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DESIGN OF GPS-GPRS MODULE FOR LOCALISATION VEHICLES AND CARGO

Summary. In the paper are presented results of market researches of logistic enterprises in Upper Silesia region which determine the level of implementation of GPS systems in vehicles. The results of that research implied design of GPS-GPRS module to be applied in vehicles as an alternative solution for modules already present on the market.

PROJEKT MODUŁU GPS-GPRS DO LOKALIZACJI POJAZDÓW I ŁADUNKÓW

Streszczenie. W pracy przedstawiono wyniki badań ankietowych przedsiębiorstw transportowo-spedycyjnych, dotyczących stopnia wykorzystania nawigacji satelitarnej GPS w pojazdach. Wyniki tych badań stanowiły bodziec do zaprojektowania modułu GPS z możliwością pakietowej transmisji danych GPRS alternatywnej do produkowanych na rynku.

1. INTRODUCTION

GPS service market is one of the fastest developing branches of industry in the world. After the introduction of GPS system for civil users, the number of users is growing rapidly and methods of application of that system in practice are alike. All of this was possible after many development branches of science and technology such as electronics, information technologies, remote detection and also growing number of producers of software, hardware and other appliances [2].

Owing to satellite monitoring systems, safety of transported cargo and drivers increases. Active surveillance of a vehicle and the whole fleet is possible by specialized monitoring centres. In case of any accidents such as theft of a vehicle (not allowed starting the engine or haulage of a vehicle) or attacking vehicle's driver a transmission module sends alarm signal to monitoring centre. Basic element of the monitoring system installed in user's vehicle is a special module. It is compound of GPS receiver and GPRS (General Packet Radio Service) module [2, 8]. The diagram to locate the position of a vehicle based on signal transmitted from a satellite is shown in figure 1.

Application of satellite navigation in land transportation can be divided into two groups: individual vehicle navigation and monitoring motion of vehicles. Navigation and monitoring of vehicles is a fast growing application of satellite navigation [1]. There are many enterprises that have already introduced vehicle localization systems. Owing to that, they can effectively manage fleet of vehicles and quickly react due to any unpredictable events and emergencies.

There are enterprises that created data bases of localization of consignees. For them it is possible to determine optimal route for a vehicle, and a driver is aided by navigation system.

Satellite navigation is usually used by transportation enterprises but recently also by enterprises specialized in logistic of communal waste e.g. Municipal Waste Enterprise in Zabrze [5].

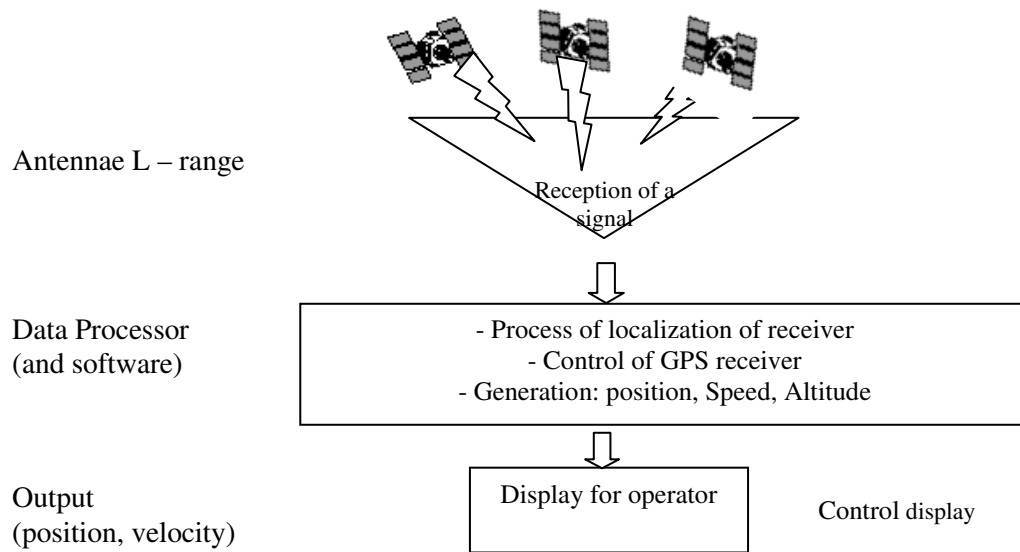


Fig. 1. Basic architecture of GPS end-user component
Rys. 1. Podstawowa architektura zestawu użytkownika GPS

2. RESEARCHES OF IMPLEMENTATION OF GPS NAVIGATION SYSTEMS IN TRANSPORTATION-FORWARDING ENTERPRISES

The number of users interested in implementation of GPS system in Polish transportation enterprises increases [7]. Until now there are not too many publications about the number of navigation systems applied in logistic branches in Poland. For the purpose of market researches in logistic were made for this purpose – transportation enterprises in Silesia area including selected cities: Katowice, Gliwice, Mikołów and Tychy. It can be assumed it is similar in other cities in Poland. The researches were made in enterprises of various sizes. with approximately 200 questions and 60 representative were selected – in which they completed which was analysed. Researches were made in Spring 2006.

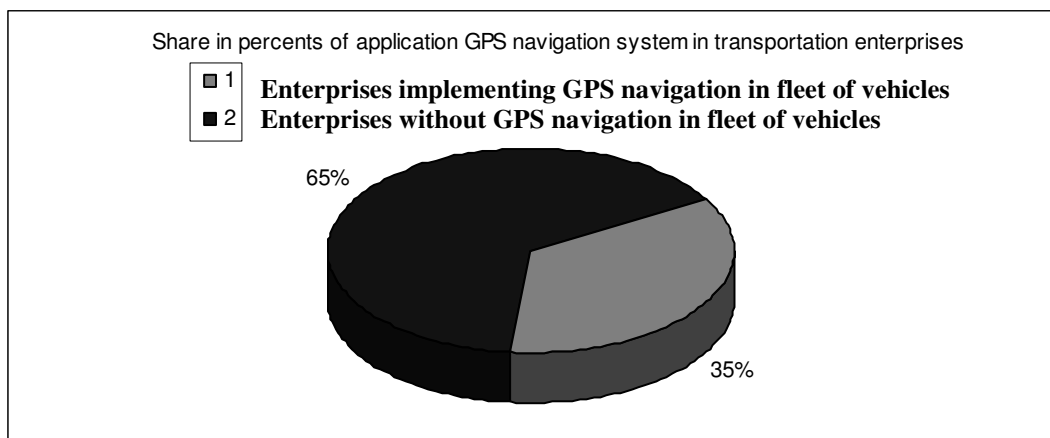


Fig. 2. Range of implementation GPS system in transportation companies in Silesia [4]
Rys. 2. Procentowy udział wykorzystania GPS przez przedsiębiorstwa transportowe na Śląsku [4]

Basing on questionnaires it can be estimated percentage of usage of GPS systems in transportation enterprises (fig. 2). Implementation of satellite navigation systems reached 35%.

The number of transportation enterprises equipped with GPS system modules reaches 35% of all investigated enterprises. Despite decreasing prices of modules that are approximately twice cheaper than 18 months ago implementation of satellite navigation system is still too expensive. The results after analysing the questionnaires indicated the level of implementation of GPS systems in enterprises of various size.

The transportation enterprises were divided into three groups depending on the size: small enterprises – having up to 6 vehicles, medium enterprises – with 7 – 15 vehicles and big enterprises – having more than 15 vehicles in their fleet. The results of those researches are shown in figure 3 [4].

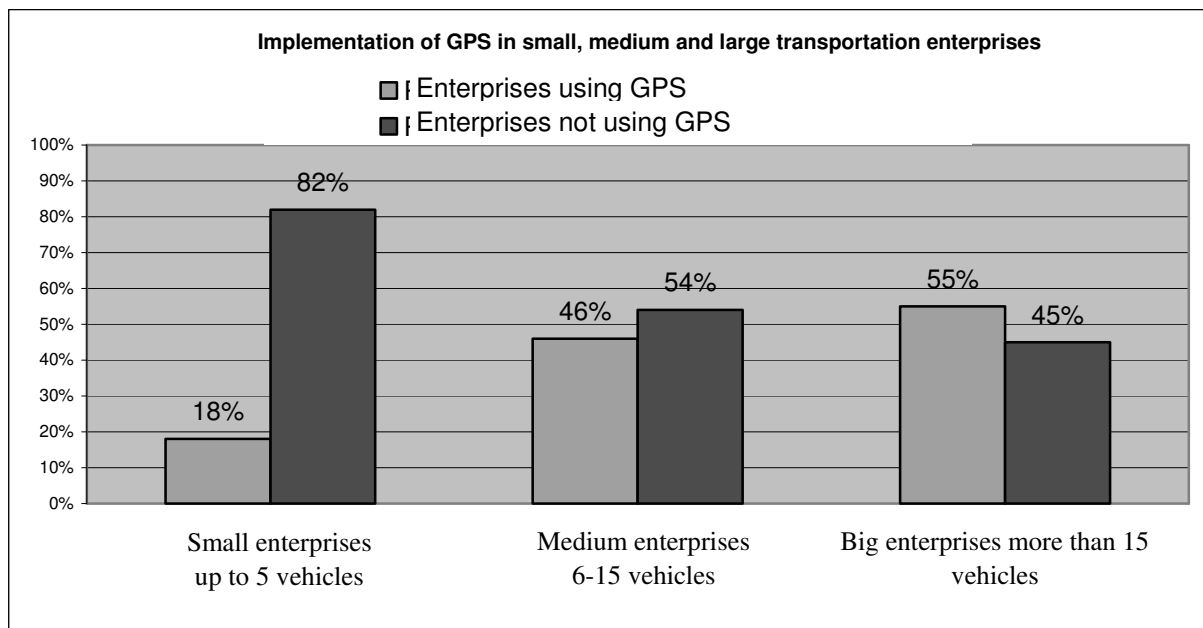


Fig. 3. Implementation of GPS In small, medium and large transportation enterprises

Rys. 3. Wykorzystanie GPS w małych, dużych i średnich przedsiębiorstwach transportowych

Altogether 788 vehicles were analyzed. The majority of the vehicles were trucks with a minority of – 6% of vans like Mercedes Vito or Peugeot Boxer. In the figure 4 it is presented the total number of vehicles with the number of vehicles equipped with GPS modules. As a conclusion it can be seen, the level of implementation satellite navigation in vehicles is relatively low and it can be assumed it would be developing in the next few years.

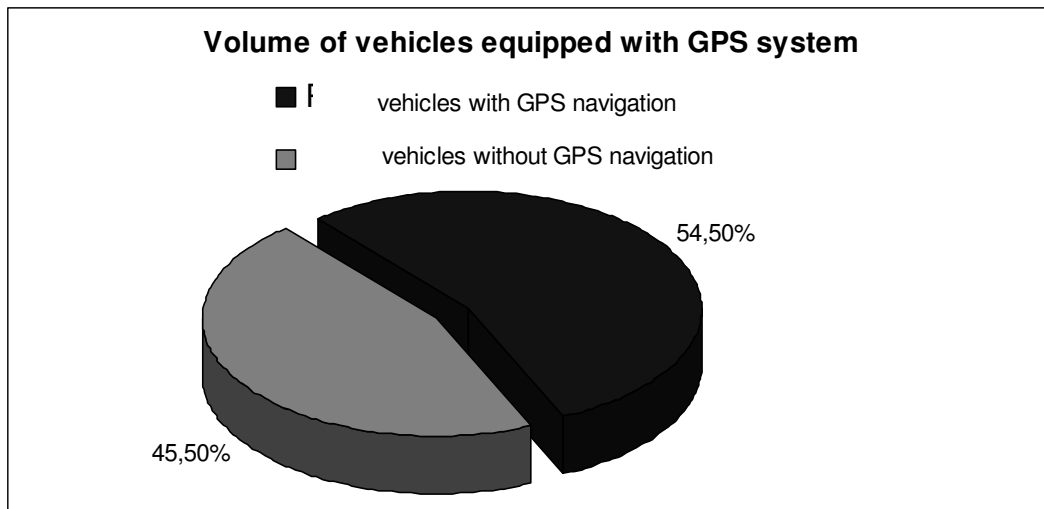


Fig. 4. Volume of vehicles equipped with GPS navigation system

Rys. 4. Ogólny udział pojazdów wyposażonych w system nawigacji GPS

3. CHARACTERISTICS AND COST OF APPLICATION LOCALIZATION SYSTEMS IN VEHICLES

The software using GPS/GPRS data allows surveillance and management of a fleet of vehicles. In this software digital maps of Poland or Europe and the whole world are included. Data from vehicles are automatically received and transferred via GPRS and saved in data bases. The programs can be executed as a standalone version or network service (e.g. in different cities). Numerous reports, statistics and easy data transfer to Excel worksheet allows to estimate working hours of drivers, payment for them and also to determine fuel consumption by vehicle, mileage etc. The advantages of application the GPS/GPRS module together with proper software are as follows:

- Monitoring of position of many vehicles in real time,
- Monitoring of selected vehicle in real time with route analyze,
- Analyze of vehicle route with a plot of fuel consumption, speed etc.,
- Generating of Reports for the whole fleet, individual vehicle and selected route,
- Reporting fuel invoice comparison with data from fuel indicator,
- Generating vehicle identity card,
- Planning of vehicles route and controlling of the route,
- Communication with driver with history of contacts.

Access to the service is possible from any place equipped with internet connection via www. Data from vehicles (position, speed, fuel level) are transferred via network using GPRS. Internet service basing on sent data can generate reports in tables routes and current position of vehicles in precise digital map (fig. 5).

One of the criterions of application GPS systems in transportation enterprises is cost of modules itself, installation, and service including monthly contract.

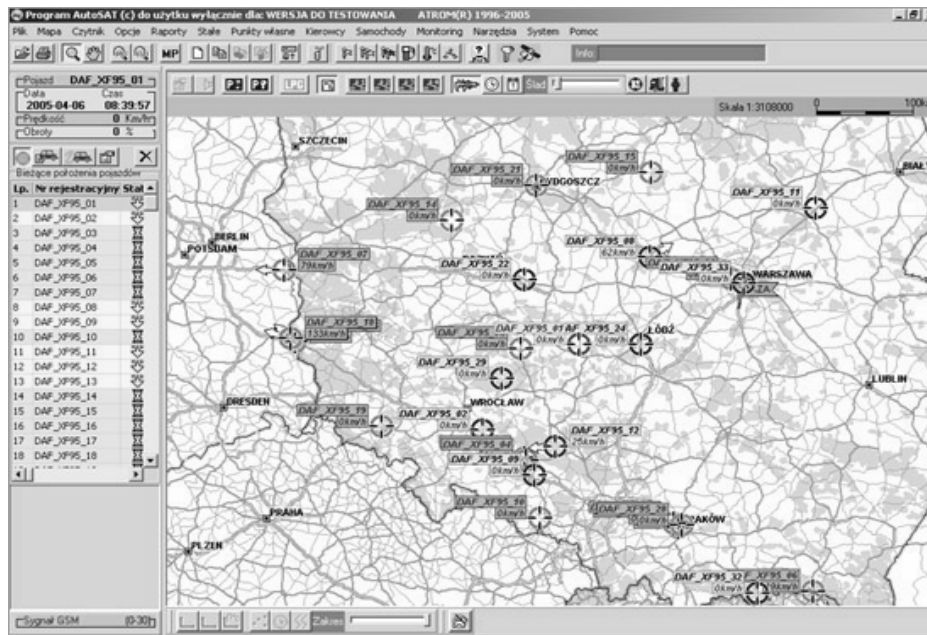


Fig. 5. Snapshot of application with marked vehicles on the map [5]

Rys. 5. Okno programu z zaznaczonymi pojazdami floty naniesionymi na mapę [5]

In table 1 are presented approximate costs of vehicle monitoring service providers in Polish market. Development cost ranges from 2000 up to 3400 PLN and monthly contract depending on type of services starts from 50 PLN and reaches 280 PLN with more sophisticated options.

In the part of questionnaires, where enterprises representatives could answer the questions describing evaluation of GPS systems already introduced in their firm, they complained the cost of development was high with general conclusion the system was useful for the enterprise. There were only two enterprises that had given up using the GPS system.

Table 1

Price list of GSM operators of the main vehicle localization systems in Poland
quoted in PLN (July 2006)

Service description	AutoGuard			Plus GSM		ERA Finder Location Service
	S2	S4	Naviflash	Space Guard	Liberty GPS	
Installation and devices cost						
Transmitter	2 200	1 340	1 990	1 950	2 430	1 770
Installation in vehicle	640	650	650	670	970	450
Development cost:	2 840	1 990	2 640	2 620	3 400	2 220
Monthly contract						
Contract variants	50 120	50 120	50 120	153 279	from 120 to 250	from 70 to 122
Development cost + contract	2 900	2 050	2 700	2 770	3 520	2 270

In transportation enterprises where GPS system was used its service quality was evaluated on medium or high level. In medium and big transportation enterprises, it was mainly described as very useful. The main advantages described were: ability of verification position of any vehicle belonging to enterprise at any time, better control of a vehicle and a driver, safety of transported goods and better management of fleet (e.g. Selection of a vehicle supplying goods that was closer destination point). It was also important to control consumption of fuel by application of fuel indicator.

About 20% of enterprises were on their way to implement GPS system or intended to develop that kind of system within 6 months. About 8% of enterprises would be interested in such system if the cost was lower. The main reasons for the enterprises not interested in implementation of navigation systems were: too expensive (no money for such kind of investment), in small enterprises – low number of automotive vehicles in firm and operating on local market.

4. DESIGN OF A MODULE FOR LOCALIZATION OF VEHICLES

There are many systems based on GPS localization. The advantages have been described in the beginning of this paper. It is important to make researches to bring new solutions of receiving - transmitting devices, taking into consideration future application and possibility to create your own software for different types of researches. At the same time the questionnaires showed still low level of implementation that kind of systems in transportation and logistic enterprises. Analysis indicates it is still expensive. That is a barrier for small enterprises with minor number of cars.

Taking into consideration results of researches made in transportation enterprises and financial conditions of development it had begun design of own construction GPS/GPRS module. The main assumption was to design cheaper module than models found on the market with possibility to create own software to control and use it. Schematic diagram of this module is shown in the figure 6. Internal communication is based on OPEN AT v.3.01 software. The module is intended to operate with external devices like ignition controller, fuel indicator, chip card or magnetic card reader.

The module after assembling in a vehicle can operate as a component of satellite navigation system with possibility of monitoring the vehicle. This function is presented in figure 7.

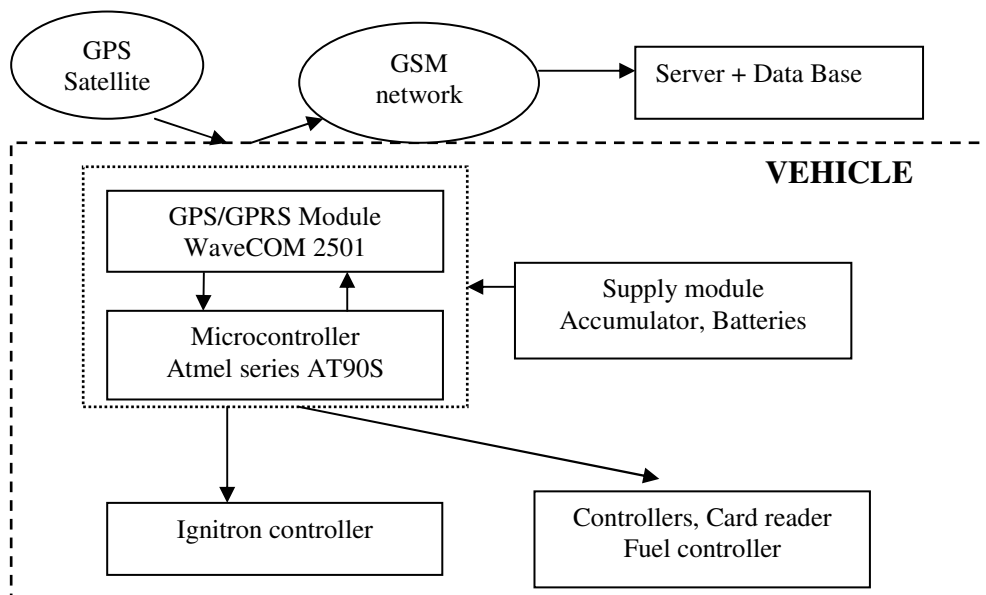


Fig. 6. Diagram of designed GPS/GPRS module

Rys. 6. Budowa zaprojektowanego modułu GPS/GPRS

Presently the final stage of assembling the module has begun. The prototype is intended to begin first tests in the first half of 2007. After positive results further researches would be made when more modules are installed in several automotive vehicles.

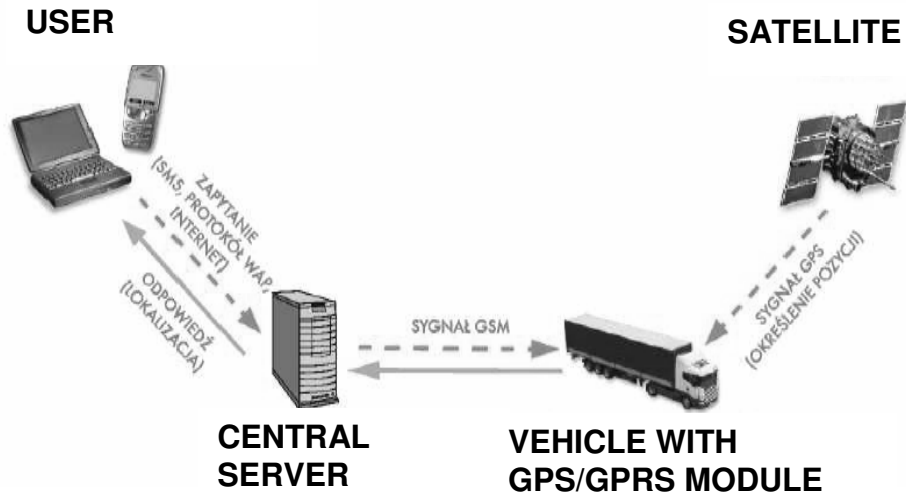


Fig. 7. Principle of operation of the module
Rys. 7. Zasada działania modułu

5. CONCLUSIONS

GPS services market is one of the fastest growing branches of communication industry in the world. However in Poland development in satellite navigation was delayed and now the period of dynamic growth of it has started. It can be proved by growing number of device and software producers and service providers alike.

Base on researches made by the Department of Logistics and Material Handling of Silesian Technical University in transportation enterprises concerning implementation of satellite navigation systems following conclusions could be made:

- implementation level of GPS based navigation is the highest in big transportation enterprises (having above 15 automotive vehicles) and in medium sized enterprises (having 7-15 vehicles),
- share of vehicles equipped with satellite navigation is about 54% in total number of tested vehicles,
- the demand to use that kind of systems is rising; about 20% of enterprises had been introducing or intended to introduce it in the nearest future.

After analyzing the advantages of GPS based navigation systems and after taking into consideration the results of questionnaires, a decision to design new solution of GPS/GPRS module had been made. This prototype construction is almost finished. After positive tests of this module it could be applied in vehicle localization systems and further work with software compatible system would be possible.

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