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National Report Romanian GNSS Permanent Network

Marcela Cristea¹, Mihaela-Simina Puia²

¹ Eng. - National Agency for Cadastre and Land Registration - Head Division of Cadastre and Geodesy
² Eng. - National Agency for Cadastre and Land Registration - Division of Cadastre and Geodesy - Department of Geodesy

National Agency for Cadastre and Land Registration Department of Cadastre and Geodesy Bucharest, Romania





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1. National GNSS Permanent Network

Nowadays, National GNSS Permanent Network includes 74 reference stations, coherently and uniformly distributed across the country.

- After September 2008, this network became the framework of ROMPOS, providing for the first time in Romania real time precise positioning services.
- The distance between the situations is presently about 70 km.



Between 2009-2014 for all permanent GNSS stations of the national network the altitude was determined, executing of works by accuracy geometric and trigonometric leveling, on short distance (below 200m, made of 2 points embodied by metal stakes). Were determined the altitude of the Antenna Reference Point (ARP) and the Bottom of Choke Ring (BCR). Thus were obtained the normal heights of permanent stations in the Black Sea in 1975 reference plane (second edition 1990).





1. National GNSS Permanent Network

- The reference stations use only geodetic receivers and antennas. Antennas acquired by National Agency for Cadaster and Land Registry (NACLR) after 2008 were calibrated with the best techniques available worldwide (absolute calibration of each individual antennas).
- The stations continuously receives data from satellites NAVSTAR GPS (all stations) and the Russian GLONASS satellites (69 reference stations). Station coordinates are determined in ETRS89 reference system.
- This year permanent GPS stations will be replaced by GNSS equipment.



Types of ROMPOS stations - Leica şi Topcon





1. National GNSS Permanent Network

EUREF Permanent Tracking Network Stations submitting GLONASS data





In Romania are: 5 EUREF-EPN stations: 2 GNSS (GPS+GLONASS) and 3 GPS



2. Romanian Position Determination System (ROMPOS) based on National GNSS Network

Romania through ROMPOS is partner of EUPOS Project (since 2008).

	Surface of Romania	Reference stations number according	Number of EUPOS stations in
	[km ²]	to EUPOS standards	Romania
ROMPOS	237 500	73	74

ROMPOS services are **provided by NACLR**, through **National Center of ROMPOS Services (NCRS)**, which is intended to monitor and control the GNSS stations activity for the automatic transfer of data to central data server, which are used for post processing position determination (the ROMPOS – GEO service) and to provide positioning services and products for real time applications.



NCRS structure recommended by EUPOS include:

- national GNSS reference network;

- the center for data processing;

- the system administrators;

- NCRS directly cooperates with similar EUPOS centers, especially from neighbor countries;

 now the ROMPOS real time services are provided free of charge to a wide range of users.



National Center for ROMPOS Services (NCRS)



- **<u>ROMPOS DGNSS</u>** for real time kinematic applications, with an accuracy range from 3 m to 0,5m;
- **<u>ROMPOS RTK</u>** for real time kinematic applications, with an accuracy range from 0,5 m to 2cm;
- <u>**ROMPOS GEO**</u> (Geodetic) for post processing applications, with an accuracy better than 2cm

Transmission of ROMPOS RTK and DGNSS differential corrections is centralized, from NCRS via **internet.**

There are also, two main types of real time positioning products:

- single base (from one site) and
- network, such as VRS, FKP and MAC (MAX şi i-MAX).





Coordinates are determined relatively to A class national geodetic network and due to this fact this values are obtained directly in **European Terrestrial Reference System 1989 (ETRS89)** which offers an homogeneity of all determinations.

To transform coordinate values from ETRS89 to National Reference System S42 (ellipsoid Krasowsky 1940, Projection Stereographic 1970), NACLR offers for free the **TransDatRO** software, which can be download from official website:

For users who want the implementation of TransDatRO software in GNSS RTK field receivers, NACLR provide the grids for transformation and the computing algorithm. As a result, coordinates determined by GNSS RTK field receivers which have implemented the transformation grids of TransDatRO application can be obtained directly in the field (on the whole country) in S42 system.





NACLR also realized the web site <u>www.rompos.ro</u> which deliver information about the system.

ROMPOS is managed through a specialized software package for post processing and real time services, Leica GNSS Spider.

This software packages realizes:

- monitoring and control of GNSS reference stations,
- \succ managing and archiving the post processing data,
- qualitative and quantitative data analyses,
- network configuration,
- creation, management and delivery of specific products and services,
- monitoring of the system users etc.





Due to the large dimensions of the network which implies a lot of calculations, the network is divided in 4 clusters which run on two servers. This architecture realize the processing on two servers and, in case of malfunction not being affected the whole network. The clusters have common stations between them, which permits their superposition.







4. Extending the ROMPOS real time services availability

GNSS data streams received from neighbor stations are used only for ROMPOS network products, for extending the coverage area of network services, according to cross border GNSS data exchange agreements. RINEX files should not be generated from public data streams.

countries						
Agreement	GNSS data stations which are the subject of agreement Romania		Signed			
ROMPOS – GNSS Net.hu (Hungary)	Arad Oradea Satu Mare Timişoara	Vásárosna mény Debrecen Gyula Szeged	Yes 2010			
ROMPOS – MOLDPOS (Moldova)	Dorohoi Flămânzi Iaşi Vaslui Târgu Bujor Brăila	Cahul Edineţ Faleşti Nisporeni Leova Comrat	Yes 2010			
ROMPOS – ZAKPOS (Ukraine)	Satu Mare Baia Mare Vişeu de Sus Dorohoi Tulcea	Khust Rakhiv Chernovtsi Izmail	Yes 2012			
ROMPOS – BULiPOS (Bulgaria)	5 stations	5 stations	No			
ROMPOS – AGROS (Serbia)	4 stations	4 stations	No			

GNSS data exchange agreements between Romania and neighbor





5. Perspectives

Replacing the equipment GNSS of permanent stations GPS

It wants redetermination permanent GNSS stations ROMPOS coordinates using a scientific software (Bernese) and validation of results by Technical Working Group EUFEF





References

✤<u>www.rompos.ro</u>

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♦ Cooperation agreement between the Institute of Geodesy, Cartography and Remote Sensing of Hungary and the National Agency for Cadastre and Land Registration of Romania regarding GNSS reference station data echange

✤Cooperation agreement regarding GNSS data echange between the National Agency for Cadastre and Land Registration of Romania and the Agency for Land Relations and Cadastre of Moldova Republic

♦Cooperation agreement between the National Agency for Cadastre and Land Registration of Romania and State Service of Geodesy, Cartography and the Cadastre Ukraine/ State Enterprise «Zakarpatgeodezcentre», regarding GNSS reference station data exchange





Thank you!

