Project Fiche – IPA Annual Action Programme 2007 for Bosnia and Herzegovina
Spatial information services for BiH, Phase 1: Establishing of Network of permanent (referent) GPS stations – BiHPOS

1. Basic information

1.1 CRIS Number:

1.2 Title: Spatial information services for BiH, Phase 1: Establishing of Network of permanent (referent) GPS stations – BiHPOS

1.3 ELARG Statistical code: 03.18 - Free movement of capital

1.4 Location: Bosnia and Herzegovina including Republic of Srpska, Federation of Bosnia and Herzegovina and District Brcko.

Implementing arrangements:

1.5 Contracting Authority (EC): Delegation of the European Commission to Bosnia and Herzegovina

1.6 Implementing Agency: Delegation of the European Commission to Bosnia and Herzegovina

1.7 Beneficiary (including details of project manager):
Ministry of Civil Affairs BiH,
Project manager: Haris Čengić;
Deputy minister of Civil Affairs of BiH
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Project partners: Ministry of Justice of BiH ; Ministry of Foreign Trade Affairs and Economic Relations of BiH - Dep. For Agriculture, Agency for statistics B&H, Entity Geodetic Administrations (Republic Administration for Geodetic and Real Property Affairs of RS and Federal Administration for Geodetic and Real Property Affairs of FBiH),

Financing:

1.8 Overall cost: 1,000,000 EUR

1.9 EU contribution: 1,000,000 EUR (100%)

1.10 Final date for contracting: N+2

1.11 Final date for execution of contracts: N+4

1.12 Final date for disbursements: N+5

2. Overall Objective and Project Purpose

2.1 Overall Objective:

To provide actual and reliable land information to facilitate effective and efficient land management, in order to contribute to poverty reduction, eliminate possible discriminations, support and develop economic growth, through reliable and transparent real property markets and land policies.

2.2 Project purpose:

The Project purpose is to set up a permanent reference system offering global positioning services in the whole BiH to the main target groups:

- B&H institutions dealing with land registration
- B&H institutions, agencies and companies dealing with transport (railway, highway, airport control, etc.)
- Municipal administrations
- Agricultural administration
- Agency for statistics B&H

2.3 Link with AP/NPAA / EP/ SAA

The European Partnership (EP) identified that further support was necessary for the improved collection and management of agricultural data. A clearly defined short term priority within the EP was:
To reinforce collection and processing of Agricultural statistics in line with EU standards and methodology.

2.4 Link with MIPD

The project proposal belongs to the sector called "European standards" (according to MIPD 2007-09).
In paragraph 2.2.3.1 is said:
"Support and establishing a strategies and politics, aiming to establish sectors policies and regulatory frame, compactable with European standards".
In Paragraph 2.2.3.3:
Programs need to be run to fulfill a general goals:
"Support to the development of a comprehensive cadastre and land registry."

2.5 Link with National Development Plan (where applicable)

N/A

2.6 Link with national/ sector's investment plans (where applicable)

Accepting proposal of Ministry of Civil Affairs BiH, and fact that Project of *Network of permanent (referent) GPS stations – BIHPOS* was in Project Investment Proposal strategy named as "New High Priority", point No. 5., Council of Ministries of BiH, on 116-th session, date 27.04.2006, supported the BIHPOS and decided to continue further financial support to this Project. Therefore, the legislative, administrative and financial frameworks are in place for the project implementation. In terms of investment plan, the feasibility plan has already been produced.

3. Description of project

3.1 Background and justification ¸

The land administration system in BiH has been adversely affected by the turmoil of the past 15 years. In the aftermath of the war, the land usage pattern has changed considerably: destroyed infrastructure, unused land - due to mine relics, spontaneous construction, after the war, etc. In addition, the land information system (land registries and cadastre) was partly destroyed during the war in war affected areas. The rest of the system, which was saved, has not been updated on timely basis, to reflect the changes. The process of restoring and updating the land information system has been slow due to budget constraints and restrictions in accuracy, as it has required to restore the geodetic reference network (which was also affected by the war).

As a result, the inaccurate land information hinders decision making process on the land usage in public administration institutions at all levels (state, entity, canton and municipality).

Most of the functions of the land administration structures are performed at municipal level. The municipal administrations are responsible for running land cadastre, as one of the parts of land administration structures. At the same (municipal), level, municipal courts run land registers. other parts land administration. However, it is very common that the data about the same land property is inconsistent between the institutions. Both parties of the land administration structures are aware of the issue and admit that the synchronisation of the date is crucial for efficient functioning of the system. This synchronisation process will require accurate measurements and data on land plots which in real time might be provided by using GPS.

These shortcomings of the land administration system create unfavourable conditions, as property market is underdeveloped, for social and economic development: uncertainty about the land use limits investments into agriculture, forestry, transport and other sectors. The factor has been recognized by the European Commission in its Regular Report on BIH progress 2006 as one of obstacles for agricultural and rural development. This situation, also, has a major influence on real-estate market, planning of the agricultural activities or forest management and protection.

While seeking for complete and fast solutions, Ministry of Civil Affairs of BiH, as administrative institution responsible for coordination of all geodetic and geodesy-connected activities on state level, has initiated a Project **Spatial information services for BiH.** The project is primarily aiming at creating conditions for a better functioning of courts and local land administration, but also at developing real-estate market, enhancing spatial planning capacities, etc,**.**

This Project has two phases. In **first** phase ***Establishing of Network of permanent (referent) GPS stations – BiHPOS,*** preconditions for a accurate measuring and land parceling would be created. Using this technology, the ways would be created for (re-)registration of land owners, updating and eliminating inconsistencies in the land books and cadastre in municipal administrations and local courts.

On ***phase two*** - ***Creating ortophoto maps***, air picturing and ortophoto maps would be made, as a complete and functional way to overview of whole Bosnia and Herzegovina, with clearly visible and proportionally marked land structure, agricultural potential, forests, roads, cities, factories and other elements. On that way, it would be possible to create functional maps of agricultural areas and to make plan of futures activities and functional development policy in this sector. Also, overview of whole Bosnia and Herzegovina on this way would create a new possibility for Statistic agencies and chance to run statistics on much reliable and accurate way.

Recognizing these advantages, Ministry of Justice of BiH and Statistic agency of BiH have fully supported **Spatial information services for BiH** project declaring its goals as his owns, and expressing a need for a future partnership on this field. Similar support was expressed from the side of Ministry of Transport and Communications and several airports and railway and road transport corporations.

Importance of this project provided permanent financial support from the side Council of Ministers of BiH, since year 2005.
The feasibility study considered the option of integrating the network of GPS stations with the existing information infrastructure that is being run by CIPS Directorate, which is also part of Ministry of Civil Affairs of BiH. CIPS Directorate runs a number of databases used by BIH public administration institutions: e.g. citizenship documents, passports, personal cards, drivers licenses, etc.

3.2 Assessment of project impact, catalytic effect, sustainability and cross border impact (where applicable):

3.2.1 Project impact

The implementation of this project across all municipalities in BiH will bring wide ranging benefits and have a long lasting impact. Main impacts will be:

Land administration:

- Faster Spatial data collection
- Functional land parcelling activities
- The Spatial data analysis and mapping if there is a need
- Faster process of getting land and owners certificate
- Reinforcing cadastre

Agriculture:

- Create conditions for collection and processing of Agricultural statistics in line with EU standards and methodology
- Encourage of activities of getting a financial supports for agriculture, as credits of (inter-)national donors support
- Growth of agricultural activities and so provided products as a part of poverty prevention
- Rural development policies at all levels will become more focussed, but access to such information at Municipal level will lead to better land use and natural resource planning

Work of courts:

- Creating conditions for a funtional work of Municipal Courts, by faster Spatial data collection, certificate of land ownership collection and registration

Municipal administration:

- Accurate Mapping of the local area
- social housing as a product of better usage of land potential and space planning
- successful management of municipal facilities and infrastructure
- Creating conditions for a big construction undertakes

Transport (public and private):

- Overall traffic safety improvement (in airports systems for navigation, and railway and highway systems traffic control and management) as result of GPS navigation
- Better choice of travelling ways and usage of roads
- Remarkable savings of fuel and time
- airports systems for navigation

Statistic agencies:

- Processing of spatial data as a part of it's standard activities
- Better planning of it's futures statistic activities
- Creating broad spectra of new options for processing spatial data (for ex. Running of road usage list, presenting a No. of rebuild houses, creating a maps of agricultural reinforced area, running a list of changes of agricultural products, etc)

3.2.2 Catalytic effect and sustainability

This situation, also, has a major influence on real-estate market, planning of the agricultural activities or forest management and protection.

By Establishing of Network of permanent (referent) GPS stations – BiHPOS Bosnia and Herzegovina will create preconditions, by running updated land book administration, for membership in INSPIRE initiative.

Countries, (non-)members of EU, were conjoined in INSPIRE initiative spotting importance of land and property in the economy of Europe, the fact that cadastral parcels and property identifiers are specifically listed in the INSPIRE Directive and the need for further work to ensure that the various coordinating groups working in the cadastral field are complementary and do not duplicate and dilute each others work.

3.3 Results and measurable indicators:

Results:

1) GPS network is installed and functional
2) Staff, employed by Ministry of Civil Affairs of BiH, is trained to maintain work of network

Measurable indicators

1) The GPS network is installed, tested and accepted by the beneficiary. The source for verification of the indicator will be the certificate of delivery and functional work
2) Number of staff trained. The source for verification of the indicator will be training reports and project reports

3.4 Activities:

To deliver the specified results, inputs from the supply contract with training element will be required (contract 1). The following activities are foreseen:

1) Delivery of equipment
2) Install and testing of equipment
3. Certifying functionality of equipment

2.1. Training of staff employed by MoCA of BiH to run system

3.5 Conditionality and sequencing:

- Before installing equipment, facilities should be (re-) built and readapted in accordance with project of GPS network. This will be done by MCA of BiH. Therefore, the Council of Ministers of BiH should re-confirm decisions the allocation of 0.5 MEUR from the state budget 2007 for the project.
  Creating and building of such network is much cheaper by using and readapting already existing government's buildings. Legal frame in solving of financial structure of such agreement is entirely in hands of Council of Ministers of BiH
- Re-arrange of facilities
  Already existing government's buildings are built for other purposes and there are some adaptations need to be undertaken in order to preparation them for futures usage as GPS stations.
- Resolving a legal and technical issues regarding of usage of facilities in Government ownership for this purpose
  Legal frame in solving of internal agreements between of different ministries is entirely in hands of Council of Ministers of BiH.
- MCA of BiH "provide" a staff (3 people)for maintenance of future GPS network
  Activities on "providing" stuff should be undertaken parallel with building of network and financed by MCA of BiH

3.6 Linked activities:

The EC has funded a Framework Contract project in 2005-6 aiming to propose "Standards for producing data for the Land Information System in BiH". The Land Administration Project aims to support the various public land administration institutions as well as the private sector

in building capacity to establish and maintain a reliable and safe full electronic land administration system with multi-institutional cooperation, including development of legislative and normative framework. One of its recommendations was the realization of orthophoto maps.

That goal is recognized as Phase 2 of this project.
Also**,** the World Bank loan (2007-2010) supports the Land Registration Project, which aims to invest in improvements of working conditions in land registry offices, in digitization of existing land registry and cadastre records, and in policy and legal development.

3.7 Lessons learned:

Neighbouring countries (e.g., Croatia, Montenegro and Serbia) already did activities on building similar networks and we are in position to compare used standards and technical issues. The Feasibility study takes into account the experience of the neighbouring countries, especially Croatia, while analysing technical solutions for the GPS network (in terms of structure of the network, equipment to be used)

Activities on ***Network of permanent stations*** will lead us to the point where all geodetic, and similar activities will be done in unique, and unified coordinating system, as it is in lands of European Union, and in neighbouring countries (Countries of Ex-Yugoslavia). It is to be believed that activities on establishing of ***Network of permanent (referent) GPS stations – BiHPOS*** will lead us to establishing of this new, modern and unique coordinating system.

4. Indicative Budget (amounts in €)

Activities	TOTAL COST	SOURCES OF FUNDING										
		EU CONTRIBUTION				NATIONAL PUBLIC CONTRIBUTION					PRIVATE	
		Total	% *	IB	INV	Total	% *	Central	Regional	IFIs	Total	% *
Activity												
Contract 1	1.000.000,	1.000.000	100		*1.000.000*	0	0				0	0
TOTAL	**1,000,000**											

* expressed in % of the Total Cost

5. Indicative Implementation Schedule (periods broken down per quarter)

Contracts	Start of Tendering	Signature of contract	Project Completion
Contract 1	Q1 2008	Q3 2008	Q3 2009

6. Cross cutting issues (where applicable)

6.1 Equal Opportunity

Equal opportunity for participation of men and women will be assured in all aspects of project implementation. Contractors involved in the project will be required to provide monitoring data recording the participation of men and women in terms of expert inputs and trainee days as an integral component of all project progress reports.

6.2 Environment

The project will not have any negative environmental effects. It is to be expected to the Environmental care will be encouraged in the future by this project.

6.3 Minorities

Participation in the project activities will be guaranteed on the basis of equal access regardless of racial or ethnic origin, religion or belief, disability, sex or sexual orientation.

ANNEX 1: Logical framework matrix in standard format

LOGFRAME PLANNING MATRIX FOR Project Fiche	Programme name and number: Spatial information services for BiH, Phase 1*:* Establishing of Network of permanent (referent) GPS stations – BiHPOS	
	Contracting period expires	Disbursement period expires
	Total budget : 1.000.000 EUR	IPA budget: 1.000.000 EUR

Overall objective	**Objectively verifiable indicators**	**Sources of Verification**	
To provide actual and reliable land information to facilitate effective and efficient land management, in order to contribute to poverty reduction, eliminate discriminations, support and develop economic growth through reliable and transparent real property markets and land policies	The numbers of property transactions and mortgages shall increase	Regular supervision reports and project reports will be made available to the Project by the Land Administration Coordination and Advisory Board.	
Project purpose	**Objectively verifiable indicators**	**Sources of Verification**	**Assumptions**
The Project purpose is to set up a permanent reference system offering global positioning services in the whole BiH to the main target groups: - Institutions dealing with land registration - Municipal administrations. - Agricultural administration - Agency for statistics	Statistics on registration progress in the cadastre and in the land registry, statistics about the use of cadastre and land registry data, statistics on costs and revenues generated by land administration activities.	The Land Coordination and Advisory Board will collect annual statistics from its member institutions about the use of services.	The new services offered by the Project will be widely used by public administrations, professionals, private economy and citizens
Results	**Objectively verifiable indicators**	**Sources of Verification**	**Assumptions**
- GPS network is installed and functional Staff, employed by Ministry of Civil Affairs of BiH, is trained to maintain work of network	- The GPS network is installed, tested and accepted by the beneficiary. The source for verification of the indicator will be the certificate of delivery and functional work - Number of staff trained. The source for verification of the indicator will be training reports and project reports	- The certificate of delivery of the equipment - Project reports	The Ministry of Civil Affairs has the necessary human and material resources to maintain the system in operation

Activities	Means	Costs	Assumptions
1. Delivery of equipment 2. Install and testing of equipment 3. Certifying functionality of equipment 4. Training of staff employed by MCA of BiH to run system	Supply contract with training of the staff issue included	cost estimate is 1.0 million EUR	
		Pre-conditions	- The co-financing by the Government is confirmed - The technical and administrative regulations are put in force before starting with the exploitation

ANNEX II: amounts (in €) Contracted and disbursed by quarter for the project

Contracted	**Q1/2008**	**Q2/2008**	**Q3/2008**	**Q4/2008**	**Q1/2009**	**Q2/2009**	**Q3/2009**	**Q4/2009**	**Q1/2010**	**Q2/2010**	**Q3/2010**	**Q4/2010**	**Q1/2011**	**Q2/2011**	**Q3/2011**
Contract 1			1,000,000												
Cumulated			**1,000,000**												
Disbursed															
Contract 1			600.000				400.000								
Cumulated			**600.000**				**1,000,000**								

Annex III - Reference to laws, regulations and strategic documents:

The organisation of the current BiH geodetic system is based upon the following legislation;

- Constitution of Bosnia and Herzegovina
- Law on Ministries (2002);
- Law on Geodetic activities (1994);
- Law on Administration and administrative organisations (1996)
- Law on the Classification of activities (2006).
- Law on real-estate trade of BiH
- Law on land books and cadastre of FBiH
- Law on land books and cadastre of RS
- Law on measuring and cadastre of BiH

Feasibility Study for Permanent GNNS (GPS) Network – BIHPOS as an Integral Part of EUPOS. (Summary annexed)

ANNEX IV Details per EU funded contract (where applicable):

***Network of permanent (referent) GPS stations – BiHPOS*- Equipment list**

1	High quality geodetic dual frequency GNSS receiver with more than 72 channels at least using only one GNSS or more than 36 channels by using of more than one GNSS for pseudorange and phase measuring corresponding GNSS (Using GPS NavSat, GLONASS, and Galileo satellite systems)
2	Absolute Phase Centre Variation calibrated GNSS choke ring antenna, or similar antenna with an accuracy (RMS for the whole angle range) of $\leq$ 1 mm in L1 and $\leq$1,5 mm in L2.
3	Antenna's protection - Redone
4	Is software solution are compatible with offered hardware
5	If the answer to 4 Yes, does the software solution enable functions of networking stations:
	• Data junction of all connected reference stations and controlling of the DGNSS data as well as in cooperation with monitoring station
	• Computing the sub-services DGNSS and Network RTK FKPs and transmitting the RTCM- data to the Internet RTCM casters. A pre-extrapolation of the FKPs should be used for time response in agreement with the function if necessary. The procedure of networking reference stations serves among other things to improve profitability, precision and homogeneity of the reference network solutions by modelling distance depended effects of GNSS error components, particularly ionosphere, troposphere and orbit effects. Profit of using position dependent area correction parameters (FKP) is shorter initialisation times, higher reliability and improved accuracy for real time position fixing.
	• Transmitting the RINEX data for geodetic sub-service to the internet servers and long-time storage of these data two years at least, at best unlimited long-time storage on CD-ROM, Geodetic sub-service to the internet servers and long-time • Processing data by offering software and creation of RTK network correction (FKP) or/and virtual reference stations (VRS),
	• Data archiving with all referent station for post processing
	• Preparing data for distribution to customers via different media i.e internet, GSM, GPRS.
	• Access policy and collecting data from customers
	• Central management of GNSS stations
	• Quality of management and system alarming
	• Data management and archiving
	• Customer service
	• Homepage, e-mail, newsletter,
6	Are you able to offer your own system DGNSS reference stations?
7	If the answer to 6 Yes, give us a list of the countries in which your system is installed and functioning as national network of DGNSS referent stations. (Give us a list of names and addresses so we can get in touch with them and ask for references).

FEASIBILITY STUDY FOR PERMANENT GNSS (GPS) NETWORK - BiHPOS AS AN INTEGRAL PART OF EUPOS

S U M M A R Y

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FEASIBILITY STUDY FOR PERMANENT GNSS (GPS) NETWORK - BiHPOS AS AN INTEGRAL PART OF EUPOS

1. Introduction

Satellite navigation using the Global Navigation Satellite System (GNSS) has largely played a relevant role in all areas of mobility in our society. Since recently, this technology has gained an increased influence in processing of spatial and spatially related information.

Through completion of the network of permanent GNSS-station, one opens up the opportunity for systematic reconstruction of the cadastre and all types of land survey, that is, geodetic works on the territory of BiH, as well as the opportunity for introduction of "the new geodetic date (ETRS89)", and in addition, this also opens up the opportunity for further development of institutional capacities in priority areas of land management.

1.2. ITRF-/IGS-stations

The stations currently active in BiH are 1 ITRF/IGS station in Sarajevo (SRJV), that is, there is also a station in Mostar working in test regime. The station in Sarajevo (SRJV) has been established under the CERGOP 99 campaign and is an EPN member officially accepted in November 1999.

1.3. The name for the Bosnian-Herzegovinian GNSS permanent network

Relying on the names of various European users of GNSS station networks, the name proposed is BiHPOS - BiH Position System (Bosnian-Herzegovinian Position System).

2. Targeted Users

The areas of application of networked GNSS stations are multiple and have been sufficiently applied:
For all surveying projects (in geodetic engineering, all types of cadastres, surveying of state borders),
For scientific and geodynamic research,
For formation and supplementation of geoinformation systems,
For airphotogrametrics and laser scanning of grounds,
In hydrography, in surveying of rivers, banks and seas,
At security services, such as the police, fire brigade, rescue services, ...,
In agriculture and forestry,
In statistics
At services involving users of pipelines and traffic communications (oil pipelines, electricity lines, gas, oil;
railroads, roads …),
In traffic and telematics (seafaring management, traffic supervision, …),
In navigation and route planning,
In public management of traffic at local and regional levels,
In catastrophe management,
In environmental protection,
In research of climate and weather forecast,
In aircrafts,
In fishing,
For the purpose of effective defense of the Country,
Simply put, anyplace requiring reliable data on position and navigation.

3. System Benefits

Installation of the network of multifunctional networked GNSS reference stations enhances the development of:

Science:

Through introduction of a single, international (European) coordinate system ITRSxx (ETRS89),
Definition of precise satellite ephemerides, definition and determination of celestial coordinate systems,
Through relevant data for single standards in geodetics, geodynamics and astronomy.

Technical components:

In the form of development of technical methods in geodesy and navigation with various levels of precision,
In use of new most modern techniques and technologies by various users,
In education and exchange of personnel with other owners of GNSS reference station units.

Economic components:

A single system and standards assist in reduction of costs,
Acceleration of screening works in geodesy and cartography,
Reduction of costs is reflected separately in introduction of a single geodetic spatial coordinate system in Bosnia and Herzegovina, that is, Europe (ETRS89). The BIHPOS stations are determined and they operate within this coordinate system,
Rarification/reduction of the current geodetic networks with permanent points, thus significantly reducing the costs given the stabilization of permanent points and determination of their position,
Avoidance of measurement at connection into the existing networks (the target is the ETRS89 system),
Avoidance of testing of points in terms of their non-changeability.

Social components:

Formation of working groups, consisting of experts coming from most various areas (geodesy, geophysics, geodynamics, information technology, astronomy, and the like),
Training and cooperation with international working groups and associations.

4. Design of the BiHPOS Network

The objective of the design is the prepare DGNSS corrective data with the required levels of precision and the necessary reliability of the service throughout the BiH territory. The base for this is homogenous distribution of stations.
The posts for future permanent GNSS stations have been selected using the following criteria and parameters. Based on the complexity of requirements in the process of planning, some of the aforementioned criteria have mutual interaction. Thus the design of the network of permanent stations consists of optimization of several criteria:

- the scope of reference stations should if possible cover the whole territory of BiH. Thus the stations need to be installed in the proximity of state borders.
- in design planning, any existing stations in the proximity of the neighboring countries shall not be taken into account.
- the station distribution must be balanced on the territory of the state. What needs to be watched for is the homogenous geometry (equal distance among stations). The whole BiH must be in the area of influence of the reference stations.

- in planning of stations, for economy reasons, one should take into account the existing infrastructure: of the meteorological stations and cadastre offices distributed by the state.
- for position precision in the PDGNSS service of 1-2 cm, the median distance among the stations for the time being, may be a maximum of 60 km. The assumption is mutual networking of stations.
- in some regions, altitude differences among adjacent points may even mount to several hundred meters. This is where the influence of the troposphere is particularly strong. The use of linear model for calculation of corrective parameters for the troposphere effect would affect the horizontal precision by 1-2 cm.
- according to the presented design, the total number of stations required amounts to 26 permanently active reference stations.

It is planned that five stations should be established in the sense of „master" stations, for instance, for observation of geodynamic processes, then for use as earth control segment for Galileo, as part of the European Permanent Network (EPN) – additionally to the existing station in Sarajevo. The question is whether BiH needs the horizontal precision of approx. 2 cm and the altitude precision of some 3 cm? For the field of permanent geodetic points onto which the whole state example, precision is not only desirable but also required. In addition, the borders of cadastre particles in cities require such precision. The developed countries of Europe have introduced such precision.

5. BiHPOS Servicing Areas

BiHPOS is to include three servicing areas with different features and precision:

DSP (DGNSS) – differential service for real-time positioning (1-3 m)
VPSP (PDGNSS) – highly precise service for real-time positioning (1-2 cm)
GPSP – geodetically precise service of positioning in near real-time and post-processing. (1 cm and less)

6. BiHPOS Precision and Tariffs

Table 1. Criteria of Efficiency of various Servicing Areas.

BiHPOS – servis	Postupak	Prijenosni medij	Tačnost	Broj korisnika	Format podataka	Buduća realizacija
DSP **D**iferencijalni **S**ervis **P**ozicioniranja u realnom vremenu	Realno vrijeme s umreže-njem	UKW/RDS Inter-net/GPRS/GSM	1-3m	neograničen oko 50 istovremeno	RTCM 2.3 (novi 3.0)	raspoloživ na cijelom području BiH
VPSP **V**isoko-**P**recizni **S**ervis **P**ozicioniranja u realnom vremenu	Realno vrijeme s umreže-njem	Inter-net/GPRS/GSM	1-2cm	oko 50 istovremeno	RTCM 2.3 (novi 3.0)	raspoloživ na cijelom području BiH
GPSP **G**eodetski **P**recizni **S**ervis Pozicioniranja	post processing	telefon, ISDN, GSM, internet	1 cm s precizni m eph. <1 cm	jako puno korisnika	RINEX 2.1 odn. RINEX 2.2	raspoloživ na cijelom području BiH

6.1. Fee for Use of BiHPOS

Fees for use of BiHPOS services must be singly determined. Table 2 shows the possible model of prices.

Table 2. Overview of BiHPOS service tariffs

Servis	Format	Medij	Učestalost	Jedinica	Naknada
DSP	RTCM 2.3 (novi 3.0)	UKW	3 - 5 sekundi	otpada	jednokratno kod kupovine uređaja
		Internet/GPRS/GSM	1 sekunda	1 minuta	0,05 Euro
VPSP	RTCM 2.3 (novi 3.0)	GSM	1 sekunda	1 minuta	0,10 Euro
		Internet/GPRS/GSM			
GPSP	RINEX 2.1	telefon/Internet	<= 1 Hz	1 minuta	0,20 Euro
		telefon/Internet	> 1 Hz	1 minuta	0,80 Euro

6.2. BiHPOS - Components

The network of permanently active GNSS reference stations consists mainly of the following components:

1. GNSS reference stations,
2. communication devices,
3. control center, and
4. users.

6.3. Determination of reference station coordinates

The quality of coordinate determination is crucial for the homogeneity and quality of the overall service. Therefore such measurement and processing methods can be used here as practiced in the EUREF campaigns. This is why the network of reference stations must rely on the A and B class EUREF points.

If possible, the measurements need to also include the EUREF stations of the neighboring states. Based on experience, measurements must be conducted in at least 2 sessions per 24 hours each. The elevation mask needs to be 10 degrees, and the registration interval must be 15 seconds. The equipment to be applied has to correspond to the current technology status. This means a modern (at least) 12-channel and 2-frequency receiver with small phase noise and absolutely calibrated antennas (variation of the phase center towards elevation and azimuth).
The procedure of absolute ground calibration in terms of quality is the best solution for the BiHPOS calibration of antennas. From the financial standpoint, the relative ground calibration for the calibration of BiIHPOS antennas with appropriate software is also suitable.

There is also a possibility for an alternative method of determination of coordinates for reference stations (with low external costs) after installation of antennas on them. The drawback here is that there will be interference of antennas with various methods of calibration.
In order to avoid replacement and new stabilization in the network of permanent GNSS stations, testing of influence of multi-path effects before final stabilization of reference stations has been planned in the BiHPOS network, and it has also been partially completed.

6.4. Transfer of data from the reference GPS stations adjusted to the telecommunication conditions in Bosnia and Herzegovina

Within the Ministry of Civil Affairs, there is an active CIPS department with a developed network infrastructure throughout Bosnia and Herzegovina. Their network infrastructure may be used for transfer of the GPS data measured from the reference stations towards the central station. This would mean avoiding of the costs of transfer of data, which would otherwise be paid to the telecom operators in Bosnia and Herzegovina.

The transfer of such data requires existence of a high degree of reliability and availability. These data, due to possible failures in transfer, are secured through automatic use of a backup line. The existing network provides high reliability of the network against sudden failures and allows for inclusion of backup lines in exceptionally short periods (<100ms).

7. Maintenance and Quality Control

The complex of the tasks related to services for maintenance and servicing and their related IT services may be distributed into three groups. In the continuation, the aforementioned services in principle serve as a guarantee for smooth operating flow of the BiHPOS and a guarantee of quality.

7.1. Hardware and Software Maintenance

Additionally to the legal guarantees of manufacturers and suppliers, they also offer contracts for maintenance and support. In order to be able to ensure quick access to maintenance services in case of a failure, maintenance contracts are also offered. The same serves for efficiency of software solutions, which must be kept updated through support contracts. Redundancy is necessary for system critical hardware components. This is why at least one GPS receiver with antenna should be available as a backup system.

7.2. BiHPOS Monitoring

The hardware and software solutions are at reference stations, that is, at the central switchboard point. They should be fully made in the automatic operating mode. Certain modules continually monitor the integrity of the whole system. The integrity monitoring ensures functionality of the whole system, that is, submission of correct data all the way from the reference station to the data for users, monitoring of position and status of the reference stations, as well as the quality of raw data. In spite of the automatic monitoring module, manual intervention is required by personnel. From experience, the daily services of personnel at one central switchboard point include:
Response to alarms of the system
Changes on system configuration
Monitoring and control of data communication (continued data link and ISDN backup lines)
Control of raw data from reference stations for integrity
Monitoring of exactness of the system
Response to service inquiries by users
Distribution of status information to relevant users
Complexity of the task, in addition of knowledge about geodesy matters, also requires expertise in IT and telecommunications.

7.3. BiHPOS Information Service

With information service, the BiHPOS operating information should be made available quickly and in an optimized manner to the owner - supplier of the BiHPOS service and to all other users.

Short-term information on the stoppage in the operation of a station or the network, information on the status of ionosphere or other relevant attributes of the system must reach the users where they are, that

is to say, on the ground. For this purpose, e-mail can be used or the user can be directly informed by SMS or call on the mobile telephone. Through the internet, e.g. through the appropriate „BiHPOS-News“ homepage, the users may obtain information on the planned and current changes in the network. This medium is suitable for presentation of mid-term and long-term information or planned changes. As a must, in addition to the aforementioned media, is introduction of one „BIHPOS Hotline“. The hotline would serve, for instance, for current answers on the BiHPOS topic by trained maintenance workers.

Map 1. BIHPOS design.