

# EUROPEAN POSITION DETERMINATION SYSTEM (*EUPOS*<sup>®</sup>)

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EUPOS: European Position Determination System

## 1. General

2. For position fixing with higher accuracy many countries have set up DGNSS reference station services since the nineties, providing DGNSS correction data for real-time positioning or their observation data for DGNSS post processing.
3. This type of service is based on a network of permanent GNSS reference stations
4. Differential GNSS methods provide an effective determination of the position by broadcasting the correction data from the precise determined reference stations to the new points. Establishment of the network of the active reference stations will allow the large variety of users to determine their position with required accuracy all the time (from 1-3 m to the 1 cm and better).
5. Some differential national GNSS systems and services in Europe are running successfully in the common reference frame ETRS89. They can serve as a relevant basis for development of a regional system.
6. The running “German National Survey Satellite Positioning Service” (*SAPOS*<sup>®</sup>) is a good example for a multifunctional DGNSS Service.

## 2. Project description

7. The project European Positioning Determination System (*EUPOS*<sup>®</sup>) is a regional extension compatible to *SAPOS*<sup>®</sup> for 14 Central and Eastern European

countries (Fig. 1).

8. The main goal of *EUPOS*<sup>®</sup> is a multifunctional regional application of DGNSS on the base of unified data formats and international standards.
9. The objective of the project is to establish *EUPOS*<sup>®</sup> system and service for realization of DGNSS application.
10. An effective position determination in the region of Central and Eastern Europe (CEE) for the needs of wide spectrum of users will be provided by the establishment of the system and infrastructure.

Several levels of services will be offered (DGNSS for geodetic positioning and land, air and marine navigation – RTK and post processing).



11. *EUPOS*<sup>®</sup> potential applications are as follows:

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| 6. <i>fundamental geodetic tasks</i><br>-<br>7. <i>scientific and geodynamic investigations</i><br>-<br>8. <i>land, air and sea navigation</i><br>-<br>9. <i>cadastre</i><br>-<br>10. <i>geographic information systems</i><br>-<br>11. <i>maritime surveying</i><br>-<br>12. <i>engineering surveying - investigations of deformations</i><br>- | 13. <i>fishing and environmental protection</i><br>-<br>14. <i>climate research and weather forecast</i><br>-<br>15. <i>agriculture</i><br>-<br>16. <i>security duties and many others.</i><br>17. <i>The EUPOS® system will be based on active permanent reference stations established in the particular countries (Tab. 1).</i><br><i>The distance between reference stations could not be greater than 70 km at maximum.</i> |
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Table 1. Number of planned reference stations

Country	Area [km <sup>2</sup> ]	Number of planned reference stations	Density of stations [s/10 000km <sup>2</sup> ]	Average distance between stations [km]
Bulgaria	110 990	33	30	60
Croatia	56 540	15	27	60
Czech Rep.	78 870	35	44	50
Estonia	45 100	14	31	60
Hungary	93 030	35	38	60
Latvia	64 500	28	43	50

Lithuania	65 200	22	34	55
Macedonia	25 710	8	31	60
Poland	312 680	71	23	70
Romania	237 500	48	20	70
Russia	*)	500 *)		*)
Serbia	88 360	26	29	60
Slovakia	49 040	20	41	50
Slovenia	20 250	15	74	37
Total/average	1 247 770 (without Russia)	870	30	60 (without Russia)

\*) The topical specified 500 points will not cover the whole territory of Russia.

By participating counties has been made a project for stations location. For Bulgaria it is shown in the figure 2. The location of the boundary stations is in progress.



Fig. 2: *EUPOS*<sup>®</sup> Stations in Bulgaria

Technical and legal standards of *SAPOS* were kindly released by German management of *SAPOS* for the aims of *EUPOS*<sup>®</sup> (Table 2).

Table 2. Services offered by system *SAPOS*

Service	RTK/ Postproc.	Transmission of differential corrections	Frequency	Accuracy	Format
EPS	RTK	FM/RDS, LW/RDS	1 sec	1 do 3 m	RTCM 2.0
	RTK	GSM, VHF (2m)	3 do 5 sec	0.5 do 2 m	RTCM 2.0
HEPS	RTK	GSM, VHF (2m)	1 sec.	1 do 5 cm < 2*) cm	RTCM 2.3 (MSG 20, 21) NMEA-AdV
GPPS	Quasi-RTK	Internet, GSM	1 sec.	≤ 1 cm	RINEX 2
GHPS	Post- processing	Internet, GSM	1 sec.	< 1 cm	RINEX 2

\*) including the Area Correction Parameters (FKP) of the networked reference stations

EPS - Echtzeit Positionierungs-Service (Real Time Positioning Service);

HEPS - Hochpräziser Echtzeit Positionierungs-Service (High Precision Real Time Positioning Service);

GPPS - Geodätischer Präziser Positionierungs-Service (Geodetic Precision Positioning Service);

GHPS - Geodätischer Hochpräziser Positionierungs-Service (High Precision Geodetic Positioning Service).

### 3. Creation phases of *EUPOS*<sup>®</sup> project

4. 1<sup>st</sup> Workshop in Berlin, March 3-4, 2002

5. Resolution

6. Initiative Committee - The aim of this initiative is the establishment of unified multifunctional *SAPOS* analogous GNSS reference station systems as a basis infrastructure in the interested CEE countries, which were represented at the Berlin workshop: Bulgaria, Croatia, Czech Republic, Estonia, Germany, Hungary, Latvia, Lithuania, Macedonia, Poland, Romania, Russian Federation, Slovak Republic, Slovenia and Serbia - Monte Negro.

7. Conferences of the Steering Committee

8. Warsaw, Poland, June 2-3, 2002 - founding of the Steering Committee of the project, proposal for the reference stations from each participating country, logo proposal - *EUPOS*<sup>®</sup>

9. Sofia, Bulgaria, November 5-6, 2002 - preparation of the *EUPOS*<sup>®</sup> project: united *EUPOS*<sup>®</sup> network which will be improved, standardization of the interface (international standard data format), financing.

10. The project *EUPOS*<sup>®</sup> was presented at the UN/USA International Meeting of Experts on the use and application of GNSS, 11-15 November, 2002, Vienna. It was accepted at the Working group session "Surveying, Mapping and Earth Sciences". The project was prepared according to the required format and it was included in the Working group report, and accepted at the Plenary session of the Meeting, and at the final Plenary session of the Meeting. It was emphasized that *EUPOS*<sup>®</sup> project is the most complete and complex proposed project.

In the draft report to COPUOS at the 7<sup>th</sup> Action Team Meeting, 10.06.2003 in Vienna the following item *"Expand the development of integrated DGNSS "full scale accuracy" infrastructure with well defined unified standards on regional levels (i.e. in Europe: EUPOS<sup>®</sup>)"* is included as recommendation. A subject of further discussions within the framework of UN/USA regional workshops would be the problems on the multi-functional DGNSS applications in Central and Eastern European like *EUPOS*<sup>®</sup>, its development for entire Europe and eventually as an element of GALILEO and EGNOS. Similar DGNSS systems can be developed for other regions in the world.

Two *EUPOS*<sup>®</sup> conferences are planned in 2003:

11. Third conference of the *EUPOS*<sup>®</sup> Steering Committee. The conference will be held in Riga, Latvia on 10-11 June 2003, and
12. Second Workshop on " *EUPOS*<sup>®</sup> - Multifunctional GNSS Reference Station Systems for Europe" that is scheduled for 21-22 November 2003 in Berlin, Germany.

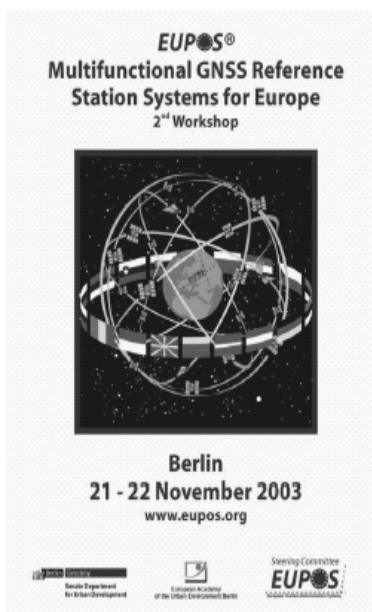


Fig.3. Poster announcing Second Workshop on *EUPOS*<sup>®</sup>, Berlin, November 2003

#### 4. Conclusion and suggestion

The realization of *EUPOS*<sup>®</sup> project is very important for the realization of DGNSS in the countries from CEE, for the improvement of their infrastructure and the benefits of its application as well as their integration in Europe.

Further extension of the *EUPOS*<sup>®</sup> project could be possible:

- a. For whole Europe
- b. To support Galileo and EGNOS.

Similar DGNSS reference station systems to be developed for other regions of the world.



