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

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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 Alert Messages Through SBAS for Disaster Management)

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:

Natural disasters:
- Earthquakes, volcanic eruptions, tsunamis, etc.
- Landslides, 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, 24-hour non-stop, in time broadcasting confirmation message.
SBAS format message

Applications:
- Broadcast of warnings/instructions on the occurrence of natural calamities, disasters, dangers for the safety of life within areas with poor telecommunication infrastructures
- Broadcast of warnings/instructions on limitations in the use of SBAS for aviation applications
- Broadcast of SAR return link

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3D real time visualization at End User Terminals

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

NovAtel Millenium geodetic L1/L2 receivers

Real-time GFS-DGPS-RTK-EGNOS/INS Navigation

Integration of the user terminal with other sensors

MMS (Mobile Mapping System)

P.C.S. (PCS Computer System)

User Platform

TCP/IP

VPN

Internet

TCP/IP

Data Server

EGNOS messages, RTCS and RTK messages

Choke ring antenna

splitter

COM1

COM1
Kinematic Applications - examples

Centre of Excellence for Research in TeleGeomatics Activities

Road Cadaster

Integration with Laser Scanner data
Some examples of available Message Types

$SRTCM59,665D7F5557679694C6753724148B7D6A457B7F675F68786D6A5E75F775D724746407B7F7F5F4547F66B687561464C6971754060E69815745665676E787F52684E66F5974535D5847C7F7B4F4B56E5048624C554040E4152E63426E704D434B40604D65447075704775745D7F5364755D707A5A6756547F79606A7E7F47*2F
$SRTCM59,665D7F5557679454567674D7E7744255664741645F687865E714E4048676D70497F747F7F7F41477F6B5B697851465C4C665D4060E794657456524C4C4C4077576E5D406B4B5A6868434044627567516F774346597F7F7E416D15795167687F737F75FA4447075705F47C774050C8687
5F707A464741757F7A606A447F4E*22
$SRTCM59,665D7F555767971496750724148487D6A71767D7B5F6878694060D7D0765B5566351467C734E667F5F71664A5744554625B4C404044746E4516F4F57F5487F7F4861625E63785167B7F75340604D6F634F4547B796A7F5B5F4547405F*27
$SRTCM59,665D7F5553466E7E5881721448487D6A41757F625F68786940407D640547A55486E795697E454506076724D574546427E7E49407F7B614F596E507046717A7F7F6C7E536157C515355714B40607365464547A4544407260A717F71*56

$GPNGA,131723.00,4539.6123860,N,01347.6873391,E,9.05,1.6,116.67,3M,,,*04
$GPNGA,131724.00,4539.6122935,N,01347.6872930,E,9.05,1.6,116.82,3M,,,*08
$GPNGA,131725.00,4539.6122765,N,01347.6872205,E,9.05,1.6,117.01,3M,,,*05
$GPNGA,131726.00,4539.6122583,N,01347.6871378,E,9.05,1.6,117.35,3M,,,*03
$GPNGA,131727.00,4539.6122169,N,01347.6871607,E,9.05,1.6,117.59,3M,,,*05
$GPNGA,131728.00,4539.6121151,N,01347.6871835,E,9.05,1.6,118.04,3M,,,*09
$GPNGA,131729.00,4539.6121016,N,01347.6872149,E,9.05,1.6,118.35,3M,,,*0A
$GPNGA,131730.00,4539.6120948,N,01347.6872013,E,9.06,1.6,118.91,3M,,,*02

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Real Time Positioning Performances

Stand Alone GPS
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

Types of DS2DC commands

- R-Command
- A-Command
- M-Command

General structure of DS2DC commands:

Command Name, Field1, ..., Campo N
SISNeT UAS UNITS client

IP server: 131.176.131.42
IP at server: 7777
Login: icetalo
Password: [***]

Message sent:
MSG

Message received:
9A0E40000040000000000005000000000000003FBB85EB99E9EB3800C5

MSG WEEK: 194
MSG GPS TIME: 580966.129
MSG TYPE: 3

Save file
Transfer via serial

Command received from the Data Server (7:41:54 PM)
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

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  [http://www.egnos-pro.esa.int/Publications/navigation.html](http://www.egnos-pro.esa.int/Publications/navigation.html)

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

Thank you for your Attention!