ESA/ESOC Real Time Infrastructure

C.Garcia[1], J. Dow, J.Perez[1], I.Romero[1]

ESA/ESOC, Robert-Bosch-Str. 5, Darmstadt, Germany
[1]GMV at ESA/ESOC

Abstract

During the second half of 2002 and the first half of 2003 ESA/ESOC has updated its GPS Network for the provision of high rate real time data at all the sites (Kiruna, Kourou, Malindi, Maspalomas, New Norcia, Perth, Redu and Villafranca). It has been possible thanks to the availability of very stable IP connectivity. An application has been developed that is flexible enough to be used in different configurations to take into account the firewalls that are present in the various subnetworks (Intranet, corporate LANs and operational LANs). A compression scheme for the standard NMEA format has been developed to reduce the bandwidth. All the stations have been equipped with redundant Linux computers. The provision of the real time data of the first stations of the ESA/ESOC Network to the IGS Real Time project is expected by early 2004.

Introduction

The European Space Operations Centre (ESOC) has operated during the last decade a network of geodetic GPS receivers deployed at the European Space Agency (ESA) Ground Stations. During the year 2003 an action was carried out to improve the data latency of the network by delivering the data of the GPS receivers in real time to ESOC. It was achievable thanks to the spread availability of IP communications at all the ESA sites.

The motivation is to provide real time data for the projects that are currently demanding it and also to improve the latency of the “near real time” data, mainly 1 Hz 15 minutes files to be processed in batch mode.

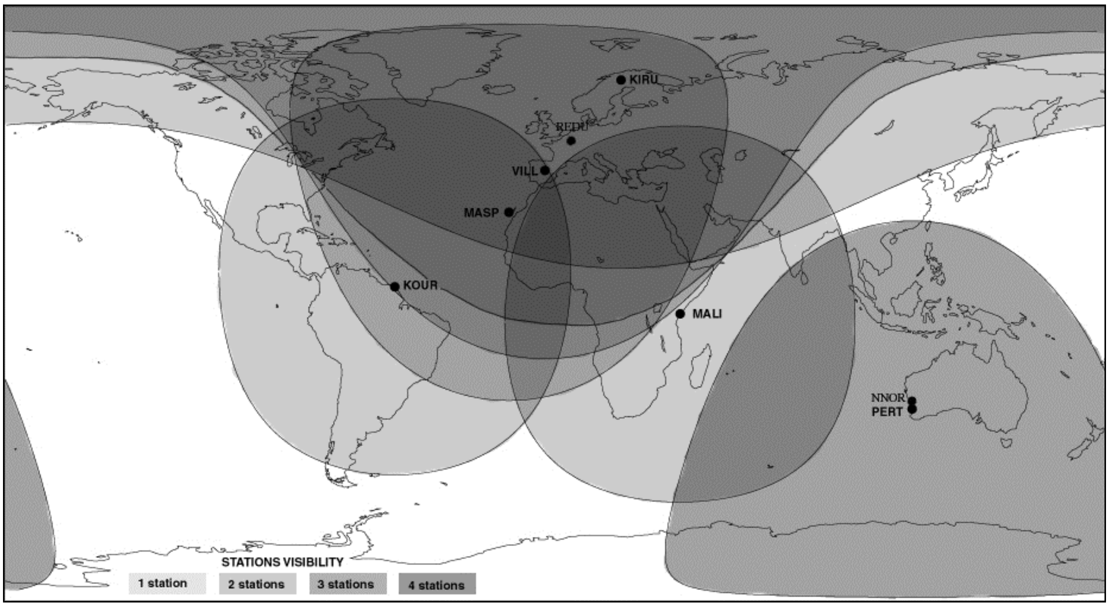

Figure 1: ESA Network Visibility

Station equipment

The intention is to provide a common equipment set-up at all stations.

All the stations have dual frequency geodetic GPS receivers. There is on-site back-up equipment (receivers and antennas) at the most critical stations to reduce the downtime in case of equipment failure.

A second computer has been installed at the stations working as a warm back-up. They are Linux OS that is suitable for the real time transmissions. The original Windows computers are being replaced by Linux.

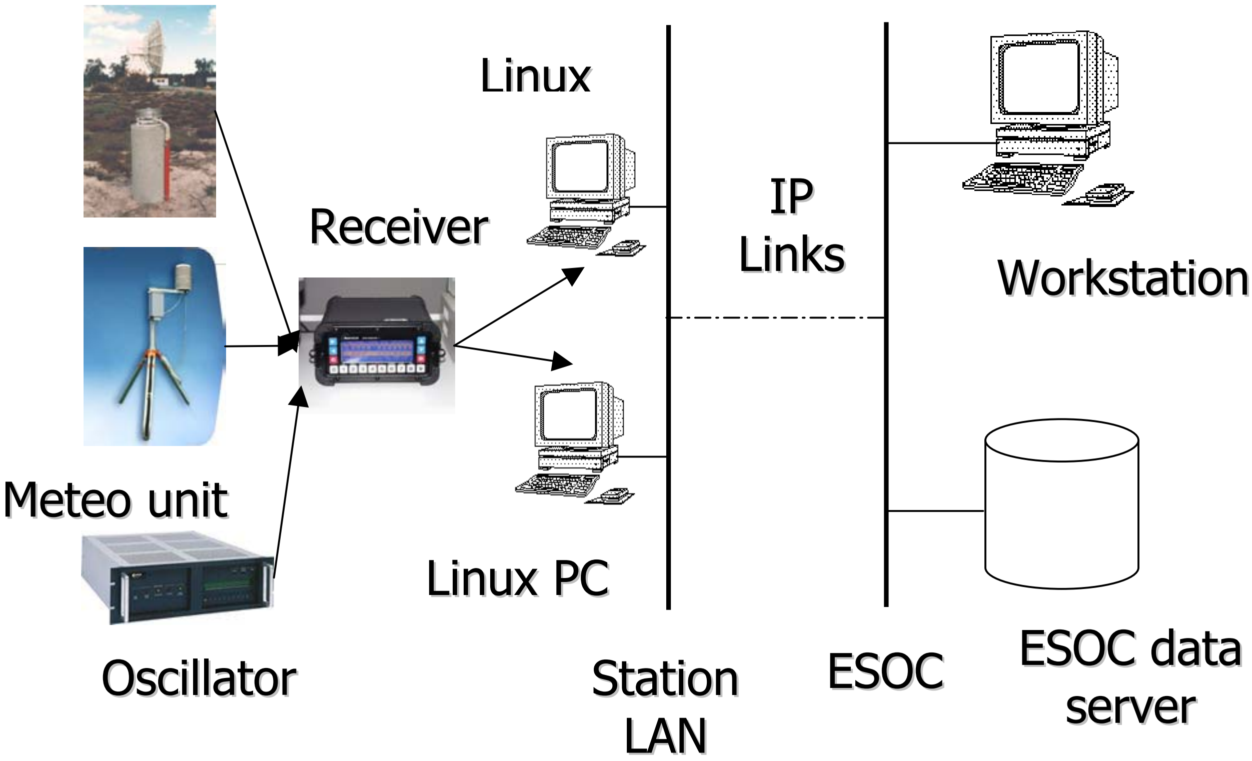

Figure 2: ESA GNSS stations equipment

	KIRU	KOUR	MALI	MAS1	NNOR	PERT	VILL	REDU
Receiver	microZ	Z-XII	Z-XII	Z-XII	Z-XII	microZ	Z-XII	microZ
On-site back-up equipmnt	**Turborogue ACT**	**iCGRS + antenna**	**microZ + antenna**	**Turborogue ACT +antenna**	**microZ + antenna**			
Computer	2 units	2 units	2 units	2 units	2 units	2 units	2 units	1 unit
Oscillator	Cs	Cs	Rb	Cs	H-Maser	Cs	Cs	Cs
Comms	Internet	Intranet (Office LAN)	Internet (VSAT to Rome)	Internet	Intranet Opsnet	Intranet Opsnet	Intranet (Office LAN)	Intranet (Office LAN)
Real time status	1 Hz to **ESOC and IGS**	1 Hz to **ESOC**	1 Hz to **ESOC and IGS**	1 Hz to **ESOC and IGS**	1 Hz to **ESOC**	1 Hz to **ESOC**	1 Hz to **ESOC**	1 Hz to **ESOC**

Figure 3: ESA Network Status

Network configuration

The ESOC real time infrastructure makes use of several IP networks. Currently the main part of the system is located in the ESA Corporate Intranet (DEVLAN). Three stations (Villafranca, Kourou and Redu) are part of the same network.

The Australian stations, Perth and New Norcia, are accessed through the Operational networks (OPSNET). The data are delivered in real time to ESOC but the only possibility to move the data out of the OPSNET is via ftp.

Three stations are retrieved using Internet, Kiruna, Maspalomas and Malindi. Malindi has a dedicated VSAT to the University of Rome and it is forwarded to ESOC with the public Internet. The firewalls have been specially developed for the remote computers and can be modified according to the system needs.

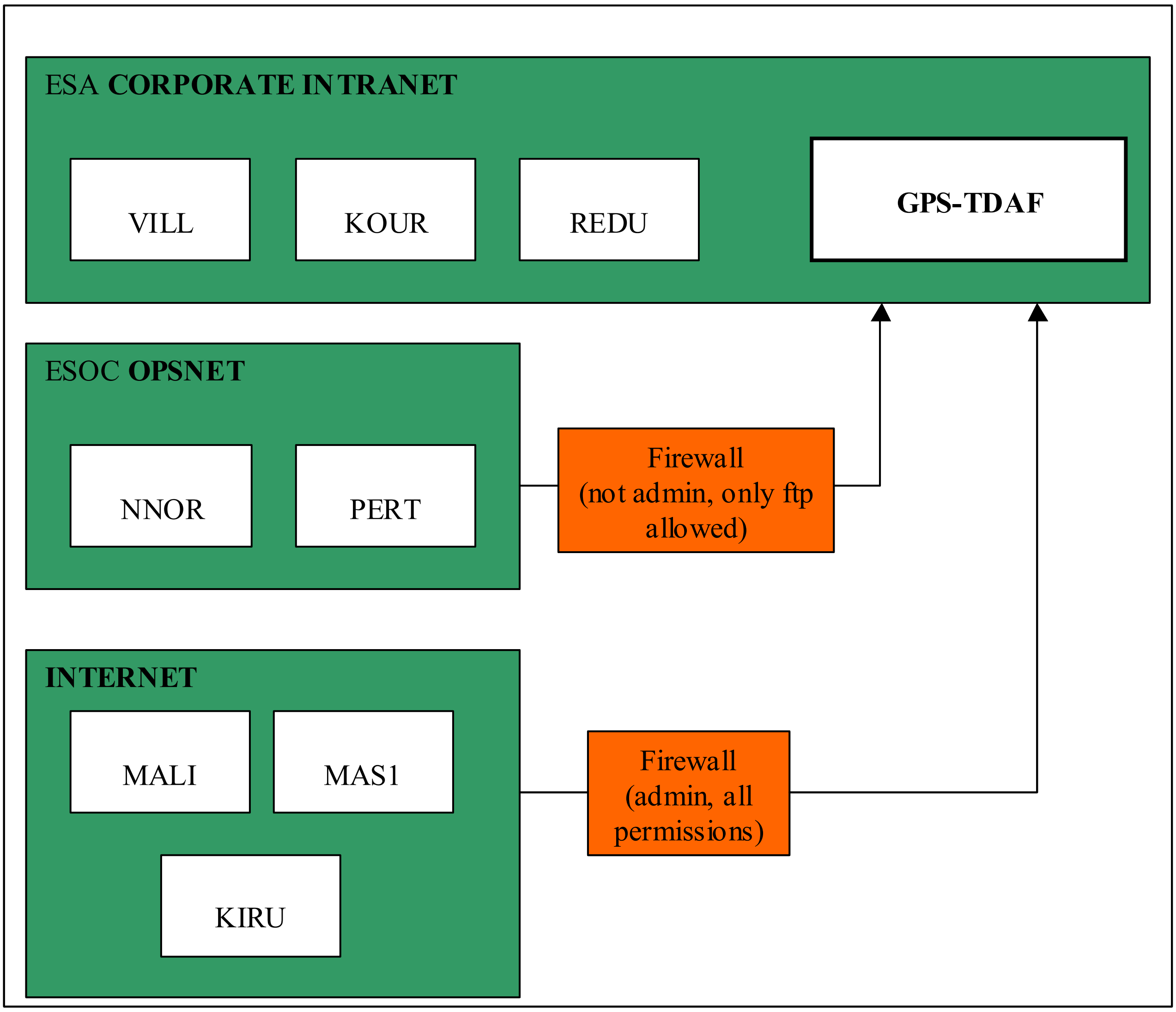

Figure 4: ESA GNSS stations IP network configuration.

System Architecture

Two applications coded in C have been developed for the real time data stream. They are:

GRTremote (GNSS Real Time System) for the remote stations. It performs the following tasks:

- Data logging from the receiver serial port.
- Compression.
- Sending to the network sockets and to the local disk.

GRTlocal at ESOC with the following functionality:

- Data reception from the IP network.
- Decompression.
- Splitting into files in the local disk.

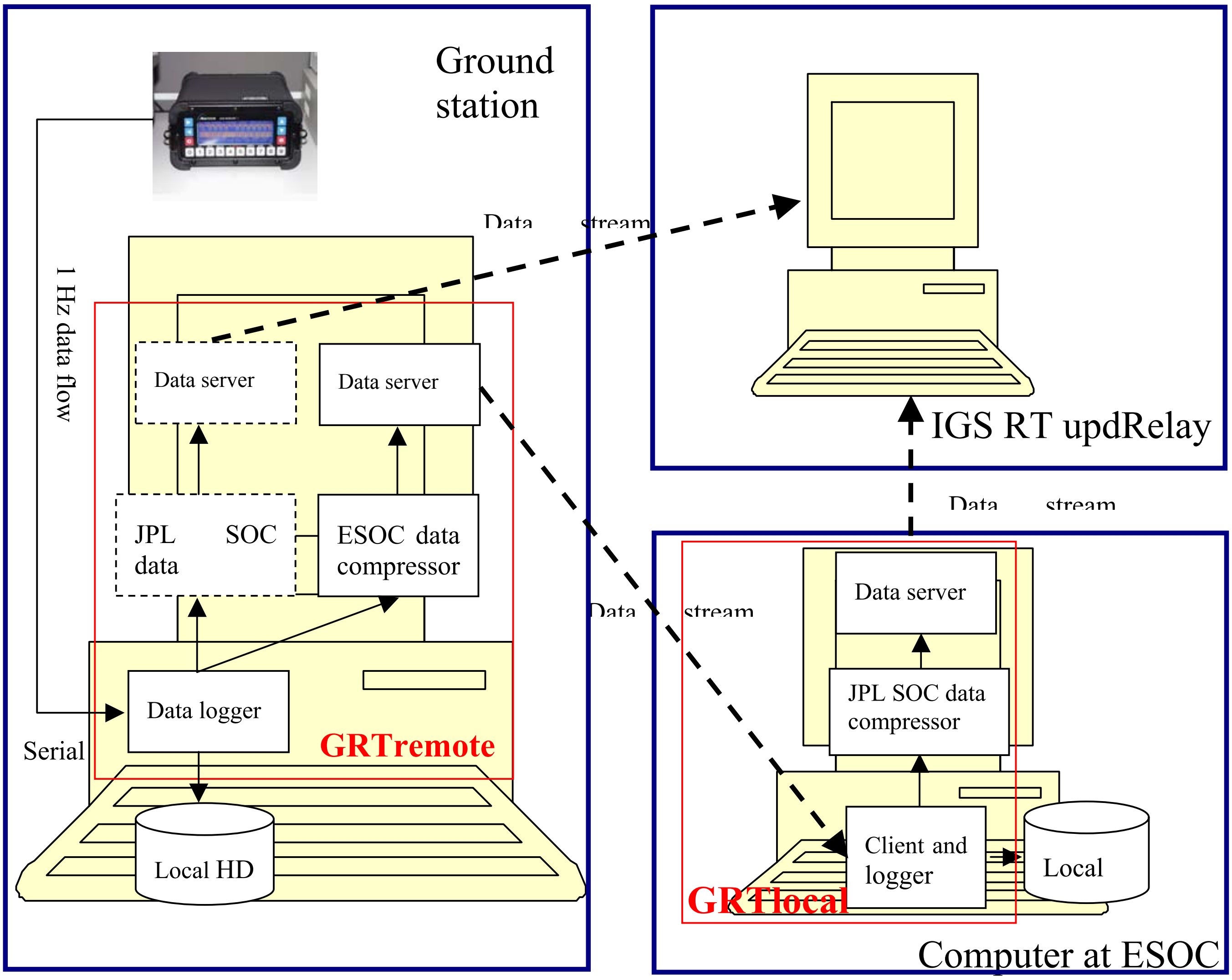

Figure 5: Real Time System Architecture

The main features of the system are:

- Compression of the NMEA stream based on the removal of empty fields, not used information and differentiation. A typical stream of 10 kbps is reduced to about 3 kbps. The SOC format will be adopted in the future if it becomes the IGS standard.
- TCP/IP stream to try to guarantee 100% of data transmission. UDP is under consideration for stations with bandwidth problems and also to follow the IGS recommendations.
- The TCP protocol is used to buffer the data during periods when the link is not available. The time and amount of buffered data are configurable.
- The client and the server can be exchanged according to the most convenient configuration to cross firewalls.

Plans for the future

Among others the following are the lines of improvement for the future:

- Integration of KOU1 (Topcon GPS + GLONASS) in the real time network.
- Improved handling of retransmissions.
- Extended cooperation with IGS to facilitate data exchange use of standard formats, compression algorithms, etc.