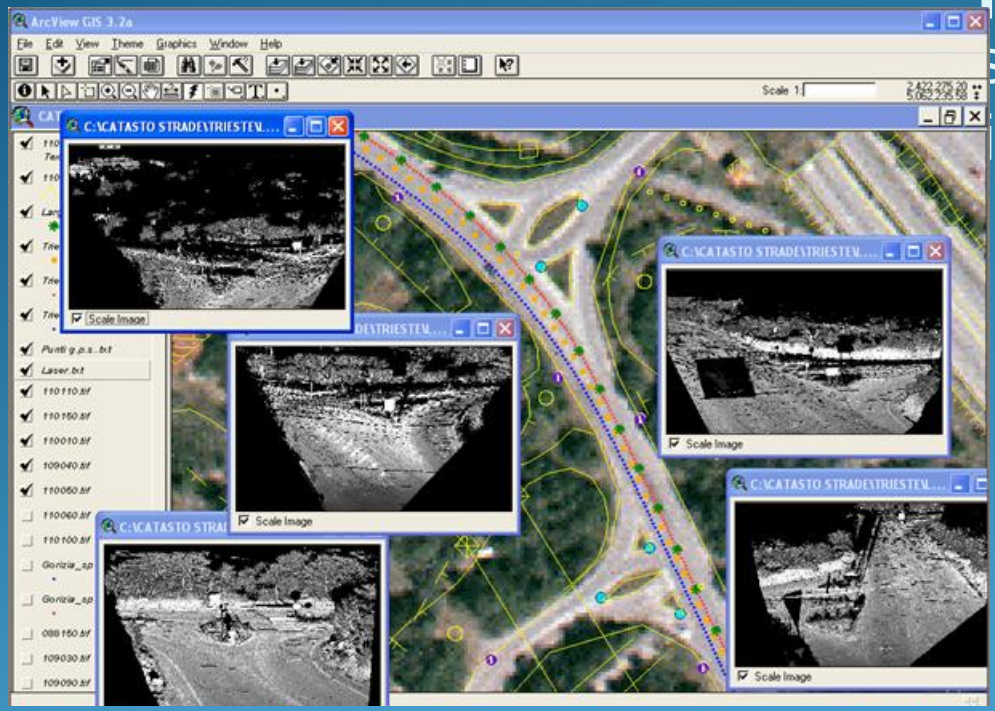
The Experimental System Architecture



Kinematic Applications - examples

search in TeleGeomatics

es



Integration with Laser Scanner data

Road Cadaster

Some examples of available Message Types

$RTCM59,665D7F557679694C67537241484B7D6A457B7F675F68786D6A5E757F775D724476407B7
F7F5F41547F6B56687651464C69717540606E696157445665676E787F52684E667F5974535D58447C
7F7B4F4B5B6E5048624C5540405E41525E63426E704D434B40604D6544707570477754 7D7F536475
5D707A5A6756547F79606A7E7F47*2F
$RTCM59,665D7F557679494567674D7E7744255664741645F6878655E714E4048676D70497F747F
7F7F41477F6B5B697851465C4C665D40606E7946574456524C4C4C4077576E5D406D4B6C5A68684
34044627567516F774346597F7F7E416D615C795167687F737F5F7A54447075705E4C7740405C6857
5F707A464741757F7A606A447F4E*22
$RTCM59,665D7F5576797149675072414 84B7D6A71767D7B5F687869
40607D407F6B55686351467C734E667F5F71664A5744564E625B4C40
4044746E64516F4F575F487F7F4861625E6378516B7B7F5340604D6F
634F45437B796A7F5B5F4547405F*27
$RTCM59,665D7F5553466E7E58517241484B7D6A41757F625F687861
40407D7640547A55486E795D697E45406076724D574456427A7E4940
7F7B614F596E507046717A7F7F6C7E53615C7C515355714B40607366
634F457A6452444072605A717F71*56

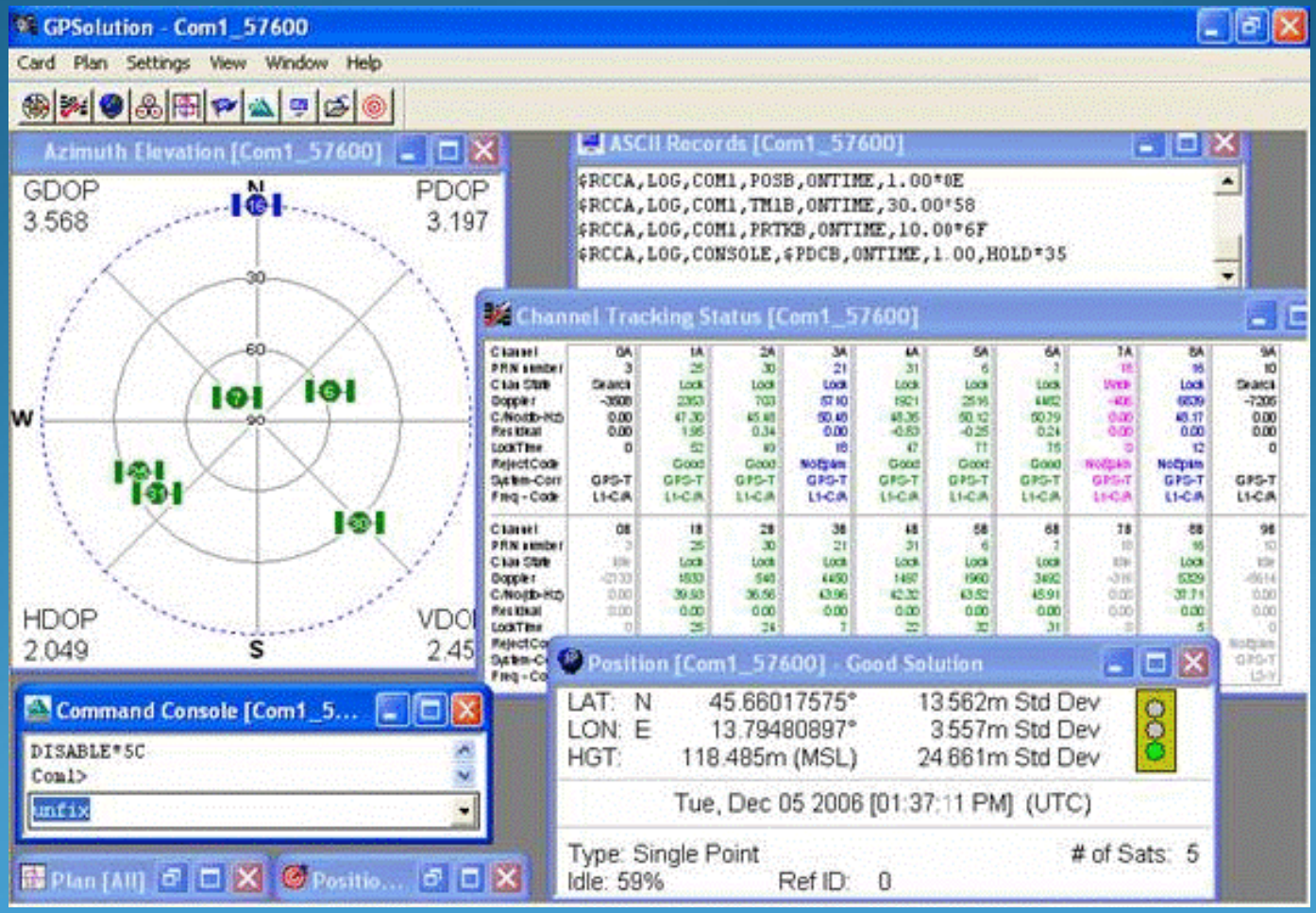
$GPGGA,131723.00,4539.6123860,N,01347.6873391,E,9,05,
1.6,116.67,M,,,,*04
$GPGGA,131724.00,4539.6122935,N,01347.6872930,E,9,05,
1.6,116.82,M,,,,*08
$GPGGA,131725.00,4539.6122765,N,01347.6872205,E,9,05,
1.6,117.01,M,,,,*05
$GPGGA,131726.00,4539.6122583,N,01347.6871378,E,9,05,
1.6,117.35,M,,,,*03
$GPGGA,131727.00,4539.6122169,N,01347.6871607,E,9,05,
1.6,117.59,M,,,,*05
$GPGGA,131728.00,4539.6121151,N,01347.6871835,E,9,06,
1.6,118.04,M,,,,*09
$GPGGA,131729.00,4539.6121016,N,01347.6872149,E,9,05,
1.6,118.35,M,,,,*0A
$GPGGA,131730.00,4539.6120948,N,01347.6872013,E,9,06,
1.6,118.91,M,,,,*02

$FRMA,379,479700.127,120,80811EA4,250,53023FB8003FE80
FE8003B97B913B93BB88EC3EC0*3B
$FRMA,379,479701.127,120,80811EA4,250,9A60000008000000
00003F740000000425625800*42
$FRMA,379,479702.128,120,80811EA4,250,C66A4810808404
FF7FFBFFDFFEFFF780128D4E00*39
$FRMA,379,479703.128,120,80811EA4,250,530E0003FE800BFF4003FF0000010003FF00000
0000391FBBB9393BBBE212BC0*3E
$FRMA,379,479704.128,120,80811EA4,250,9A003FC4003FE8000003FFBFE8000003FD0003
FE8003B97B913B93BBA0ADA1C0*35

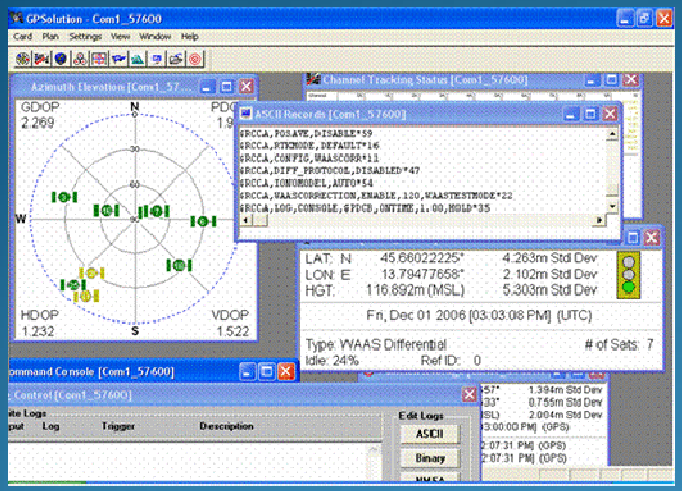
Stand Alone GPS

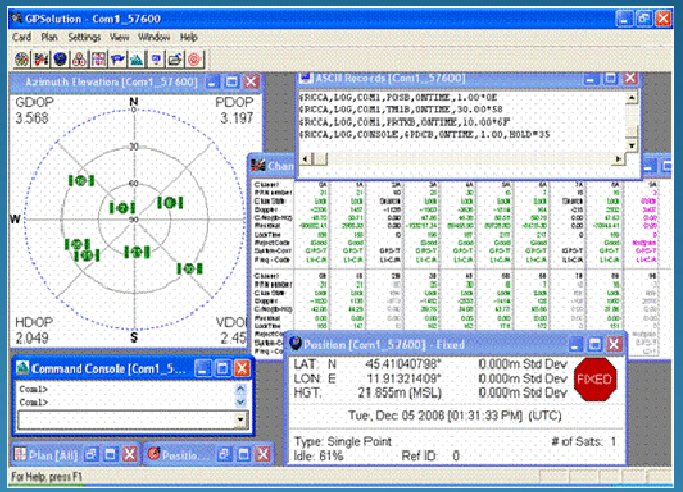
Real Time Positioning Performances

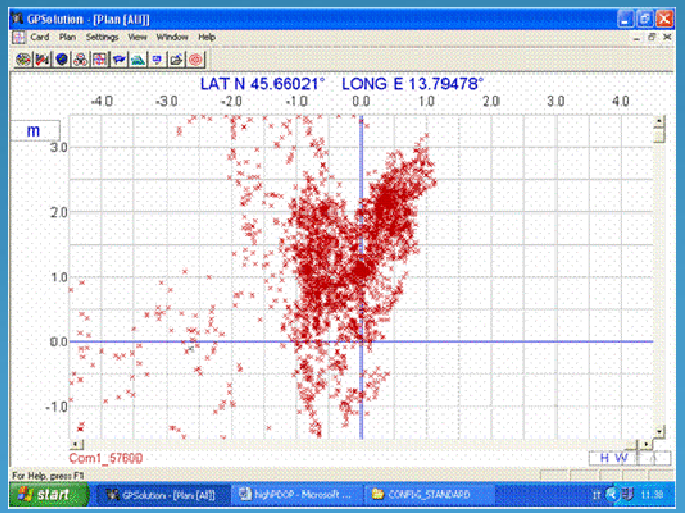
Real Time Positioning Performances - Stand Alone GPS



Real Time Positioning **EGNOS Performances** and RTCA corrections generation



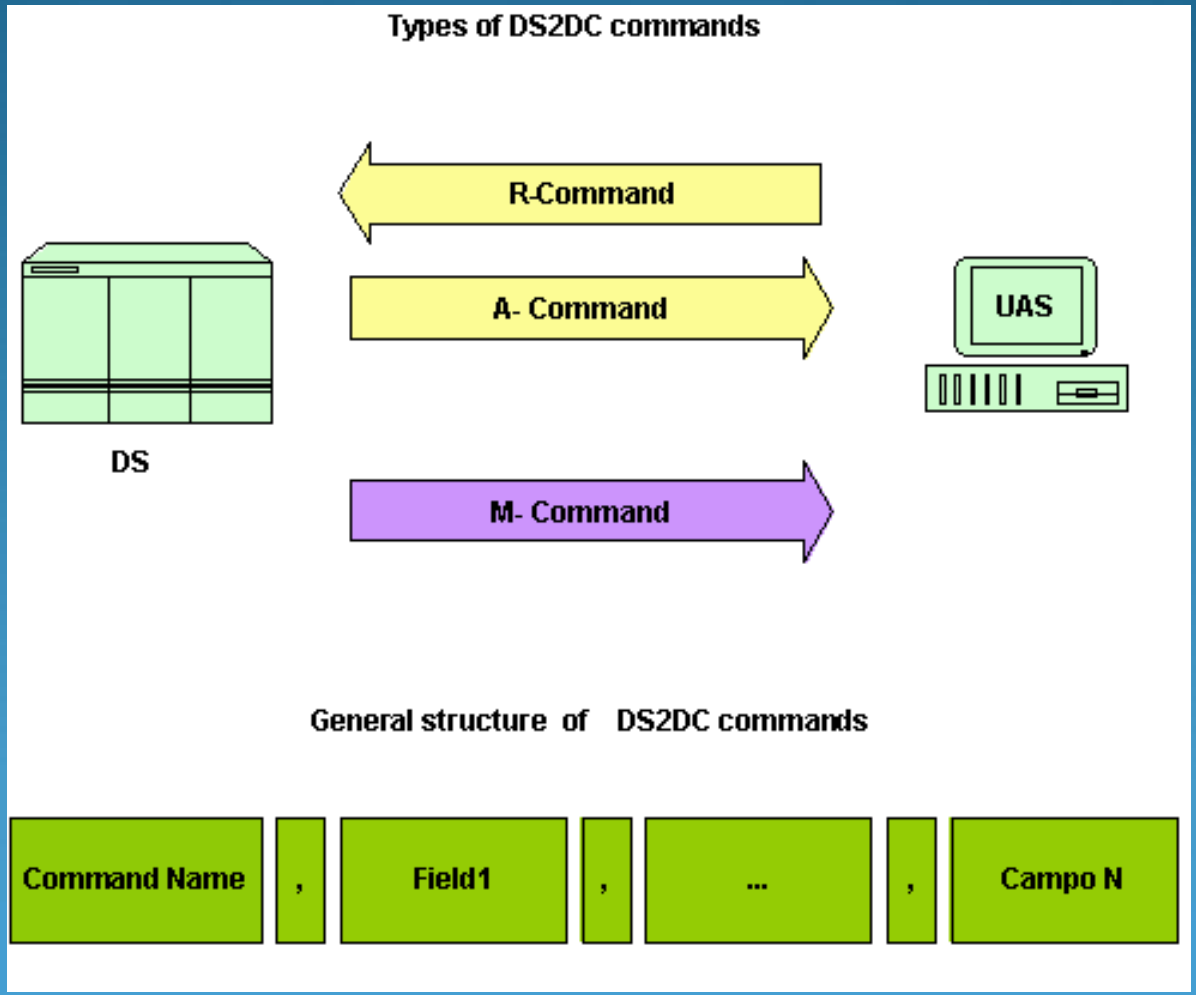




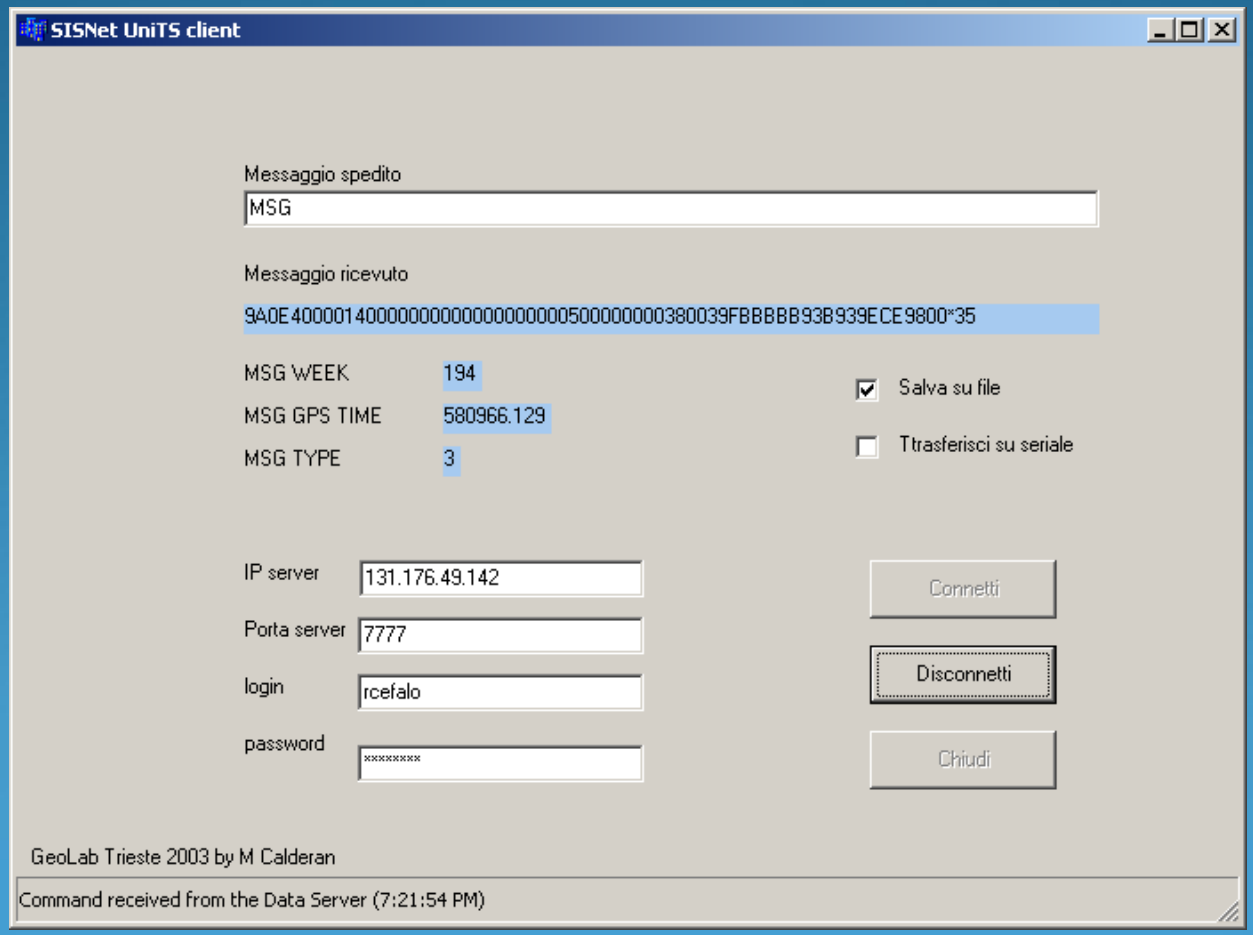
Real time EGNOS positioning

RTCM/RTK corrections generation

UNITS UAS (User Application Software) Architecture



SISNeT UAS UNITS client



Accuracy related to User Needs

- *Depending on the operational conditions and on the operation area (distance from reference station/visibility of EGNOS satellites), the **user can choose the augmentation** to be included in the computation of position, velocity and time.*
- *The research project has encompassed the following activities:*

✓ ***Development of the Data Server***

(2 GPS/SBAS receivers + 1 PC + dedicated SW)

✓ ***Development of the User Terminal***

(1 GPS/GPRS/UMTS terminal + dedicated SW)

Encompassed Activities

- *Tests on the availability/accessibility of augmentations on the data server*
- *Tests on the communication link between the server and the user terminal*
- *Static and dynamics tests to assess the navigation performance of the user terminal*
- *Integration of the user terminal with other sensors*

References

- ***A. R. Mathur, J. Ventura – Traveset, C. Montefusco, F. Toran, H. P. Plag, L. Ruiz, I. Stojkovic, J.C. Levy , 2005***

Provision of emergency communication messages through SBAS: The ESA ALIVE concept , IAIN 2005,

http://www.egnos-pro.esa.int/Publications/navigation.html

- ***M. Calderan , R. Cefalo, C. Montefusco, 2008***

Development and Applications of an Experimental Data Server hosting EGNOS and RTCM /RTK messages, IIN Journal, in printing

- **http://www.esa.int/esaNA/egnos.html**

- **http://cordis.europa.eu/fp7/home_en.html**

The Authors

Thank you for your Attention!