

POLAND IN THE EUROPEAN NETWORK OF MULTIFUNCTIONAL REFERENCE STATIONS EUPOS

Part 1. GENERAL INFORMATION ON THE EUROPEAN PROJECT EUPOS

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1. INTRODUCTION

EUPOS (European Position Determination System) is a new European initiative of establishment of the multifunctional reference station system in Central and Eastern European countries. The Project EUPOS was initiated in 2002 by the Berlin Senate Department for Urban Development and European Academy of the Urban Development Berlin. The project consisted previously in establishment of multifunctional satellite reference stations in Central and Eastern Europe, but lately also some Asian countries request to join the EUPOS Project and to be admitted to EUPOS ISC as EUPOS members. Number of member countries is steadily increasing. In 2008 Moldova was intended to participate in the project and at the last conference in Tallinn in April 2009 at the EUPOS International Steering Committee Kazakhstan was admitted as the EUPOS country. So, EUPOS network will contain more than 1000 stations in the area of 19 European and Eurasian countries. Currently 19 following countries are the members of the EUPOS Project: Bosnia and Herzegovina Bulgaria, Czech Republic, Estonia, Germany, Hungary, Kazakhstan, Latvia, Lithuania, Macedonia, Moldova Montenegro, Poland, Romania, Russian Federation, Serbia, Slovakia, Slovenia and Ukraine. The number of planned stations in particular countries are given in attached table. One common project standard set is observed by all countries, however the project will include the existing or developed infrastructure in participating countries. Experiences of all participating countries in establishing and operating satellite systems will also be used. The system will be compatible with the German network SAPOS and in future will use as main signal the signal of the European system Galileo. The network of reference stations will provide services for both positioning of the geodetic control points and for navigation. Several levels of services of positioning accuracy will be offered.

The system EUPOS is a ground-based augmented GNSS system. As augmentation it uses the close connection to the precise satellite global and European controls permanently checking its stability and integrity (**ground-based augmentation system**). It covers about 25% of the territory of the European Union and about 60% of the area of the whole Europe. If we take into account the Asian territories of the Russian Federation and the territory of Kazakhstan where the EUPOS network will be established, the network of the reference multifunctional station system EUPOS will be extended to more than 10 million square kilometres.

The conferences of the EUPOS International Steering Committee (ISC) are held twice a year. Fifteen working conferences of the EUPOS ISC were organised up to now. The conferences were devoted to discussions on practical aspects of realisation of establishment of the network, the standards and possible sources of financial support for realisation of the Project.

The project EUPOS was presented at many international conferences and symposia. On 12 November 2003 the representatives of the EUPOS International Steering Committee have held consultations in Brussels with Galileo Joint Undertaking and the European Commission EuropeAid Co-operate Office. The objectives of consultations were to inform the EC about the Project EUPOS, its organisation, standards and services, links to the European Project Galileo and expected benefits for all participating countries. As positive aspects there were recognised short time (2,5-3 years) of realisation of the Project and the fact that the organisational structures of the project are already available. It was advised that the attempt could be made to request for financial support from different EU Programmes: ERDF for EU member countries, ISPA – for EU candidate countries, CARDS – for West-Balkan countries TACIS – for the Russian Federation and INTERREG III C – for Germany (Coordinator of the Project).

Number of planned EUPOS reference stations

No.	Country	Area [km ²]	Number of planned EUPOS DGNS reference stations
EU member countries			
1.	Bulgaria	110 950	23
2.	Berlin (ISCO)	891	4
3.	Czech Republic	78 870	26
4.	Estonia	45 220	13
5.	Hungary	93 030	36
6.	Latvia	64 600	24
7.	Lithuania	65 300	25
8.	Poland	312 680	98
9.	Romania	237 500	48
10.	Slovak Republic	49 035	21
11.	Slovenia	20 270	15
West Balkan States			
1	Bosnia and Herzegovina	51 000	30
2.	Macedonia (FYROM)	25 330	15
3.	Serbia and Montenegro	88 360	32
Other countries			
1.	Russian Federation	17 075 000	500 ?
2.	Kazakhstan	2 713 300	500 ?
3.	Ukraine	603 700	200 ?
4.	Moldova	33 700	15
T o t a l			1625 ?

In August 2006 the Head Office of Geodesy and Cartography has signed with the Polish Ministry of Economy the agreement on financial support for establishment of EUPOS reference stations in Poland. The respective fund as given in the Project EUPOS was accepted and support was given from structural ERDF EU programme. In order to cover the whole territory of Poland and to achieve the proper cross-border links there were finally established 98 reference stations. The establishment of all stations was concluded by June 2008 and by this time the Polish part of the European EUPOS network called ASG-EUPOS (Aktywna Sieć Geodezyjna EUPOS) was thoroughly available for users with all offered services. The details will be given in the next sections of this paper.

2. GENERAL CHARACTERISTICS OF THE EUPOS

To characterise shortly and very generally the Project EUPOS the following should be said:

The EUPOS stations will be permanently operating, multifunctional DGNSS reference stations.

The distance between the stations will be 60-70 km dependent on the topography. Higher density may be required in conurbation. Existing reference station systems (e.g. EUREF, IGS) should be connected or incorporated.

The co-ordinates of the stations will be determined with high precision, both in ETRS 89 and in conventional geodetic reference systems by connecting to EUREF points as well as to the other control networks of the countries.

- EUPOS will use the signals of Galileo as basis standard as soon as it is available and Global Positioning System (NAVSTAR – GPS) as basis standard up to the complete availability of Galileo and as optional additional standard after complete availability of Galileo, also Russian Global Navigation Satellite System (GLONASS) will be used as optional additional standard.

Only high quality geodetic GNSS dual frequency receivers will be used at EUPOS reference stations. Antennas will be calibrated and positions of reference station antennas will be checked regularly for any displacement

A common use of reference stations in neighbouring countries close to border areas will be taken into account. The reference stations will be networked with each other, even cross-border.

All participating countries will observe the unified standards or/and will build up their multi-functional systems fully compatible with future European system GALILEO.

Generally EUPOS will offer several levels of RTK and post processing services for geodetic positioning and land, air and marine navigation:

- EUPOS DGNSS for real time or post processing DGNSS applications by code and code-phase measurements with metre up to sub-metre accuracy;
- EUPOS RTK for real time DGNSS applications by carrier phase measurements with centimetre accuracy;
- EUPOS Geodetic for DGNSS applications by phase measurements in static or kinematic mode with centimetre up to sub-centimetre accuracy.

A quality management will guarantee a minimal 99 %-level of security of supply and system integrity of EUPOS. Malfunctions automatically activate an alarm plan which sets

off appropriate corrective measures. Depending on the requirement, data links, computers or transmitters etc. are switched over and different reference stations will temporarily be used as principal reference station for providing the correction data. The system will be designed so that the technology can generally manage itself and the EUPOS operation will be maintained. All malfunctions etc. will be recorded automatically and evaluated within the framework of the quality control management. Malfunctions, faults and losses of quality are therefore automatically identified in real time.

3. ORGANISATION

The management of the project EUPOS is performed by:

- International EUPOS Steering Committee (ISC),
- National EUPOS Service Centres (NSC),

The International EUPOS Steering Committee and its office (ISCO, Berlin) were established during the first Workshop „Multifunctional GNSS Reference Station Systems for Europe“ held in Berlin in March 2002. The committee will be extended by representatives of all accessing countries. The main tasks of the ISC are: coordination of the project actions and management, agreements with the NSC and manufactures, dissemination of information, organisation of EUPOS workshops and symposia, clarification of technical questions and standardisation, organisation and coordination of software and hardware tests and support of the countries in training the technical staff. The EUPOS ISC has the rights to initiate the close cooperation between EUPOS and other organisations.

National EUPOS Service Centres (NSC) are established in every EUPOS country. They deal with the tasks of planning, establishment and maintenance of the national EUPOS network. Beyond these activities, the most important tasks of the EUPOS Service Centre are: contact with the International EUPOS Steering Committee and its office, coordination of the interests and the activities of the national authorities and other governmental bodies, checking the integrity of the network, testing software and hardware in agreement with the International EUPOS Steering Committee and their own interests, providing adequate information for the users about the status of the network, organisation of educational and training courses for the technical staff and the users, transferring the international development trends and contributes to the EUPOS developments.

The National EUPOS Service Centres will have adequate communication links to the EUPOS reference stations and the necessary computing power and equipment. It should dispose the highly qualified, competent and motivated manpower.

4. COOPERATION OF EUPOS WITH OTHER ORGANISATIONS

The representatives of EUPOS International Steering Committee and its office ISCO in Berlin take part actively in conferences of many other organisations and present very interesting initiatives. As a result of these activities the cooperation links with the following organisations was established:

- EUPOS cooperates with the UN Office for Outer Space Affairs;
- EUPOS is an associated member of the International Committee of GNSS (ICG);
- GALILEO Joint Undertaking accepted the ground-based GNSS augmentation systems and welcomed EUPOS;

EUPOS initiates cooperation of sub-Saharan African countries and GNSS enterprises under patronage of the UN/ICG to establish „full scale accuracy” ground-based DGNSS; EUPOS is a member of the Radio Technical Commission for Maritime Services;

EUPOS ISC cooperates with two Working Groups:

- WG on Technical Cooperation with the Industry (TCI), and
- WG on System Quality, Integrity and Interference Monitoring (SQII);

International EUPOS Steering Committee has established close cooperation links with the IAG EUREF Sub-Commission for Europe of the IAG Commission X on Global and Regional Geodetic Networks.

5. RELATION LINKS OF EUPOS TO GALILEO SYSTEM AND EUREF

The Galileo signals will be the basis standard for the EUPOS stations as soon as the system Galileo is available. Systems GPS and GLONASS will be additional optional elements. Evident interrelations between the system Galileo and the EUPOS network can be noted as follows:

- Galileo gains a huge number of new users; it may be assumed that more than 1000 reference stations in 18 countries will work permanently using the Galileo system;
- By EUPOS Galileo will transfer the reference system to all users in Central and Eastern Europe;
- EUPOS will offer and guarantee the services of proper accuracy as recommended by the Galileo programme;
- EUPOS stations could be integrated into Galileo programme. Some selected EUPOS stations could be incorporated to the Galileo ground control segment.

System of EUPOS stations will be related to the European EUREF Permanent Network EPN the main objectives of which is to monitor and maintain the European Terrestrial Reference Frame ETRF. In particular the following can be said:

- EUPOS reference stations will be connected to the EUREF EPN;
- The EUPOS stations will be related to the ETRF system and will transfer the ETRF to all Central and Eastern European countries;
- Some selected EUPOS Processing Centres could serve as EPN Local Analysis Centres;

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