Differential corrections provided by Rompos Romania transmission via GPRS with the help of the radio transmitter

Lecturer PhD. stud. eng. Stefan Suba
University of Oradea, Faculty of Arhitecture and Constructions
Assistant PhD. stud. eng. Sorin Nistor
University of Oradea, Faculty of Arhitecture and Constructions
Assistant PhD. stud. eng. Andreea Jocea
Technical University of Civil Engineering of Bucharest

ÖSSZEFOGLALÁS

A XX. század a következőket jelenti: sebesség és pontosság. Ezek döntő szerepet játszanak a döntéshozatalban, és ezek hatása érezhető minden szakágban. A jelen bemutató mindössze a GPS-es helymeghatározásban játszott szerepet mutatja be. Ezekkel egyidőben alakult ki az egyre nagyobb kérés a pontos és gyors helymeghatározáshoz, és válaszként érkezett ezekre a problémákra a a kinematikus – és főleg a valós idejű kinematikus RTK – helymeghatározás technikája. Azonban a pontos helymeghatározás érdekében szükségünk van a differenciálkorrekciók vételére. Az alábbiakban bemutatjuk, hogyan is juthatnak el ezek a korrekciók a kétfrekvenciás vevőinkhez – a mobil Internet, illetve a rádiójelek segítségével.

1. INTRODUCTION

All over the world this method of measurement is used - RTK - because of the work speed and accuracy provided. The main advantages are the velocity of the determination (in a few seconds) and the accuracy, which is of the order-centimeters and can even reach millimeter accuracy. This working method requires the use of dual frequency receivers and a receiver which allows the use of differential corrections. This method is based on time correction principle and applying it in real time to obtain the coordinates as precise and as fast as possible. These corrections are time differential corrections. How to obtain these differential corrections is dependent on how we choose it. We will continue to discuss only about the method of obtaining differential corrections provided by the permanent stations and VRS method. The problem discussed in this paper is how we can transmit these differential corrections from the casters to the users. These can be transmitted in two ways: by radio transmission and by GPRS transmission.

2. TRANSMISSION OF DIFFERENTIAL CORRECTIONS

The purpose of this paper is not to dissect the kinematic RTK method, but how to transmit differential corrections - how differential corrections reach users. The following part will present two ways of how differential correction are transmitted:

a) Differential correction transmitted using radio waves:

The most common method of transmitting the differential correction is with the help of UHF band and sometimes VHF band with the data bit of 9600 bps. With the help of radio transmission we can send information on long distances. The radio waves are electromagnetic waves. The frequencies chosen depends on the restriction imposed by the governmental agencies. Especially " the power" restriction is the topic subject due to the fact that this restriction has a direct impact to the distances between the rover and transmitter. This distance is a few kilometers between the rover and the radio transmitter.

b) Differential correction transmitted with the help of mobile Internet.

Due to the available bandwidth of Internet, researchers managed to develop a protocol that allows transmission of differential corrections to GPS receivers via the Internet. This development has started growing, as a result of more and more demands for data transmission over the Internet as the many other problems that radio transmission is "suffering" the transmission of differential corrections through radio signal, the latter, so the signal amplitude and frequency modulation for data transmission is being restricted by government agencies.

Differential correction is being transmitted to Internet due to the utilization of NTRIP protocol (Network Transport of RTCM via Internet Protocol). This protocol was developed by the Federal Agency for Cartography and Geodesy of Germany. With the help of this protocol they are three classes of objects that are communication between them:

- GPS station servers that assure differential correction;
- Users that what to have aces to this differential correction;
- Transmitters that computes differential correction and they are transmitting the differential correction;

With the purpose to obtaine this differential correction, the client must have an IP address and password, and in return the caster will transmit the stream of the differential correction. The casters are operating in standard model HTTP port 80 and sometimes on port 2101.

At the beginning the data transmitted with the help of the mobile Internet was the GPRS (General Packet Radio Service), and in the following years new ways were developed to transmit the data. They are EDGE (Enhanced Data rates for GSM Evolution), CDMA2000 (also known as IMT Multi-Carrier (IMT-MC) and UMTS (Universal Mobile

Telecommunications System) - all of this are the third-generation (3G) mobile telecommunications technologies.

The **GPRS** technology is a technology that transmits data with the help of mobile phone or a modem in a fast and efficient way. The most important characteristics are that the phones that are using GPRS can by permanently connected to the Internet. Transfer rate differs depending on the chosen package, but can reach a speed of 171 kbps with eight access channels at the same time. Lately the development has put increased accent on the EDGE and 3G technologies.

EDGE (Enhanced Data Rates for GSM Evolution) allows access to data, three times faster than GPRS. It works alongside GPRS technology, and is making access to them depending on coverage. One advantage is that it will not show an interruption in the supply of data when moving from an area with EDGE coverage in an area with GPRS coverage and vice versa. Unfortunately, data transmission speed cannot be assured with certainty because the rate is divided between users of the same cell.

3G is the acronym of the “third generation mobile telephony”. With this technology, you can get a transfer rate up to 3.6 Mbps - which is the network speed. The transfer speed which can be reached up to 2.8 Mbps.

Lately developed 3G technology can offer speed up to 21.6 Mbps.

CDMA2000 (also known as IMT Multi-Carrier (IMT-MC)) is a family of 3G mobile technology standards, which use CDMA channel access, to send voice, data, and signaling data between mobile phones and cell sites.

Universal Mobile Telecommunications System (UMTS) is one of the third-generation (3G) mobile telecommunications technologies, which is also being developed into a 4G technology. The first deployment of the UMTS is the release99 (R99) architecture.

The development of these technologies are trying to obtain higher speeds, but unfortunately, for surveying these three new technologies - 3G, 3G, EDGE - are not offering the desired coverage. It is understood that their development in rural areas was not a priority because of the low demand in these areas.

3. COMBINING THE TWO METHODS

Because the problem of "coverage" of the mobile Internet, this has made possible the development of the system in which the two methods are "combined". In countries that do not focus on the transmission of data via Internet, the possibility of accessing the

differential corrections becomes increasingly difficult, if not impossible. The transmission problem was solved through a software developed by the Federal Agency of Cartography and Geodesy in Germany.

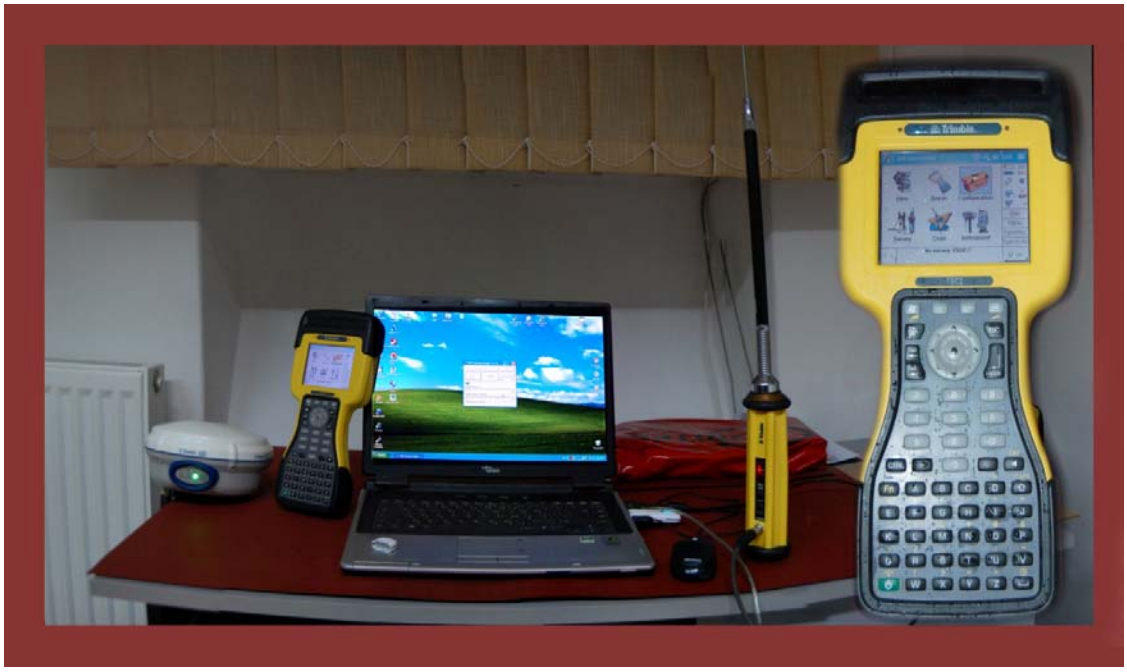

Figure 1. The equipment

Combining the two methods is as follows:

- will seek an area relatively close to the work place where we have access to the Internet, the distance to be at most the order of kilometers,
- transmitting differential corrections via radio waves, in first case we will need:
  - -the hardware, this part is composed of a laptop, modem GPRS
  - -the software, specialized software to access the differential corrections and transform them into a format that can be passed down through radio waves.

The use of this technique is possible only on dual frequency receivers.

This data conversion is possible by using specialized software. Such software is the GNSS Internet Radio, developed by the Federal Agency for Cartography and Geodesy in Germany.

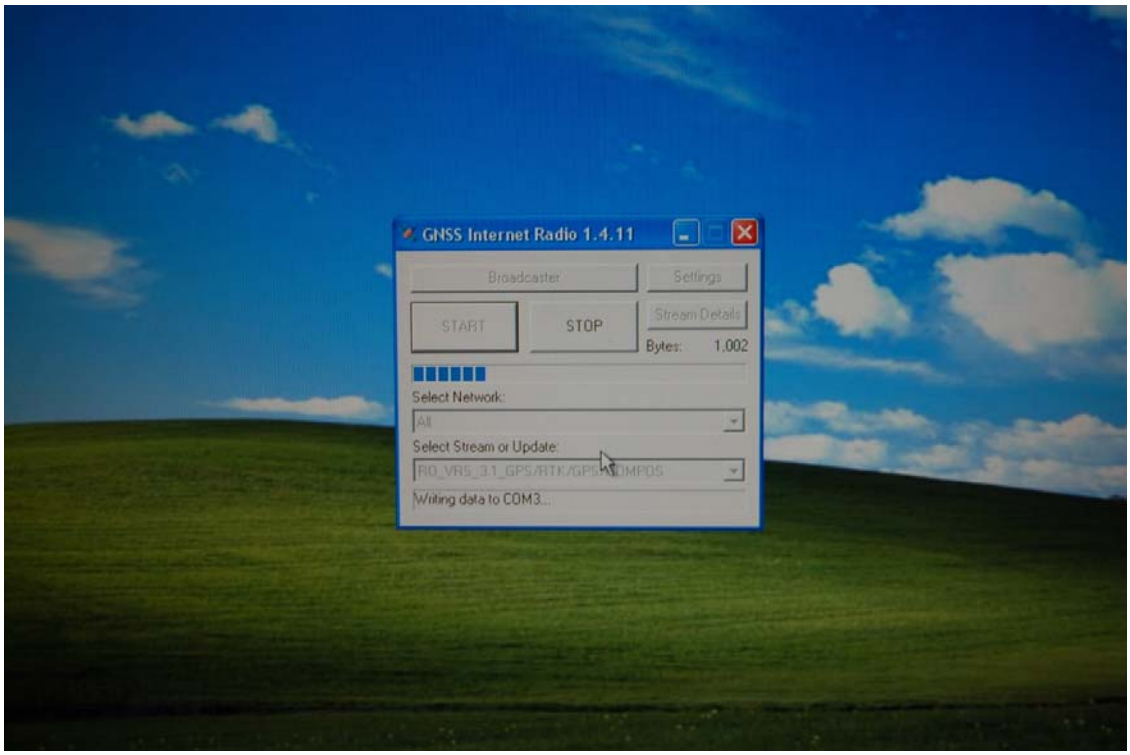

Figure 2. Transmitting the corrections

Using GNSS module software, we will use:
- Ntrip Client (Networked Transport of RTCM via Internet Protocol
- RTCM data transmission by Internet Protocol).

Because the work performed in kinematic method – RTK- this involves a continuous movement. This may cause problems with GPRS signal stability due to inhomogeneous coverage of areas of the GPRS signal transmission relays. The radio signals do not experience such problems, but is recommended to have a special attention to existing barriers and the distance between the radio transmitter and receiver.

The latest specifications for obtaining differential corrections with virtual station, it is recommended to not exceed the distance of 2 km-due to various atmospheric factors.

An advantage of this software GNSS Internet Radio - Ntrip client is that we can change at any time by entering the coordinates position of the virtual point where we are creating the new virtual point.

This method is possible with devices that allow using the module NTRIP. If it is reaching a distance too large to use the radio transmitter, it will recourse to a second transmitter set to repeater. So the first transmitter will be set only for transmission while

the second will receive and then transmit forward differential corrections. If we don't have two radio transmitters, but we have two rovers, one of them can also be set as a repeater with the help of the internal antenna of the rover.

One of the factors that must be taken into account is that this method, in order to be economically efficient, we have to use free radio frequencies.

4. CASE STUDY

Measuring the earth road from Halmeu locality, Satu Mare county, Romania.

In this work, we carried out topographical plans to modernize roads in Satu Mare County – Halmeu village.

Measurements were made with a Trimble R6 dual frequency receiver. We also used a laptop, a radio transmitter (PLD 450) and a modem. On the laptop we had installed the GNSS Internet Radio.

At the beginning, we had to examine the possibility of accessing the site from where we will receive differential corrections - ROMPOS Romania.

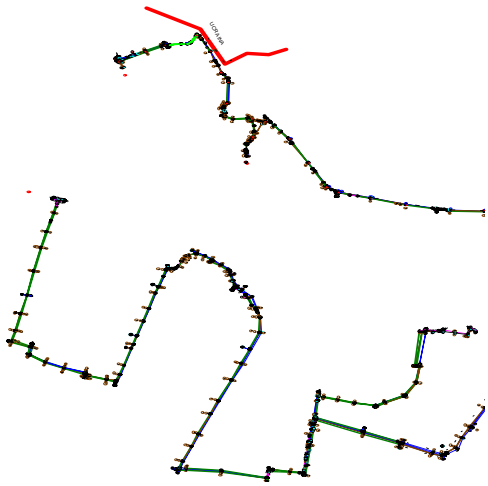

Figure 3. Covered area

After these tests, we have to go the location of the area of interest and the receiver will determine a point - this point can be with the precision of a few meters. This position is to be forwarded to the the program.

This coordinates will become the virtual point coordinates. At a distance of 1-2 km from the virtual point we will determine a new position which will be communicated in order to change the virtual point position.

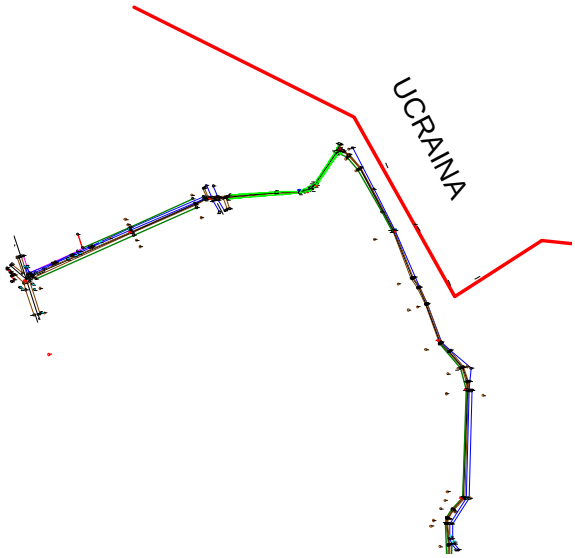

Figure 4. Detail of the measured area

Because of the complexity of the road networks and distances that were around 20 km we had to move in different positions with the entire system.

5. CONCLUSIONS

Several issues must be considered when choosing the art of communication for the transmission of differential corrections:

- **Technical aspect**: distance and coverage, transmission bandwidth, protocol, trust in the system. More precision offered by RTK method decreases in accuracy if the transmission of differential corrections is the low transfer rate. To obtain values of precision of a few centimeters or millimeters of the transmission of differential corrections must be made in the interval of second or even less. Another issue would be

communication dish – the size of the dish must be small enough that it can be integrated into the rover.

- **Economic aspect**: communication costs consist of purchase price of the "senders". If we use such method for obtaining the corrections provided by a national system has to keep account monthly price paid for providing these corrections or direct acquisition of another receiver that will provide differential corrections.

- **Administrative aspects**: bands of radio frequencies may not be used free of restrictions imposed by government agencies. In many countries certain frequencies in the UHF band can be used free but the transmission of differential correction can be made on distance to several kilometers.

This has led to combining the two methods: using the Internet as the primary method of differential corrections purchase and distribute aid their transmitter radio on a free frequency. The problem created by this method is that the transmission of differential corrections provided by a national system is a way to get anyone with a dual frequency receiver set to the same radio frequency transmitter to obtain these data. To protect them, or rather "sharing" their data not be made without our consent will set different values to "delay" - (delay's) signal to both receiver and radio transmitter.

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CONTACTS

Lecturer PhD. Stud. eng. Stefan SUBA
University of Oradea
Faculty of Arhitecture and Constructions
410058 Oradea, Romania
str. Barbu Stefanescu Delavrancea nr. 4
Tel. +40 259 408 447
Email: stsuba@yahoo.com
WWW: www.arhiconoradea.ro

Assistant PhD. stud. eng. Sorin NISTOR
University of Oradea
Faculty of Arhitecture and Constructions
410058 Oradea, Romania
str. Barbu Stefanescu Delavrancea nr. 4
Tel. +40 259 408 447
Email: ing_nistor@yahoo.com
WWW: www.arhiconoradea.ro

Assistant PhD. stud. eng. Andreea JOCEA
Technical University of Constructions - Bucharest
Faculty of Geodesy
020396 Bucureşti, Romania
B-dul Lacul Tei nr. 122-124, sector 2
Tel. +40 21 2421208
Email: ajocea@yahoo.com
WWW: http://geodezie.utcb.ro