Network Operations and Data Flow within the EPN

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Introduction

The EUREF Permanent Network (EPN) was initiated in 1995 by the IAG sub-commission 'EUREF', responsible for the European Reference Frame. It consists of GPS tracking stations, data centers and analysis centers organized following a similar hierarchy as the IGS and based on voluntary contributions.

The EPN has been submitting weekly network solutions to the IGS since May 1996. What makes the EPN Regional Network different from most of the other Regional Networks contributing to the IGS is that the EPN involves a larger number of different agencies (51!). The mutual friendly competition between the different agencies involved, drives the EPN to meet new challenges, e.g. the EUREF-IP activities. In addition, thanks to its close link with the IGS, the EPN grows hand in hand with the IGS; promoting the IGS standards in Europe and stimulating the European GPS community to evolve together with the IGS.

Growth of the tracking network

The EPN tracking network has continued to operate successfully during the year 2001, integrating 21 new stations in its network (see Figure 1):

ALME	Almeria, Spain	H	TG	
AQUI	L'Aquila, Italy	H		
CACE	Caceres, Spain	H		
CANT	Santander, Spain	H	TG	
ELBA	San Piero Campo Nell'Elba, Italy	H		
GAIA	Gaia, Portugal			
GSR1	Ljubljana, Slovenija			
LAGO	Lagos, Portugal			
LINZ	Linz, Austria	H		
MALL	Palma de Mallorca, Spain	H	TG	
NPLD	Teddington, UK			IGS
OBE2	Oberpfaffenhofen, Germany (replaces OBER)	H		
OROS	Oroshaza, Hungary	H		
PADO	Padova, Italy (replaces UPAD)	H		
PDEL	Ponta Delgada, Portugal		TG	IGS
POLV	Poltava, Ukraine			IGS
RABT	Rabat, Marocco			IGS
SULP	Lviv, Ukraine	H		IGS
TLSE	Toulouse, France (replaces TOUL)	H		IGS
TUBO	Brno, Czech Republic	H		
VALE	Valencia, Spain		TG	

With:

- H = Hourly data submission
- TG = Collocated with Tide gauge
- IGS = Included in the IGS network

Site logs are available at the EPN Central Bureau and station managers are notified promptly when inconsistencies between the RINEX headers and the site logs are detected. All EPN stations have their data available at least at one of the EPN data centers (check http://www.epncb.oma.be/datacent.html for access info) and are processed by at least three different EPN Analysis Centers. Similar to the IGS mail, changes within the EPN are notified through a mail exploder to which users can subscribe. An archive of these e-mails is available from (http://www.epncb.oma.be/eur_mail.html)

The total number of EPN stations reached 126 at the end of 2001; about 50% of them deliver hourly data.

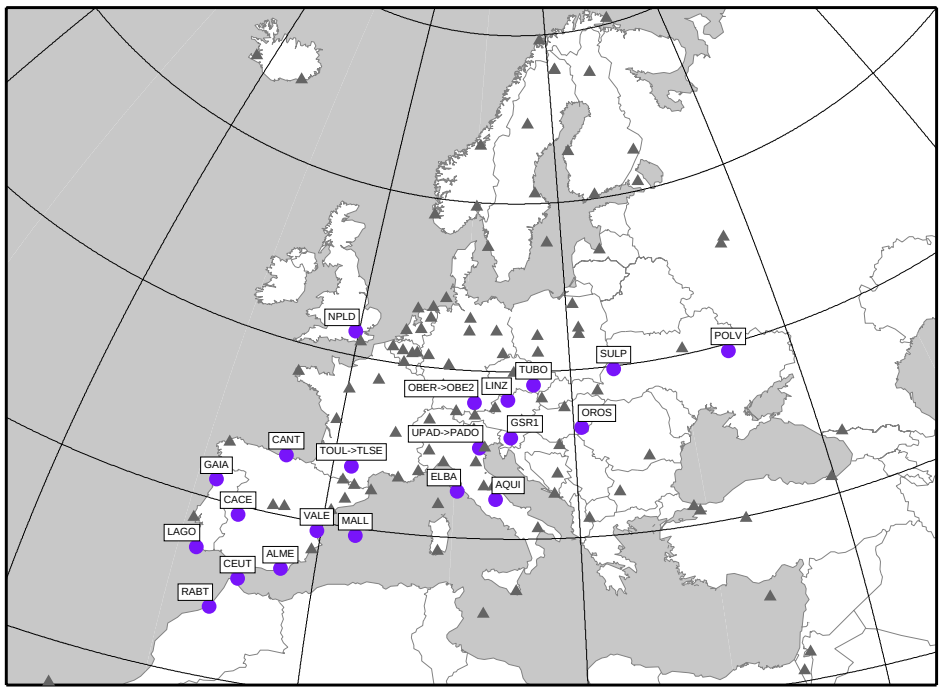

Figure 1: EPN tracking network (status Dec. 2001), stations denoted with circles joined the EPN in 2001.

Site Upgrades

Due to the size of the EPN, it is not possible to list all site configuration changes in this report. In general, we can say that the EPN has continued to modernize it GPS equipment. Information about receiver/antenna/firmware upgrades is available from the site logs and station discontinuities can be visualized from the coordinates time series available at the EPN CB web site (more in next section).

User Interface

The Central Bureau of the EPN maintains a website (http://www.epncb.oma.be/) providing relevant information about the EPN. For each of the EPN stations, this comprises:

- The site log file + station pictures
- Monthly updated tracking status using azimuth/elevation graphs
- Different types of coordinate time series
- List of the Data Centers making available its daily and hourly data + data holding files
- List of the Analysis Centers processing its data
- Link to all relevant EUREF and IGS mails.

In addition,

- Lists of the inactive stations, planned stations and temporarily excluded stations

- Downloadable tracking network maps in different formats
- Guidelines for stations and data centers
- Standard receiver and antenna names (from IGS)
- Antenna calibration values (from IGS)
- Metadata information, such as the SINEX template, extlog.sum, extlog.txt (similar to the IGS logsum.txt and loghst.txt), and updated whenever a new site log is submitted,
- All weekly EPN solutions in SINEX format

are also available.

Data Flow

In general, the EPN daily data flow has improved within the last year: at the EPN Regional Data Centre (RDC) at BKG (Bundesamt für Kartographie und Geodaesie) the number of broken files is now negligible. In addition, the EPN CB checks daily the RINEX headers using the station log sheets, so that metadata inconsistencies are quickly detected and corrected.

Within the EPN, a fall-back Data Center (DC) was set up at the OLG (Observatory Lustbuehel Graz, including the Austrian Academy of Sciences and the Federal Office of Metrology and Surveying). OLG consists of two public ftp servers (olggps.oeaw.ac.at and geols01.iwf.oeaw.ac.at), both accessible by anonymous ftp, and a data centre shielded by a firewall, including storing devices.

This DC is ready to take over the activities of the BKG RDC in case of a major outage (days). Fortunately, there was no such event in 2001. In the meantime, OLG acts as a Local Data Center and in addition, mirrors the daily files of the BKG RDC. Presently, the activation of the fall-back procedure from BKG to OLG will be done manually within 15 minutes after the decision to switch from BKG to OLG, but the procedure can also run automatically.

Thanks to the increasing reliability of the hourly data transfer, a growing number of stations delivers hourly RINEX files without a daily one. The concatenation of the hourly data files is then done at the DC. The EPN stimulates this procedure for all stations with reliable hourly transfers.

If there is a need for quickening the deliverance of hourly files, the synchronization of the computer clocks should be improved; deviations of up to ten minutes can be found. The synchronization can take advantage of the fact that most station software are able to use GPS time for correcting the computer clock and consequently setting in this way very sharp the time of data submission. For the rest, a clock correction using the NTP-daemon (available for UNIX and Windows) should be used.

EUREF-IP

EUREF has decided to set up and maintain a differential GNSS infrastructure (DGNSS) on the Internet using stations of its network (EUREF Resolution #3, 2002). The objective is to disseminate RTCM corrections over the Internet in real-time for precise differential positioning and navigation purposes. The acronym for these activities is EUREF-IP (IP for Internet Protocol). EUREF-IP aims to meet the growing need for Europe-wide improved real-time determination of coordinates.

EUREF makes available server and client software (Euref-ip-rtcm, V. 1.0) to access the appropriate data stream for positioning or navigation application (see http://igs.ifag.de/euref_realtime.htm for details).

A first DGPS trial server providing RTCM corrections over the Internet has been set up at BKG, Germany. Additional stations from the EPN are expected to become involved soon. Receiving RTCM corrections from this real-time network enables the determination of coordinates referred

to the European Terrestrial Reference System ETRS89. The minimum requirements for participation in today's EUREF-IP test phase are:

- Operation of a GPS/GLONASS receiver with well-known antenna position, capable of generating RTCM corrections,
- Operation of an Internet-connected PC next to the receiver, running a server program.

Today's trial software is based on a plain Serial-to-TCP conversion of streaming data on the reference-side (server) and TCP-to-Serial re-conversion on the rover-side (client). Conventions on formats for a more sophisticated dissemination of RTCM corrections over the Internet do not exist. EUREF-IP intends to make new software available under the terms of the GNU General Public License. This software will include protocol definitions to transport RTCM corrections from servers via casters to clients. It will consider specifics of reference station networks, security and firewall issues, and massive simultaneous access in support of location-based services. The software will be available free of charge by the end of 2002. Because its functionality does not interfere with RTCM standards, it will simply replace today's trial software.