

CREATION OF ZAKPOS ACTIVE NETWORK REFERENCE STATIONS FOR TRANSCARPATHIAN REGION OF UKRAINE

S.Savchuk, I.Kalynych, I.Prodanets

The use of traditional methods and measurement instrumentations of geodesy at coordinate assurance of topographic, geodesic and cadastral work is practically exhausted. High precision and reliability of determining coordinates at the given moment of time are achieved by means of the methods which are based on satellite technologies - GPS, GLONASS, GALILEO and, equally importantly, including real-time service. It is modern GPS-technology in the differential mode RTK technology in combination with other devices, as an integrated system, that allows to solve any tasks in the sphere of precise coordinate assurance.

Since the end of the 90-ies the most developed countries have done intensive work on the creation and implementation of active network reference stations. Taking into consideration their financial possibilities, most countries of Central and Eastern Europe did not have the opportunity to realize their own systems of satellite reference stations. In 2002 a All-European system of multifunctional use of global navigation satellite system EUPOS was planned. This project is supposed to be launched for all interested countries. Potential EUPOS users are geodesy and geodynamics, cartography, geology, road building and operation, road transport, railway, forestry, melioration, meteorology, environmental protection, state and communal services etc.

At present the network of "classical" permanent satellite stations in Ukraine includes more than 20 stations which are subordinated to different organizations and their number is constantly rising. On average there is one permanent station per 50 000 sq. km of the Ukrainian territory. The stations are equipped with geodesic dual-frequency GPS receivers and precision antenna of different producers (90% - Trimble company). Only 8 stations regularly transmit the results of measurement to the corresponding European Analysis Centres. Access to the results of the measurements of these permanent stations is completely open to all users through Internet FTP-addresses.

However, at present no project on the functioning of active network permanent satellite reference stations has been realized in Ukraine. Certain theoretical developments in this direction have been made by the scientists of Main Astronomical Observatory of National Academy of Sciences of Ukraine and Lviv Polytechnic National University, and several practical steps have been taken by Kharkiv specialists.

It is obvious that at present it is practically impossible to launch a modern high-performance technology of the use of satellite geodesy resources a system of real-time coordinate assurance - on the whole territory of Ukraine simultaneously. Therefore a group of scientists have decided to show the ways of modern satellite technology implementation in one part of Ukraine the Transcarpathian region.

The top-priority ways of launching a network of reference stations were:

- 1) Optimal location of reference stations within Transcarpathia;
- 2) Correction of stations' location from the point of view of administrative and territorial system of the region and economic differentiation of its districts;
- 3) A priori estimation of the precision of coordinate determination without taking into consideration their combination into a network and with such consideration.

In order to solve the given task we have used the geometric or administrative-territorial approach to the planning of GNSS-networks with the estimation of the precision of determination of the coordinates of a point (in all combinations) from N points. As a result of mathematical modelling a project of the optimal network of reference satellite stations has been developed for the territory of the Transcarpathian region. While optimizing the network the administrative and economic-territorial model of the region was taken into account (Fig. 1).

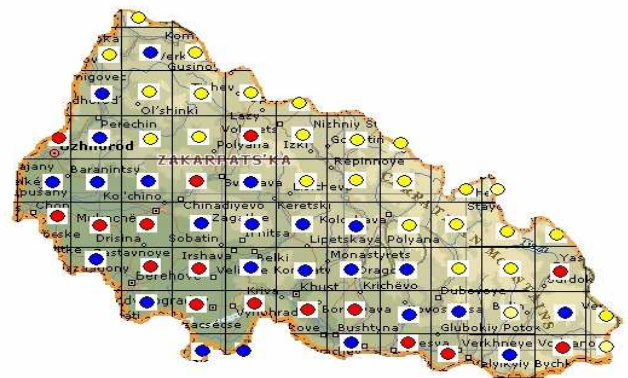


Fig. 1. Economic differentiation of Transcarpathian districts (red circle weight 3, blue circle weight 2, yellow circle weight 1)

As a result of this research a project of ZAKPOS network of reference stations for the Transcarpathian region has been developed and a priori estimation of the precision of determination of spatial coordinates for two network versions has been done. The first variant includes territorially located active reference stations which transmit differential corrections irrespective of each other. The second variant involves a combined network of active stations which transmits the same differential corrections to users. Figure 2 shows one of the possible variants of reference stations location with the estimation of the precision of coordinate determination for the second variant.

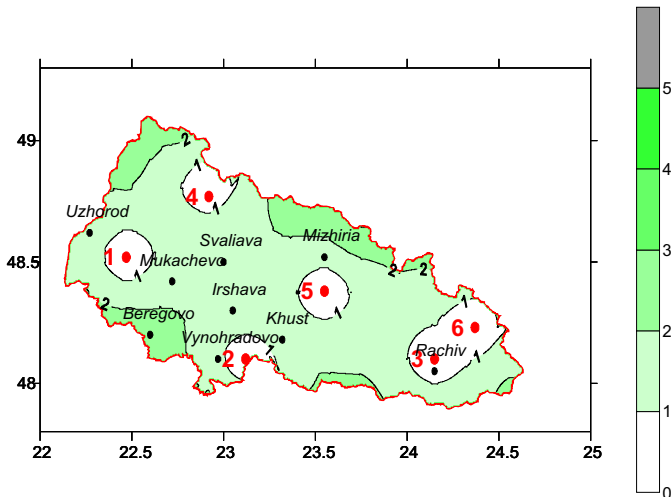


Fig. 2. A variant of territorial distribution of a network of reference stations in the Transcarpathian region and the estimation of the precision of coordinates determination (isolines are drawn every 1 cm)

According to the results of the modelling and considering the administrative and territorial system of the Transcarpathian region optimal places for reference satellite stations location are situated in the city of Mukacheve, the towns of Khust and Rakhiv and the villages of Mizhgiria and Liuta. Management Centre is supposed to be located in the city of Mukacheve (Fig. 3). The Figure also shows schematic location of the nearest EUPOS network stations: **USDL** (ASG-EUPOS network, Poland), **SKSV** (SKPOS network, Slovak Republic), **VASA** (Hungary network) reference stations.

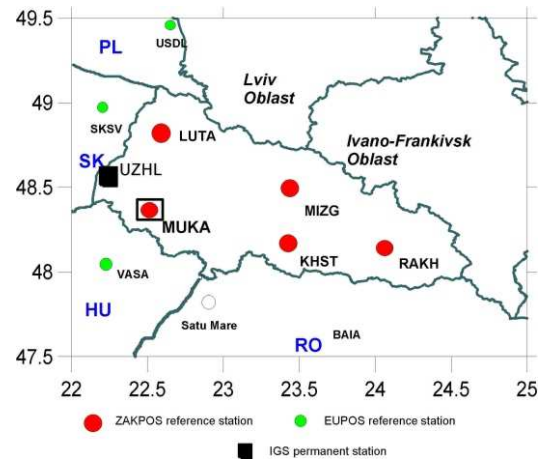


Fig. 3. A plan of reference stations network location in the Transcarpathian region

At present we have purchased 5 Trimble NetR5 reference stations with Zephyr Geodetic 2 antenna, 5 Trimble R8 VRS Rover mobile receivers and Trimble network software (GPSBase software, GPSNet software, RTKNet software). Preparatory work for testing ZAKPOS network is being done.

Prof. Stepan Savchuk
 Institut Geodesy
 Lviv Polytechnic National University
 Stepan Bandera Str. 12, 79013 Lviv
 Ukraine
 Phone +38-032-258-2181
 Fax +38-032-274-4300
 E-mail ssavchuk@polynet.lviv.ua

Dr. Ivan Kalynych
 The Regional State Administration
 of Transcarpathia
 Narodna Sq. 4, 88008 Uzhgorod
 Ukraine
 Phone +38-0312-61-32-09
 Fax +38-0312-61-33-56
 E-mail upzem@ukr.net

Dipl.-Ing. Ivan Prodanets
 DP « Zakarpatgeodezcentr »
 Grushevskoho Str. 39, 89600 Mukacheve
 Ukraine
 Phone +38-031-31-55041
 Fax +38-031-31-55041
 E-mail geo@geodez.mk.uzhgorod.ua