SPACE

# GNSS MONITORING NETWORKS

Satellite communications, earth observation, navigation and positioning and control stations

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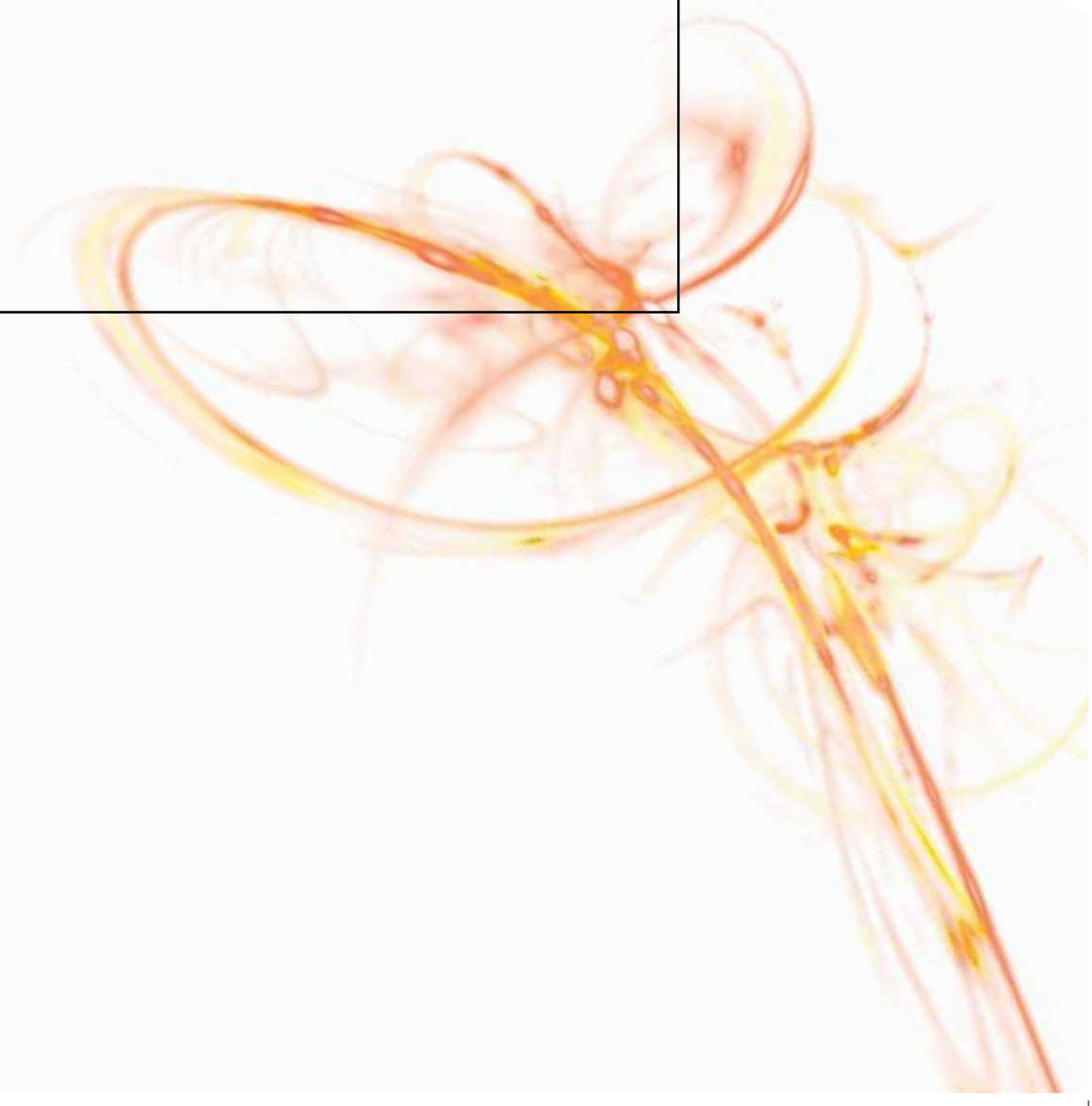


# GNSS MONITORING NETWORKS

Indra's solutions portfolio for GNSS monitoring covers from single and transportable GNSS monitoring station up to worldwide networks of stations.

## Introduction

The extension of the GNSS constellations and the use in different applications implies the need to have specific monitoring tools to verify the Quality of the Service provided. These GNSS Monitoring facilities measure key performance indicators at each level of the service chain: at Service Provider level, for continuous supervision of the quality of the service; at the user level (Aeronautical Navigation Service Providers, for instance) for continuous checking of the performances needed for their applications; etc..

## Overview

A GNSS Monitoring facility is composed of a network of sensor stations, a communications network and a central processing facility.

The sensor station is in charge of capture the Signal-in-space of a set of GNSS constellations, prepare and retransmit to the central processing facility. A set of sensor stations will be distributed in the Service Area of interest.

The communications network could be based on a proprietary network or using the internet infrastructure, with the appropriated security elements.

The central processing facility polls all the sensor stations of the network, preprocess the raw data, evaluate the quality of that data and compute the different key performance indicators of the accuracy, integrity, availability and continuity, system parameters like the status of the satellites, the errors distribution, the ionosphere maps, etc.

## EGNOS Mission Monitoring

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

As part of the EGNOS infrastructure, a monitoring chain was implemented for the continuous evaluation of the quality of service provided. INDRA developed two main elements of the monitoring chain:

- RIMS (Ranging and Integrity Monitoring Stations)
- Mission Monitoring tool (as facility inside the CCF Central Control Facility)

The RIMS constitute the network of ground reference stations of the EGNOS System. A total of 46 stations have been manufactured up to now: 37 deployed, 4 planned in near future (as per Aug2010), the rest as test platform.

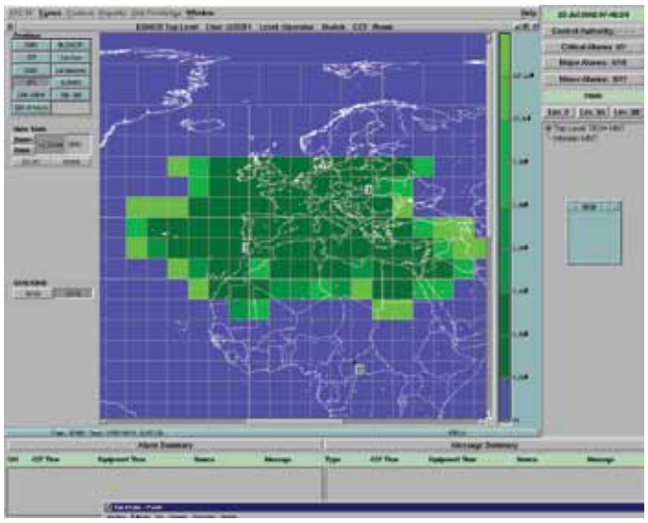
The **RIMS** purpose is to collect satellite data and raw measurements from GPS, GLONASS and GEO; to transmit these data to the facility in charge of the integrity and differential corrections computation; and to transmit the other facility in charge of archiving them, and to evaluate the Quality of the Service by means of the Mission Monitoring tool.

The main functions are the following:

- Perform pseudorange code/phase measurements towards the satellites in view (GPS L1 and L2 signal + GEO L1 + GLONASS L1 signal)
- Demodulate Signal in Space (SIS) messages
- Mitigate local multipath and interference
- Support the detection of anomalies in signals from space
- Packet and transmit data to the MCCs via the EGNOS wide area network
- Provide BITE and Remote Monitoring & Control capabilities

The **Mission Monitoring tool** has the following functions:

- Evaluation of different quality-of-service indicators (QoSi) for the different modes of navigation covered by EGNOS
- Continuous Monitoring
  - Accuracy: Global, over the service volume; Local, in each RIMS
  - Availability: Global
  - Indicators: Local Accuracy Factor, Instantaneous Availability Factor, Short Term Accuracy Indicator, Change Service Level
  - Satellites status: GNSS status, as per integrity flags
  - Ionospheric delay and error
- Prediction
  - Availability: Global, expected for the next hours



## GSTB: Galileo system test bed – GIOVE Mission Segment

http://www.giove.esa.int/

The Mission Segment of the Galileo experimental satellites (GIOVE A+B) were lead by INDRA. As a functional chain, a GIOVE signal monitoring network was implemented based on a set of GESS (Galileo Experimental Sensor Stations) and a GPC (GIOVE Processing Facility).

The **GESS**, manufactured by INDRA, is a dual-constellation multi-frequency multi-receiver station that is capable of tracking GPS L1, L2 and L5 and Galileo L1, E5a, E5b, E5 (AltBOC) and E6 signals

The main capabilities of Sensor Station are:

- Acquisition of the SiS from GIOVE satellites and GPS constellation
- Support up to 3 receivers and 2 antennas
- Provision of a high quality frequency reference, based on RAFS
- Generation of raw data 15min files
- Compression and local archive up to 10 days
- Support to the remote monitoring, configuration and control from the GPC
- Remote SW upgrades from the GPC
- Local console for first level of maintenance
- Support more than 1 hour of power outages

Inside the GPC, the **Data Server Facility** (DSF), developed by INDRA, is in charge of:

- Data Collection and Archiving :
  - Near real time raw data acquisition (every 15 mn)
  - Decompression, conversion of data to RINEX 3.00
  - GIOVE telemetry collection
- System Monitoring and Control
  - GESS Data Quality Assessment
  - GESS Remote Monitoring & Control facilities
  - GPC Processing facilities monitoring and Control
- Data Processing Management
  - Routine Navigation Message generation scheduling
  - Experimentation Core Products Data Collection
- Data Distribution
  - FTP and Web services
  - Users Access control, authentication and authorization

Reference Antennas

20 U GESS (1 receiver unit)


38 U GESS (3 receiver units)

## Portable GNSS Monitoring Station (PGMS)

The objective of the Portable GNSS Monitoring Station (PGMS) is to monitor the performance of a GBAS Cat-I station available in an airport and the other GNSS systems. The whole monitoring station is independent from any of the systems that it is monitoring, and has been designed to be easily deployed on field and transported.

The monitor receives the signals from the GPS constellation (L1), the SBAS satellites in the region (EGNOS in the European region) and the signals from a nearby GBAS Cat-I station.

PGMS computes the navigation solution with the different augmentation systems. Positioning errors, protection levels, integrity and availability are obtained for GPS, GPS-RAIM, SBAS and GBAS solutions. The station also monitors the quality of the received signals through the correlation function analysis and the interferences in the L-band and VHF bands of interest.

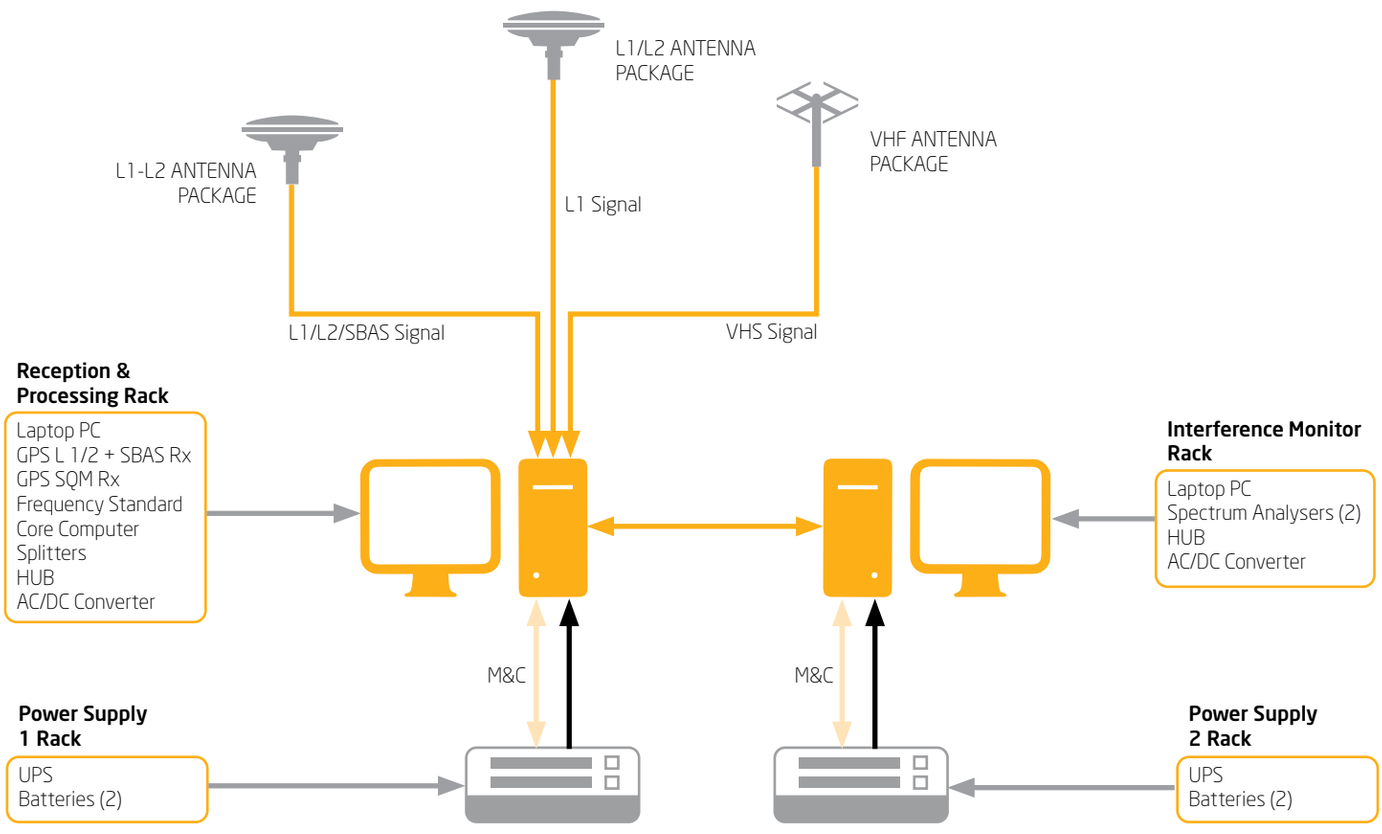
The Monitor is able to work autonomously (without operator assistance) for long periods of time (minimum 8 hours with batteries) acquiring and processing GNSS data.

It is equipped with an operator's interface that can be activated to follow the process in real time.

Special emphasis is put on the data storage, retrieval and exportation and on the robustness of the continuous collection.

All acquired data, intermediate results, processed data, alarms, alerts, status information, etc. are stored, assuring its integrity, and can be exported to the appropriate standard formats (ie PEGASUS).

A visualisation interface is provided to retrieve and plot the archived data.



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