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LITPOS – A PART OF *EUPOS*®

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Abstract. LitPOS (Lithuanian Positioning System), the network of permanent reference GNSS stations, became operational in July 2007. It provides data both for real-time and post-processing applications. LitPOS stations cover the whole territory of Lithuania. Total number of GNSS stations is 25, therefore the integration of some stations of neighbouring countries is foreseen. It is possible on the basis of cooperation in ***EUPOS***® project. The European Position Determination System (***EUPOS***®) project is an initiative and cooperation of currently 15 Central and Eastern European countries (CEE) and two German states that build up a ground-based European regional GNSS augmentation system with uniform standards that will cover a territory of about 10 million square kilometers. ***EUPOS***® provides a high-quality differential GNSS information for high-precision positioning and navigation usable in a large field of applications. To enlarge the ***EUPOS***® activities transcending technical realizations the project ***EUPOS***® – Interregional Cooperation (***EUPOS***®-IRC) was launched on October 2006; since it is accepted as a European Union INTERREG IIIC Programme operation. Main aims of this operation are to identify, point out and enable possibilities and benefits of the use and application of GNSS technology in the field of regional development, to establish a long-lasting cross-border cooperation between experts in the field of GNSS and geoinformation, on the one hand, and regional policy experts and stakeholders, on the other hand.

Keywords: GNSS, LitPOS, EUPOS, INTERREG.

1. Introduction

LitPOS (Lithuanian Positioning System) is a new Global Navigation Satellite System infrastructure for Lithuania. GNSS stations became operational in July 2007. It combines a network of base GNSS stations with dedicated communication channels and appropriate hardware and software.

Main developers are:

- National Land Service under the Ministry of Agriculture – financial support and supervising;
- Private company "GPS Systems Baltija" – software and hardware;
- State enterprise "Infostruktūra", private company "FIMA" – infrastructure (dedicated Intranet lines, electric power supply);
- Institute of Geodesy of Vilnius Gediminas Technical University – acting as overall coordinator and LitPOS operator.

Objectives of LitPOS:

- to foster the implementation of GNSS techniques in Lithuania;
- to support a broad spectrum of GNSS based applications in positioning and navigation;
- to economize precise geodetic and cadastral surveying and to bring better comfort to surveyors;
- to provide the "24/7/365" real time positioning service with national-wide coverage;
- to harmonize the national geodetic infrastructure with the European Union countries and to facilitate the implementation of European Terrestial Reference System and European Vertical System.

2. LitPOS - General features

LitPOS – a Multipurpose Positioning System for Lithuania. It is an active network of permanent GNSS stations (Fig. 1).

LitPOS stations become very important geodetic points having the combined set of geodetic parameters:

- Coordinates to LitPOS stations are transferred from National Zero Order GPS Network and EPN stations (Juceviciute *et al.* 2003, 2004; Jivall *et al.* 2005, 2007).
- Geopotential heights and normal heights of National First Order Vertical Network are used for data transfer to LitPOS stations (Petroskevicius, Parseliunas 1998; Buga *et al.* 2002, Skeivalas 2008).

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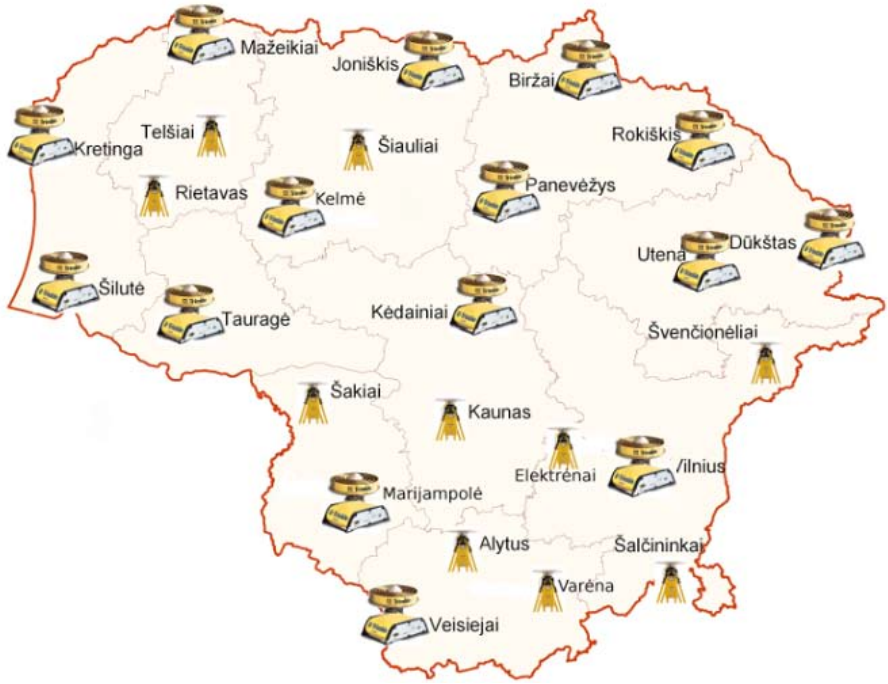

Fig. 1. Distribution of LitPOS stations

- Gravity values of National Zero and First Order Gravimmetric Network are used for data transfer to LitPOS stations (Zakarevicius *et al.* 2004; Petroskevicius 2004).
- Height transfer from National Vertical First Order Network by precise levelling to GNSS station benchmark, and height transfer from it to antenna pier by trigonometric levelling (using total station).

Services and Products: Real-time services: RTK (Real-Time Kinematic) using ***VRS*** *(Virtual Reference Station)* technology; real-time Differential Global Positioning System service;

Post-processing products: RINEX data files for further processing.

3. LitPOS Network Structure

Total number of GNSS stations is 25. They are communicating with 2 central servers using dedicated intranet lines.

Instrumentation of **15** stations (Fig. 2):

- **Trimble NetRS receivers** with **Chock ring antennas**,
- TRIMMARK 3 RADIO MODEMS,
- PTU200 combined pressure, humidity and temperature transmitters,
- DSL modem,
- AC adapter 12V,
- e-Power Switch,
- UPS,
- electric power gauge.

Instrumentation of **10** stations (Fig. 3):

- **Trimble 5700 receivers** with **Zephyr geodetic antennas**,
- Com server,
- DSL modem,
- AC adapter 12V,
- e-Power Switch,
- UPS,
- electric power gauge.

Typical view of GPS antenna mounted on the roof of fire station is presented in Fig. 4.

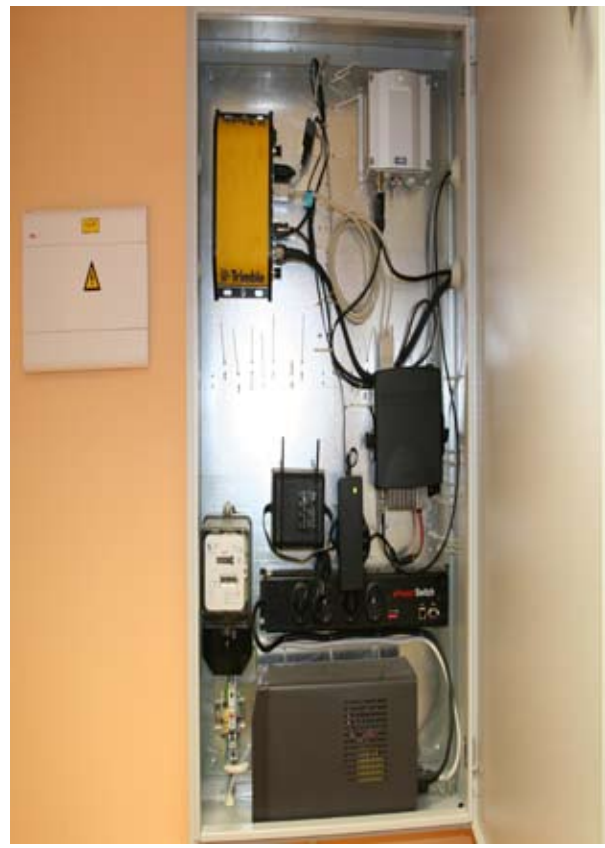

Fig. 2. LitPOS station with Trimble NetRS receiver

Fig. 3. LitPOS station with Trimble 5700 receiver

LitPOS hardware of operating centre consists of 3 PC and 2 servers (Fig. 5).

LitPOS software modules are:
GPStream (Figs 6, 7),
GPSNet (Figs 8, 9, 10),
NTRIP Caster (Figs 11, 12).

4. LitPOS – a part of *EUPOS*®

EUPOS® is both an international initiative and a project to establish and to provide a basis infrastructure particularly for positioning and navigation in Central and Eastern Europe (CEE) realized by ground-based multifunctional DGNSS reference station systems and services in the participating countries, which agreed on uniform standards (Rosenthal *et al.* 2007). The ***EUPOS***® ground-based GNSS augmentation system will cover about 25 % of the European Union territory and more than 60 % of the whole Europe. Taking into consideration also the Russian territory in Asia, where this infrastructure will be established, ***EUPOS***® will be realized for an area of about 10 million square kilometers. Members of the ***EUPOS***® cooperation are: Bosnia and Herzegovina, Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Macedonia, Poland, Romania, Russia, Serbia and Montenegro, Slovakia, Ukraine and the German States Hamburg advisory and Berlin as chair.

EUPOS® provides DGNSS correction data for real-time positioning and navigation as well as GNSS observation data for post-processing position determination. ***EUPOS***® is able to support precise positioning and navigation with high accuracy (meter, decimeter, centimeter

Fig. 4. GPS antenna on the roof of fire station tower

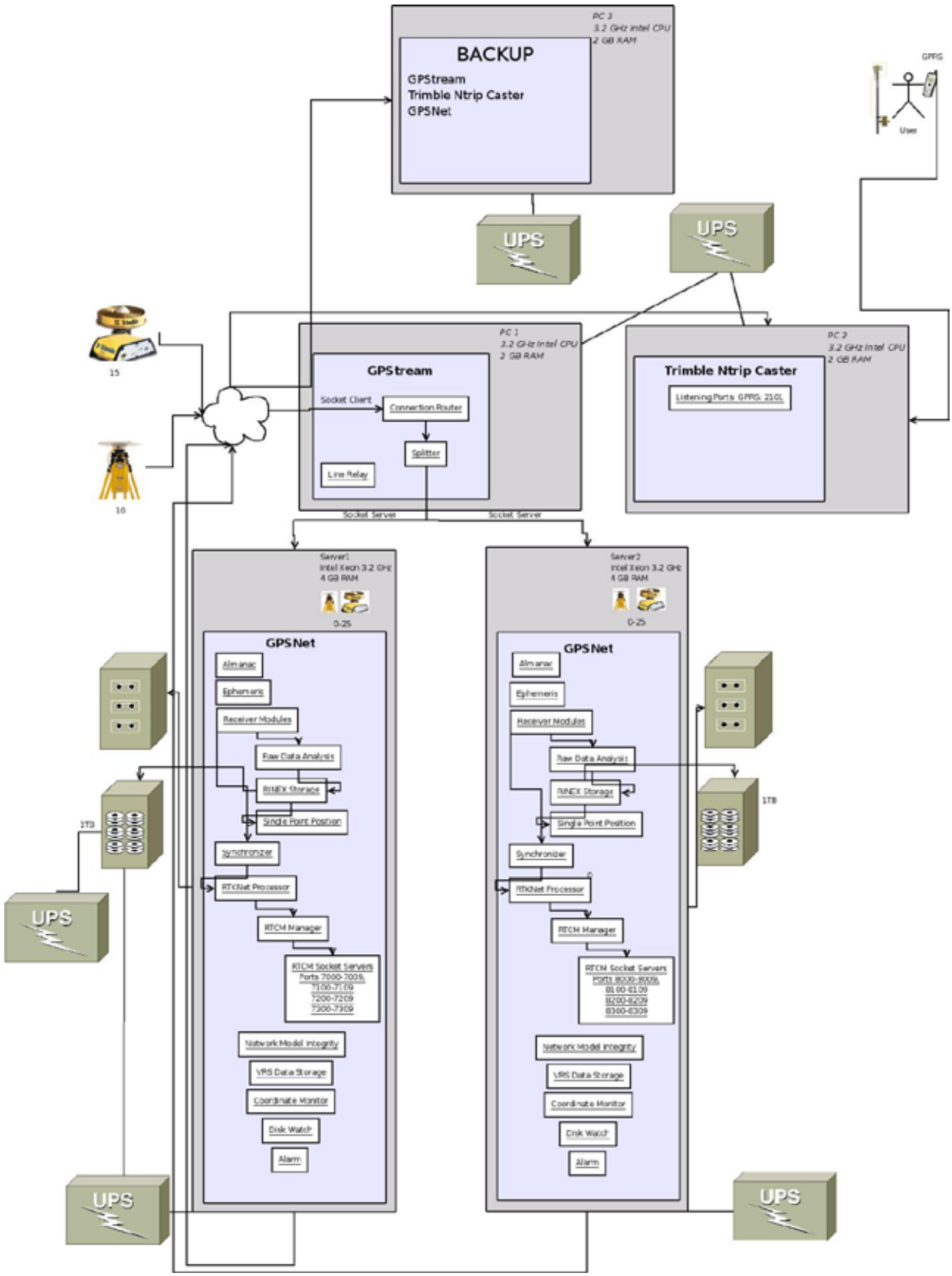

Fig. 5. Principal scheme of hardware and data flow

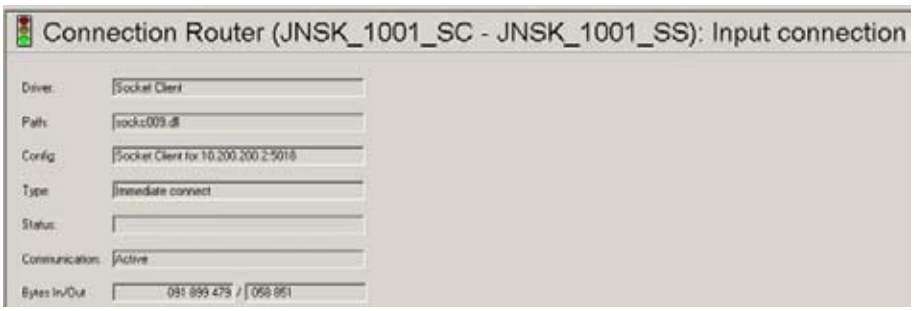

Fig. 6. Example of connection router to station JNSK

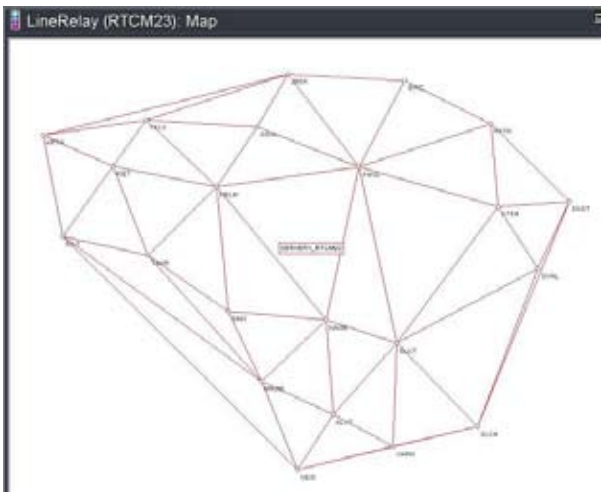

Fig. 7. Line relay window with LitPOS network map

in real-time and centimetre and sub-centimetre in post-processing) and with a guaranteed availability and quality. ***EUPOS***® is independent of private company solutions and uses only international standards and open standards.

At last more than 800 ***EUPOS***® reference stations are planned currently: circa 500 stations by the Russian Federation and about 300 stations by other participating countries. The progress of the ***EUPOS***® system realization in the member countries is different, since it depends on financial facts. Lithuania receives funding support by the EC and realizes the national ***EUPOS***® system in 2007. The establishment of the reference station systems advances in the most ***EUPOS***® member countries too (Rosenthal *et al.* 2007).

The cooperation in the ***EUPOS***® project enables to include into **LitPOS** the stations of neighbouring GNSS networks (Figs. 13, 14).

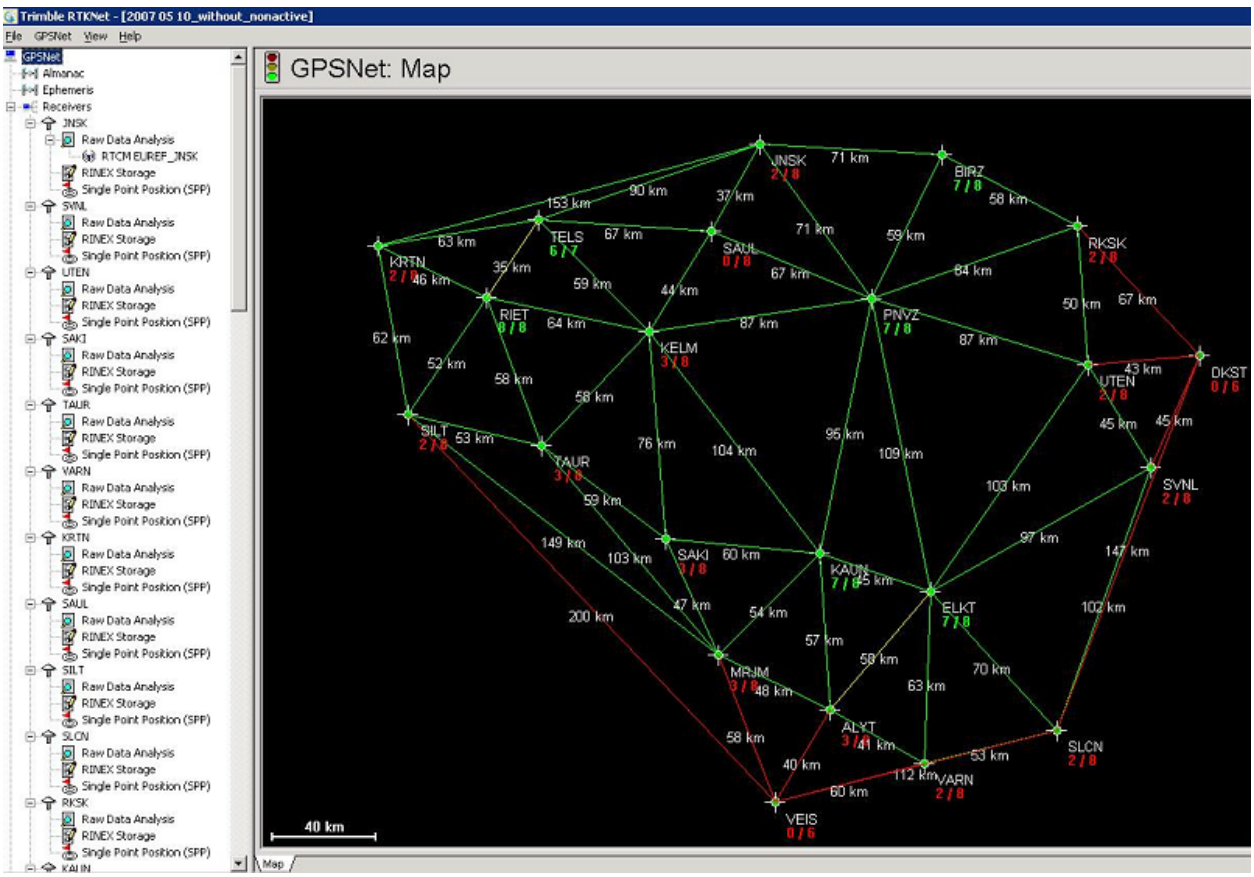

Fig. 8. LitPOS network map in the GPSNet window

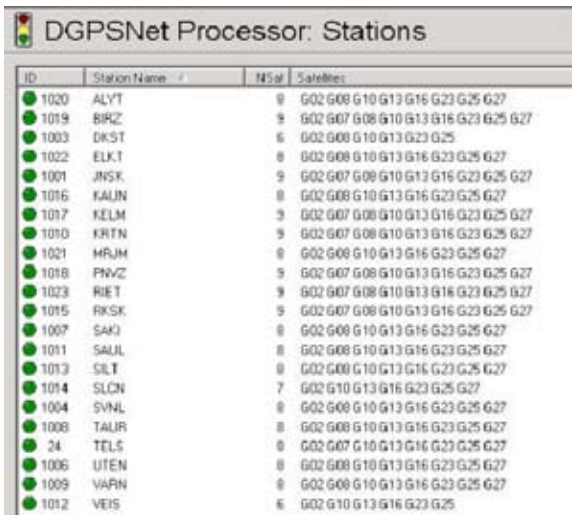

Fig. 9. DGPSNet Processor window

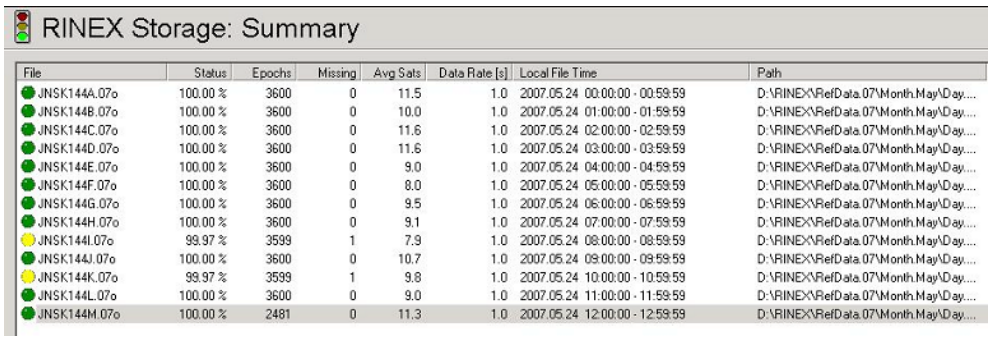

Fig. 10. Information on RINEX storage

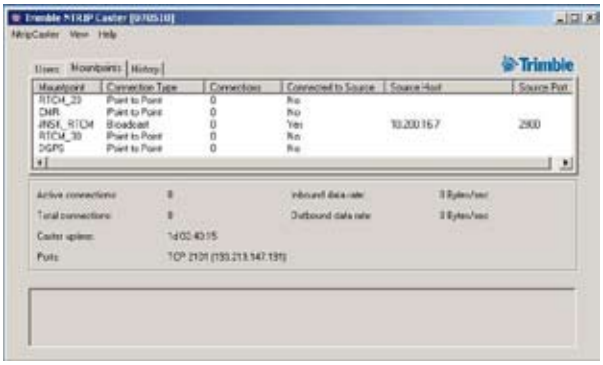

Fig. 11. Information on broadcasting stations

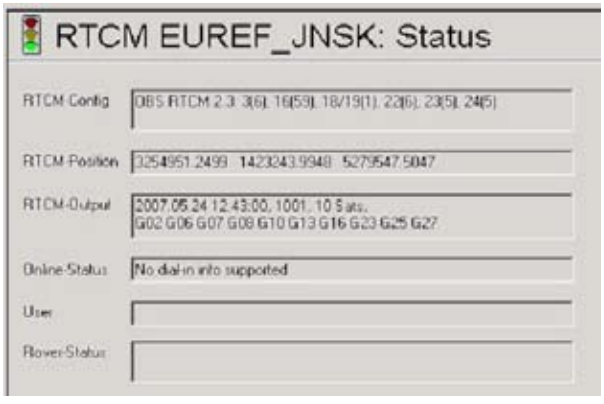

Fig. 12. Information in broadcasting station JNSK

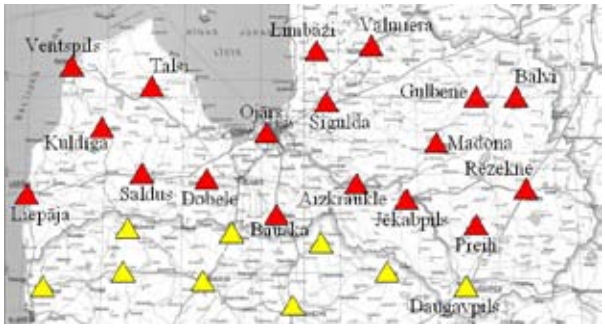

Fig. 13. GNSS stations at Latvian-Lithuanian border

Fig. 14. GNSS stations at Poland-Lithuania border

5. Lithuanian *EUPOS*® website

Website *http://eupos.vgtu.lt* (Fig. 15) mainly devoted for

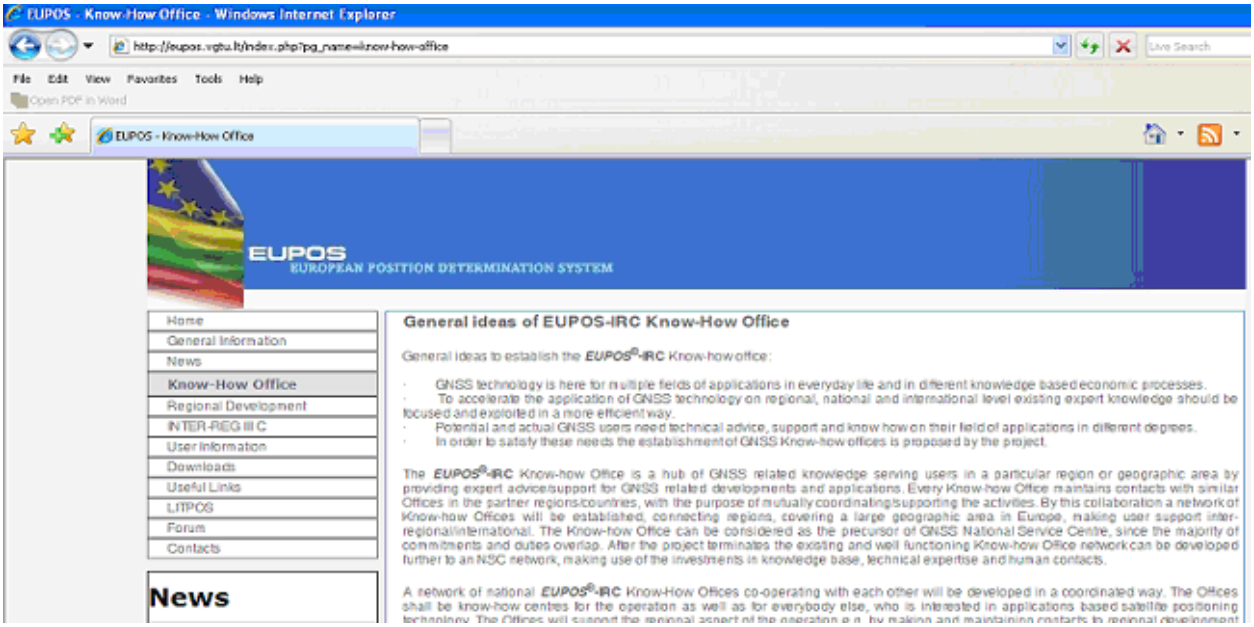

Fig. 15. Main page of eupos.vgtu.lt site

the EUPOS Know-how office functions was launched in March, 2007. Main features:

- Free Content Management System improved and edited for eupos.vgtu.lt needs in March,
- Programming finished in March,
- Page released for testing and basic usage in March,
- Information uploaded (continuing),
- Content Management System (CMS):
- Free CMS used,
- Modules edited and adapted for eupos.vgtu.lt site,
- Training for users in using CMS arranged,
- Current modules:
  - *News* module,
  - Simple *text* module,
- Forum for information exchange,
- Lithuanian version of the page,
- User authentication for access to non-public areas.

6. Conclusions

1. LitPOS is a new geodetic infrastructure for referencing spatial geoinformation.
2. LitPOS provides the direct linkage to the National Coordinate System and height datum.
3. LitPOS is going to be a part of *EUPOS®*.
4. We are actively seeking applications, users and partners for this new infrastructure
5. Lithuanian *EUPOS®* website contributes for large scale information dissemination.

Acknowledgements

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