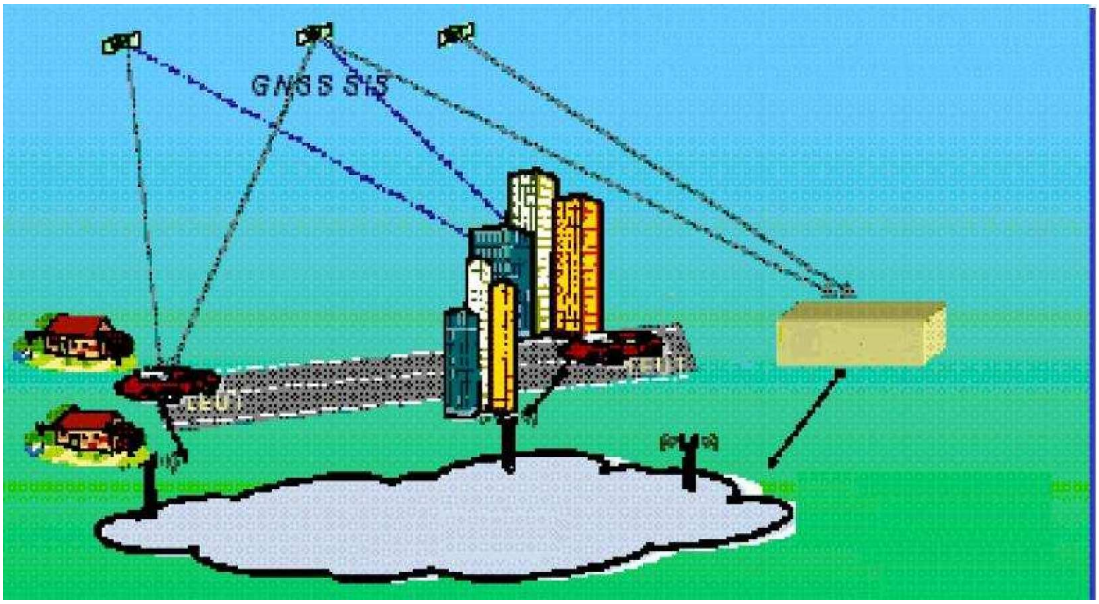
SYSTEM FOR THE DIFFERENTIAL CORRECTION DATA TRANSMISSION AND RECEIVING, WITH INTERFACE FOR GALILEO SYSTEM – GPSE D



Programme: CEEX
Project code: M1-C2-1451
Contractual Authority: Romanian Space Agency - ROSA
Conrtactor: SC IAROM SA Bucharest-project coordinator

Partners:
-SC AEROSTAR SA Bacau -
INTERGIS GRUP SRL Bucharest
-TECHNICAL UNIVERSITY OF CIVIL ENGINEERING OF BUCHAREST

The project's goal is the study of the possibilities to development of a system for the differential correction data transmission and receiving and development of an integrated equipment for relative positioning including an radio receiver module intended for receiving the differential correction data from the system. The equipment will be provided with interfaces for a various equipments or sensors, and also with facilities of storing, processing and displaying of maps and is intended to mobile users whence can not use the internet.

Targets:

1. The study for development of a national system for differential correction data transmission from the permanent stations for differential correction data computing that are included in the EUPOS national network, to any kind of users.
2. The development of an integrated equipment for receiving of the GPS signal and of differential correction (ERCD-01), having facilities for interfacing with Galileo system in future, destined to mobile users who need a sub meter accuracy positioning (and who can′t access the internet).

In the above presented context, the proposed objective is the study, establishing of requirements and manufacturing of an prototype equipment that can perform the absolute and relative positioning for an earth mobile using the GNSS technologies, with an accuracy better than 0,5 m, embedding the facility of receiving radio transmitted pseudorange differential data correction.

The project′s main objectives are:

1. The studies and analyses regarding the differential correction data transmission at national level having in view the actual and future context of the broadcasting infrastructure (bands of frequency, propagation, coding, information embedding in the signal, type of modulation, standards)
2. The studies and analyses regarding the geographic information transfer and processing
3. The studies and analyses regarding the optimal correction data receiving (the information extraction, detection/decoding)
4. The requirement specification for hardware and software developing
5. Hardware design
6. Software design
7. Build up the prototype
8. Hard and soft testing for performance proofing

The project´s stages:

Stage I

Studies and analyses concerning the differential correction and geographical information transmission system on national level

Terms: 10.12.2006

Stage II

Studies and analyses concerning the optimal receiving and processing of differential correction data and geographical information

Terms: 10.04.2007

Stage III

Prototype equipment definition Terms: 10.09.2007

Stage IV

Prototype equipment design

Terms: 15.01.2008

Stage V

Prototype equipment ERCD-01 manufacturing

Terms: 10.05.2008

Stage VI

Hard and soft testing for performance proofing

- Programme CEEX: -**Project code M1-C2-1451**
- Contractual authority: -**Romanian Space Agency – ROSA**
- Coordinator of project: -**SC IAROM SA Bucharest**
- Director of project: **-Diplomat Engineer Mihail Nicolae TONCEA**
- The project's consortium: **-SC AEROSTAR SA Bacau**
  -INTERGIS GRUP SRL Bucharest
  -Technical University of Civil Engineering Bucharest
- Duration of project: **15.09.2006-30.09.2008**

The main focus of this project is the definition of a system for broadcast and receiving differential correction data, using the GNSS and radio broadcasting technologies.

The first stage of the project was focused on:

1. Identifying the main capabilities of broadcasting differential correction data at national level, data being delivered by the national reference stations network.
2. Establishing the diagram of the system for broadcasting differential correction data through the VHF broadcasting diffusion system using the RDS (Radio Data System) facility.

The searching report compare the main systems of broadcasting with capabilities of data transfer at national level such as: GSM/GPRS, LW, VHF, UUS, and the marine radio communication system from the standpoint of view of covering, availability, standardisation and initial infrastructure today available.

The main conclusion, considering the terrestrial distribution of the stations, is that for pseudo range differential data correction, destined to terrestrial traffic (auto), the most useful facility for broadcasting is the RDS implemented on the VHF broadcasting system.

Upon this assumption a system diagram was proposed based on which the main included equipments can be developed.

In the second stage of the project the studies were focused on methods and algorithms for optimal data receiving.

In fact, the analysis shows that the VHF/RDS is an optimal transmitting – receiving system by point of view of digital information transfers and is very useful for differential correction data transmitting.

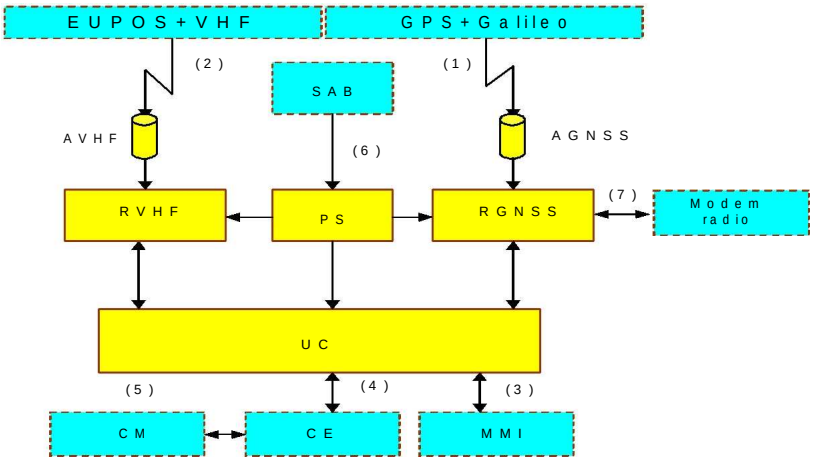
Also, some considerations are made about the transmitting of RTK corrections and are revealed that the DARC (Data Radio Channel), a system based on BPSK modulation of the 5-th harmonic of 19 KHz pilot signal, is adequate.

If a temporary transmitting RTK correction is needed on limited area (10Km) and there is a clear on line of site between the Base Station and user, there are sufficient modems with output power of about 5W in UHF band.

In the third stage the functional and technical hardware and software requirements were defined, identified by ERCD-01, for design, software development and manufacturing of the equipment for receiving the GNSS signal and differential correction data via VHF/RDS.

The definition documents do includes the Development Specification (SD) and the Software Development Specification (SDS).

The bloc diagram is presented below.



The equipment contains the following parts (in yellow):

1) GNSS Antenna (AGNSS)
2) VHF Antenna (AVHF)
3) GNSS Receiver (RGNSS) – Trimble LASSEN SKII
4) VHF Receiver (RVHF) – Microtune MT 1393
5) Controller (UC) – uPSD323A
6) Power Supply (PS) – PHILIPS TDA 3602

The blue parts (CM = Card Memory, CE = Extern Computer, MMI = Maine Machine Interface, SAB = Board Main Power Supply) are external systems.

Also, in this stage, there has been made a market study for finding and purchasing the critical parts needed for equipment manufacturing.

In the fourth stage was defined the manufacturing documentation (execution designs, manufacturing technology), Testing Procedures (PT) and the Evaluation Report (RE)).

These contain all manufacturing indications, testing and evaluation procedures and the draft for results registration of the qualifying tests.

In the fifth stage the ERCD-01 equipment was manufactured in accordance with the manufacturing documentation and was developed the software in accordance with the SDS. Also, we have made some preliminary testing.

Its front and back views are presented below (figures 1&2).

Figure 1: Front view of ERCD-01

Figure 2: Back view of ERCD-01

On the front panel there is an alphanumeric display for displaying the GPS position and summary indication related to the base station and the VHF broadcasting station that transmits the differential data correction.

On the back panel are placed all the connectors for interfacing with antennas and external systems.

In the sixth stage we have to run a testing program in accordance with Testing Procedures document.

The expected characteristics are summarised in Table no. 1.

Table 1

Parameter	Min.	Type.	Max	Unit	Condition/Note
GNSS section GPS Band Number of channels Out* Serial interface		 L1 8 NMEA 0183 RS232			 P2/NMEA
VHF section RF Band RF Sensitivity RDS Sensitivity	 87.5	 1.8 18	 108.1	 MHz µV dBµV	 S/N= 30 dB >80% correct blocs
Correction data format RTCM Message Serial Interface		 RTCM SC 104 M1 RS232			P1/RTCM In/Out** See notes
Power supply	9,2		18	Vcc	
Current consumption			0,5	A	
Dimensions		160x100x100			LengthxLongxWidth
Operating Temperature	-10		+50	^{o}C	

Notes: *The PVT solution is corrected while the data corrections are available

**The equipment is delivering the correction data at P1/RTCM output and also can accept the correction data at P1/RTCM, for inside RGNSS, from a local Base Station.
The RGNSS is removable and can be replaced by a GALILEO/GPS receiver.
For any information please contact us.