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CURRENT STATE AND PROSPECTS OF SATELLITE NAVIGATION APPLICATIONS IN TRANSPORT

ABSTRACT

The article describes new possibilities of how to use global satellite navigation system Galileo, which is made by the European Union and its European Space Agency ESA. Compared to original army systems GPS and Glonass, Galileo is built to be used for civil applications. Galileo is built up in order to be compatible with current systems. This fact creates the assumption for the interactive back-up, the enhancement of visible satellites number and of required navigation performance demanded in transport and other applications, where extreme precision, integrity, availability and connection are claimed. Galileo offers various kinds of services – from open service through safety of life service, commercial service, public regulated service to the search and rescue service. These services will cover all sections of human activities, mainly the transport, in which the greatest expansion is expected in the area of automobile transport

KEY WORDS

GPS – Global Positioning System, Galileo, Egnos, Differential Global Positioning System

1. INTRODUCTION

At present, there are two radio navigation satellite networks: the US GPS and the Russian Glonass systems, both designed during the Cold War for military purposes. Since the Russian system has not generated any civil applications, Galileo offers a real alternative to the de facto monopoly of GPS and US industry. GPS is used to a large extent for civil purposes but it does have several major shortcomings:

- A mediocre and varying position accuracy (sometimes to only several dozen metres), depending on place and time;
- The reliability leaves something to be desired. Regions at high latitudes, crossed by many aviation routes do not have dependable coverage. Signal penetration in dense areas and town centres is unreliable. Furthermore, the predominantly military character of GPS means there is always risk of civil users being cut off in the event of crisis.

Whether intentional or otherwise, signal interruptions can have disastrous consequences, especially as there is no warning and no immediate information about errors [4].

For the existing satellite navigation systems to be able to replace classic radio navigation or navigation systems in the near, it is necessary to ensure that the existing satellite navigation systems meet strict criteria defined by ICAO (ICAO International Civil Aviation Organisation). The ICAO crew developed and ratified standards and recommended procedures for the section of global satellite navigation systems [1].

These standards define some requirements for efficiency. Required navigation performance RNP is specified by the idea of all the system with continual coverage in the space of SIS (Signal in Space). Before mentioning these requirements we state brief division of augmented systems.

Ground Based Augmentation Systems GBAS. The selection of the oscillation band for the transmission of GBAS data and the modulation of transmitted waves was the main success which was achieved with standards developing.

Airborne Based Augmentation Systems ABAS are assigned for the integration of the whole GNSS information (Global Navigation Satellite Systems) and the information from other navigation sensitive elements on-board the aeroplane. Requirements for ABAS were minimized to the necessary level for the defining of this augmentation system.

Satellite Based Augmentation Systems SBAS. Three satellite-based augmentation systems will be introduced at the same time: Wide Area Augmentation System WAAS in North America, Multifunctional transport Satellite-based Augmentation MTSAT

(MSAS) in Asia and the Pacific and the European Geostationary Navigation Overlay System EGNOS. The Contact functional ability of these systems depends on the adaptation to common standards [4, 5, and 6].

Augmentation Systems are introduced because of the necessity of providing RPN requirements.

Accuracy

GNSS Standards determine the demanded accuracy for the signal in the space for different operation conditions. They determine limits of accuracy in detail for warnings. In case these limits are not exceeded, the user will not be warned.

Requirements for the accuracy of the signal in space were defined for the satellite-based augmentation systems (SBAS) and ground-based augmentation systems (GBAS), too. Requirements for GNSS system must correspond to requirements of other systems that are being used nowadays [5].

Integrity and Time to Alert

On the basis of given warning value for the accuracy of the system it was necessary to determine the maximum allowable possibility (risk integrity), when not keeping the basic specified value of the warning does not have the influence on the final level of the safety for the specific operation. Integrity is the safety requirement. It is a step to gain confidence that the information may be taken as correct for the entire system. Integrity includes the ability of the system to warn the user on time and correct when the system must not be used for the intended operation.

Continuity

Requirements for continuity influence the safety of the system, too. Continuity determines the tolerated probability of the loss of navigation and insures that the failure of the navigation system can pass without reduction in the safety of the specific operation.

The range of values is specified by the connection requirements for the aviation (marine navigation, road navigation, etc.), initial approximation, approach and landing. These requirements are dependent on some factors that include intended operation, traffic intensity, and complexity of the air space and availability of alternative navigation means.

Availability

Requirements for availability are determined to characterize the service provided by the system which is from the point of view of the service identical with the one which is now achieved by other means of navigation. These requirements influence the economic efficiency of the system.

The range of values for availability requirements responds to its dependence on the range and the length of fails, the operating rules at restoration, availability of alternative navigation means and intensity of the observed place.

We will present the augmented systems SBAS in detail.

2. WIDE AREA AUGMENTATION SYSTEM – WAAS

The beginning of WASS stretches back to 1983, when the study of GPS for the aviation was authorized. Then, the operations on the signal specification for WAAS and other requirements for standards of inaccurate and accurate landing approach continued. The testing of the system went on until as late as 1996, and the first contract for the realization of WASS was signed in 1996.

In the middle of 1994, the FAA (Federal Aviation Authority) issued a Request for proposals to deploy the operational WAAS. The RFP called for a phased implementation of integrity, ranging and accuracy functions. In 1996, this first WAAS contract was terminated and new award was made. In spite of these difficulties, the FAA planned to implement a Flight Verification System (FVS) in the period 1997-98, where the FVS will consist of 2 Master Control Stations (MCS), 5 Reference Stations (RS), 2 Ground Earth Stations (GES) and 1 Geostationary satellite. They intend to implement an initial WAAS consisting of 2 MCSs, 24 RSs, 6 GES and 2 geostationary satellites in the period from 1997-98. This initial WAAS will provide primary means for non-precision approach, terminal area and enrooted flight; it will be supplemental for precision approach. End–state WAAS was deployed to reach full operational capability in December 2001, with additional RSs and Geostationary satellite as needed to provide primary means Category I precision approach navigation throughout NAS (National Airspace System). In addition, the FAA hopes to proceed with appropriate institutional, technical, operational and financial arrangement to make WAAS part of a worldwide system [5].

3. JAPANESE SATELLITE-BASED NAVIGATION AUGMENTATION SYSTEM MSAS

The MTSAT – Satellite-Based Augmentation System, (MTSAT = Multi-functional Transport Satellite System). Parallel with Europe and the United States, Japan is developing a geostationary overlay called the MTSAT Satellite-Based Augmentation System (MSAS). MSAS is based an aeronautical package to be flown on the Multi-functional Transport Satellite

(MTSAT), which also has a meteorological mission. MTSAT was launched in 1999, and subsequent launches are scheduled for every 5 years [3].

In 1994, Japan initiated the design of the MSAS with research by ENRI which is part of Japan's Ministry of Transport. MSAS is distinct from EGNOS and WAAS, because it will include two-way voice and data communication. This communication capability will be used to provide Automatic Dependent Surveillance (ADS). Specifically, MSAS is based on the ICAO FANS (Future Air Navigation Systems) concept including: GNSS for navigation; and the Aeronautical Mobile Satellite Service (AMSS) for two-way voice/data including ADS.

MTSAT-1 was launched in 1999, and MSAS was operational with this satellite in 2001. In 2005, MSAS will be operational with MTSAT-1 and MTSAT-2. Japan is coordinating the development of MSAS with Europe, the U. S. and other regions around the World.

4. EUROPEAN GEOSTATIONARY NAVIGATION OVERLAY SERVICE – EGNOS

The European Space Agency, the European Commission and the European Organisation for the Safety of Air Navigation (Eurocontrol) are jointly developing EGNOS, Europe's augmentation system for satellite navigation. This ECU 150 million project will provide civil GPS or GLONASS users – on land, and at sea or airborne – with improved accuracy, integrity and availability. Working together, the three entities are known as the European Tripartite Group (ETG) [3, 5, and 7].

The ETG signed on 27 June 1996 leases for the first two navigation transponders that will be used to broadcast EGNOS signals to users. These transponders are being flown by two INMARSAT-III satellites, located at longitudes 64 East (Indian Ocean Region) and 15.5 West (Atlantic Ocean Region-East, AOR-E). Together they will cover not only entire Europe but also Africa, South America and most of Asia. The IOR satellite was launched on 3 April 1996 and has been operational since 12 May. The AOR-E satellite was scheduled for launch in August. In its final set-up, EGNOS will provide Ranging Service, will broadcast GPS-like navigational signals to improve overall satellite navigation service availability.

For instantaneous determination of his position, a user has to receive signals from four satellites. Neither GPS nor GLONASS can provide this at all times and all locations worldwide. EGNOS will help to fill this gap:

- The integrity Service will broadcast range error estimates for each GPS, GLONASS or EGNOS navigation signal. Without this EGNOS capability, information on abnormal performance or failure of GPS and GLONASS would take 15 minutes or longer to reach the user. The integrity service will enable users to decide whether a navigation satellite signal is out of tolerance before any critical situation arises.
- The Wide Area Differential Service will broadcast correction signals to improve the precision of satellite navigation. The Wide Area Differential Service will establish a precision of 5 – 10 metres.
- The Ranging Service was planned to start in 1997. The other service was introduced gradually between 1998 and 2000. EGNOS itself will be composed of:
- The space segment: Two INMARSAT-III transponders, later to be extended to meet the extreme safety requirements for certain aircraft precision approaches to airports.
- The air segment: Ranging and Integrity monitors distributed over the service area will be connected to Master Control Centres, where the EGNOS signals will be generated. At least three such centres are needed to meet civil aviation safety requirements,
- The user segment: EGNOS standard receivers.

Although these activities were directed to the aviation, the decided standards have to provide safety and reliability of satellite systems that will improve all kinds of transport, especially in the stage of the transition to the intelligent transportation systems.

There have been signal cut-offs of a few minutes during GPS operation, which leads the system provider to adaptation to civil needs and necessity of standards development for utilization of satellite navigation in civil aviation. If these standards meet aviation demands they will suit also other users. Standard and recommended procedures – SARP, which are focused on accuracy, integrity and time to alert, continuity and availability, have been passed.

These standards lead to building of augmentation systems such as American WAAS (wide area augmentation system), Japanese MSAS (MTSAT satellite augmentation system), European services EGNOS (European geostationary navigation overlay service) and even probably Chinese satellite navigation augmentation system SNAS (Big Dipper) [5].

5. EUROPEAN GALILEO NAVIGATION SYSTEM

Inspires of these standards they are only services based on originally military GPS of Glonass satellite systems.

The European Union (EU) therefore decided, in close cooperation with the European Space Agency (ESA) to develop a system of its own that meets the criteria for accuracy, reliability and security.

Galileo comprises a constellation of 30 satellites divided between three circular orbits at an altitude of around 24,000 km to cover the Earth's entire surface. They will be supported by a worldwide network of ground stations.

Galileo offers superior and constant accuracy owing in particular to the structure of its satellite constellation and ground relay system. Guaranteed accuracy to 1m is necessary for certain applications, such as entering a seaport or guiding a vehicle into a parking space. Galileo will provide the following services: [2, 7]

- The *Open Service* (OS) is defined for mass-market applications. It provides signals for timing and positioning, free of direct user-charge. Open Service will be accessible to any user equipped with a receiver while up to three separate signal frequencies are offered within the Open Service, cheap single-frequency receivers will be used for applications requiring only reduced accuracy. In general, Open Service applications will use a combination of Galileo and GPS signals, which will improve performance in severe environments such as urban areas. Open Service does not offer integrity information, and the determination of the quality of the signals will be left entirely to the users. There will be no service guarantee or liability from the Galileo Operating Company on the Open Service.
- *Safety-of-Life Service* (SoL) will be used for most transport applications where lives could be endangered if the performance of the navigation system was degraded without real-time notice. The Safety-of-Life Service will provide the same accuracy in position and timing as the Open Service. The main difference is the worldwide high integrity level for safety-critical applications, such as maritime, aviation and rail, where guaranteed accuracy is essential. This service will increase safety, especially where there are no traditional ground infrastructure services. This worldwide seamless service will increase the efficiency of companies operating on a global basis – airlines and transoceanic maritime companies. The EGNOS regional European enhancement of the GPS system will be optimally integrated with the Galileo Safety-of-Life Service to have independent and complementary integrity information (with no common mode of failure) on the GPS and Glonass constellations.
- The *Commercial Service* (CS) is aimed at market applications requiring higher performance than offered by the Open Service. It provides added value services on payment of a fee. CS is based on adding two signals to the open access signals. This pair of signals is protected through commercial encryption. Access is controlled at the receiver level, using access protection keys. The uses foreseen for the Commercial Service include data broadcasting and resolving ambiguities in differential applications. These will be developed by service providers, who will buy the right to use the two commercial signals from the Galileo operator. Developing commercial applications either by using the commercial signals alone, or by combining them with other Galileo signals or external communications systems opens a wide range of possibilities.
- The *Public Regulated Service* (PRS) will be used by groups such as the police, coastguard and customs. Civil institutions will control access to the encrypted Public Regulated Service. Access by region or user group will follow the security policy rules applicable in Europe. The PRS is operational at all times and in all circumstances, including during periods of crisis. A major PRS driver is the robustness of its signal, which protects it against jamming and spoofing.
- The *Search and Rescue Service* (SAR) is Europe's contribution to the international cooperative effort on humanitarian search and rescue. It will allow important improvements in the existing system, including: near real-time reception of distress messages from anywhere on Earth (the average waiting time is currently an hour); precise location of alerts (a few metres, instead of the currently specified 5 km); multiple satellite detection to overcome terrain blockage in severe conditions; increased availability of the space segment (30 Medium Earth Orbit satellites in addition to the four Low Earth Orbit and the three geostationary satellites in the current COSPAS-SARSAT system). Galileo will introduce new SAR functions such as the return link (from the SAR operator to the distress beacon), thereby facilitating the rescue operations and helping to reduce the rate of false alerts. The service is being defined in cooperation with COSPAS-SARSAT and its characteristics and operations are regulated under the auspices of the International Maritime Organisation and the International Civil Aviation Organisation.

Architecture is made up of four components:

- *Global Component* - the central component will be the global constellation of 30 satellites, distributed over three planes in Medium Earth Orbit (MEO). Within each plane, one satellite is an active spare, able to be moved to any of the other satellite positions within its plane, for replacement of a failed satellite. This will be complemented by regional and local components.

- *Regional Components* - the service provided by Galileo is global and this includes the delivery of integrity worldwide. However, the design of the system is such as to permit the introduction of data from regional service providers using authorised integrity up-link channels provided by Galileo, thereby making it possible to "personalise" integrity under partnership agreements with the relevant countries. The cost of this component will be borne by the region in question.
- *Local Components* - the Galileo system will provide high level of performance to users worldwide, even in places where there is no ground infrastructure. However, in the case of specific applications in given areas, even more demanding levels of positioning performance will be necessary or, alternatively, integration with other functions, e. g. local communications, will confer added value on the basic service.

Using these local components enables getting very high accuracy (see Table 1)

6. TRANSPORT APPLICATIONS

Inspires in this part would like to describe transport applications after introducing Galileo navigation system

Road applications

The road sector is the major potential market for Galileo applications. By 2010 there will be more than 670 million cars, 33 million buses and trucks and 200 million light commercial vehicles worldwide.

Satellite navigation receivers will provide new services to people on the move: electronic charging, real-time traffic information, emergency calls, route guidance, fleet management and Advanced Driving Assistance Systems (ADAS). Galileo will offer urban travellers an increased availability of satellite signals, reducing the effect of shadowing by buildings. Route guidance using satellite navigation is already a well-established product offered by car manufacturers. The majority of these systems are based on satellite navigation systems and onboard sensors (odometer and gyros) to compute optimal routes in real-time. However, GPS does not offer sufficient coverage in urban areas to be used alone. Galileo with its 30 satellites will increase the coverage and accuracy. This will enable manufacturers to use cheaper sensors to fill the satellite navigation gaps (tunnels, narrow streets).

Many additional services can be offered, including emergency calls with automated transmission of location, breakdown assistance with communication of the car position together with other information such as the nature of the vehicle's malfunction, and recovery after theft (500,000 cars are stolen and not recovered in Europe alone each year). The monitoring and management of traffic fluidity will be significantly facilitated when a great number of cars are equipped with satellite navigation receivers and guidance systems. For example, if the average speed of the cars equipped with Galileo receivers in road sector drops significantly, a control centre can anticipate a traffic jam and suggest that approaching vehicles choose a different route. A very important application will be tracking and managing emergency and rescue vehicles. Combined with dynamic traffic information, an ambulance with a Galileo receiver and communication link will be able to reach its destination much faster. Traffic lights could be controlled to speed the arrival of an emergency vehicle. Advanced Driving Assistance Systems

Table 1 - Performance of the Local Component

SERVICE	GLOBAL (Single Freq Code)	LOCAL (Single Freq Diff Code)	GLOBAL (Dual Freq Code)	LOCAL (Dual Freq Diff Code)	LOCAL (Dual Freq Diff Carrier)
Horizontal Accuracy	15m	1m	4m	0.5m	0.10m
Vertical Accuracy	35m	1.5m	8m	0.75m	0.15m

SERVICE	GLOBAL SOL Integrity Level	LOCAL Integrity Levels
Time To Alarm	6 s	1 s
Horizontal Alarm Limit	12 m (TBC)	1 m
Vertical Alarm Limit	20 m	1 m
Integrity Risk	1 * 10^{-7} per hour	1 * 10^{-9} per hour

SYSTEM	2G (GSM)	2.5G (GPRS)	3G (UMTS)
CAPACITY	9600bps	56000-115000bps	384000-2000000bps
DIRECTION	Two-Way	Two-Way	Two-Way

(ADAS) combine vehicle capabilities to improve mobility and active safety. Galileo will provide important additional data to ADAS on the vehicle environment. ADAS then warns the driver of imminent danger or takes full or partial control over the vehicle. For instance, the speed could be reduced by ADAS under poor visibility conditions if the car approaches a tight turn too fast. This function will be possible only with accurate position data of guaranteed integrity furnished by Galileo and local elements. It is expected that half of the vehicles operating in Europe by 2020 will carry ADAS. Galileo will offer the possibility to implement new and more advanced methods of user-friendly road charging: charge for the use of particular roads at particular times with particular vehicles, or charge users travelling in a certain urban zone, according to the distance driven. Although there are other techniques for road tolling, only satellite navigation leads to a reliable seamless service thus avoiding isolated system implementation which puts a burden on user equipment. The vehicle will use Galileo to determine its location and to store the distance driven on every type of road (charged or free). Then it reports the results to a monitoring centre for a central charging entity to invoice the user. This would work on both inter-urban and urban roads. [2,5]

Aviation applications

Satellite navigation will become an important part of civil aviation considering its high accuracy position determination.

Enormous accuracy of plane location will enable guidance during all phases of flight, starting by taxiing to runway, continuing by guidance during flight, and approach for landing till landing. Performance of all mentioned activities is possible during any meteorological conditions, with observed safety margins required by ICAO.

The possibility of employing both systems GPS and Galileo will ensure high robustness through the redundancy and high reliability of the service.

Since in some areas capacity of airspace is used to its maximum, very precise position determining will enable reduction in separations between aircraft and also increase in capacity of airspace.

The major need of commercial operators during critical flight phases, such as take-off and landing, is to operate in all weather conditions. As consequence, the precision approach is mandatory for a gate-to-gate navigation system. Galileo, with the aid of ground-based augmentation (local elements) will satisfy the needs for precision approach as defined in the aeronautical standards, and could replace or complement the navigation infrastructure of airports in regions where the system is inadequate. For example, some airports are not equipped with instrument landing systems (ILS). Galileo offers many benefits for overall safety and optimization of schedules and routes. It will also help to increase runway capacity by shortening runway occupancy time. There will be savings in time and fuel, and reductions in noise

Galileo and satellite navigation will be available for all kinds of aviation activities, such as ultra-light aircraft, balloons and recreational flights. The integration of position information and communication links opens up a wide range of applications. [2, 5, 7]

Maritime applications

Sea and water ways are mainly used for world-wide goods transportation. Galileo will present the base for innovation and progress in navigation as well as in many other maritime activities as for example fishery, oceanography, crude oil and natural gas. Recovery satellite navigation benefits all navy applications including leisure boats, merchant navy, unregulated and regulated ships. Galileo will return enhanced accuracy, integrity, certificated services and high availability (accessibility).

Galileo will be used in every phase of marine navigation: ocean, coastal, port approach and port manoeuvres, under weather conditions [2, 5, 7].

Rail applications

At present GPS usage is penetrating also into the railway transport, designated for continuous monitoring of the train sets for safety purposes and rail network capacity utilization.

Fast development in the field of mobile and optical telecommunications and information systems as well as in satellite navigation systems has affected railway transport too. Modern systems are implemented in railways for the increase in safety, productivity, effectivity of the operation. Control centres can monitor exact location of locomotives. As a consequence all types of trains (freight, passenger) would be able to run with shorter headways at higher speed and safety.

The railroad control mechanics and management systems have been highly developed as an effect of spurt expansion in the field of telecommunications and satellite technology. Their up-to-date current conception is based on determination of train (vehicle) location, following information transfer from train to the control centre, automatic processing and backward transmission of control orders into the vehicle and to other users.

Utilization of GPS method (GPS+GALILEO) is possible also in railway geodetics at pointing construction with 1^{st} class of precision (m x, y=0, 02 m) along the railways.

Continual and kinematics method with receiver equipment on the moving vehicle that is the prospect for diagnostics of rail situation and numerical background papers for cyclic rail maintenance preparation. Satellite methods have brought improvement into tunnel designing and surveying without need for special terrestrial survey net construction.

Galileo will be able to offer numerous rail transport applications, ranging from traffic, wagon and cargo control and monitoring to train signalling, track survey and passenger information services. In particular, Galileo will make it possible to reduce headways between trains and therefore increase train frequency. In addition, it will make it easier to locate the entire rail fleet. [2, 5, 7]

In personal navigation

Galileo opens the door to several location-based services by integrating positioning with communications, typically in handheld terminals. A handset will determinate its position using either Galileo alone or in conjunction with other systems.

Location-based services depend on service providers or network operators knowing the position of the mobile caller in order to provide appropriate information.

Data sent to a user handset can be automatically customised to provide on-demand services such as information about nearby restaurants, hotels and theatres, and weather forecasts.

People-tracking is another application, where external staff could be coordinated more efficiently: medical and welfare employees visiting patients; policemen; fire engines; commercial workers. This service can be generally used to control and coordinate the activities of a group. The same technique can improve the safety of children on their way to school.

In search and rescue

The majority of today's emergency distress beacons operate within the COSPAS-SARSAT satellite system. Unfortunately, the accuracy is very poor (typically a few kilometres) and the alert is not always issued in real-time. The advent of Galileo is expected to improve Search and Rescue (SAR) operations dramatically, while maintaining compatibility with existing emergency transmitters onboard ships and aircraft.

The distress signals must be detected under severe conditions from anywhere on Earth. Galileo will significantly improve the system by detecting distress beacons in real time and locating them with an accuracy of a few metres. Adding a return link – from the SAR operators to the beacons – will further help the rescue operations. Galileo SAR element will be Europe's contribution to a wide international humanitarian effort.

In crisis management

It requires fast response times and the most efficient use of resources. An effective response to forest fires, for example, calls for early alert and reliable and accurate position information about the location of the fire. Police and emergency services need reliable and accurate knowledge on the location of deployed forces in order to coordinate them efficiently.

Other crisis situations include floods, maritime emergencies, oil spills, earthquakes and humanitarian aid operations.

In environmental management

Galileo is expected to play an important role for the scientific community. For example, the continuous collection of data will allow new experiments in various research areas. Galileo can contribute to ocean and cryosphere mapping, including the determination of the extent of polluted areas (and tracking the offending tankers to their origins), studies of tides, currents and sea levels, and tracking of icebergs. It will help in monitoring the atmosphere, including the analysis of water vapour for weather-forecasting and climate studies, and ionospheric measurements for radio communications, space science and even earthquake prediction. In nature, the movements of wild animals can be tracked to help preserve their habitats.

In recreation

The leisure market will see a tremendous surge in developments that we cannot even imagine today. GPS services are already established for recreational flying and sailing, but Galileo will extend them to personal navigation via handsets with map displays and secondary communication functions. Integration with mobile communications technology will open up new scenarios and applications for personal mobility.

Attractive tourist packages can be based on Galileo coupled with interactive multimedia communications linked to local information providers.

The key advantage of Galileo is its focus on interoperability, which will easily allow its integration – at system and user levels – with the existing and future systems, such as GSM and UMTS.

In the same way as nobody nowadays can ignore the time of day, everyone in the future will need to know their precise location

7. CONCLUSION

Galileo is Europe's satellite radio navigation programme. It was launched on the initiative of the European Commission and will amount to the same kind of technological revolution as the one sparked off by mobile phones. It will also make for the development of a new generation of universal services in areas such as transport, agriculture or fisheries. To date, this technology, which promises to be highly profitable, is only mastered by the US GPS system and Russia's

Glonass system, both of which are financed and controlled by the military authorities.

The Galileo programme will be administered and controlled by civilians and offers a guarantee of quality and continuity which is essential for many sensitive applications. Its complementarily with current systems will increase the reliability and availability of navigation and positioning services. A four-phase development procedure has been proposed: definition in 2000, development until 2005, deployment until 2010, followed by actual operation. [3]

The above mentioned development of transport applications depends on the creation and precision of digital maps. Nowadays digitalization of the European network is being worked on and according to the project NextMAP (200-2002) - enhanced digital maps for driver assistance applications, 70–100% of data for application of intelligent transportation systems with the precision of up to 0, 3 m are supposed to be available by 2012.

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ABSTRAKT

SÚČASNÝ STAV A PERSPEKTÍVY SATELITNEJ NAVIGÁCIE A JEJ APLIKÁCIE V DOPRAVE

Článok popisuje nové možnosti využitia globálneho satelitného navigačného systému Galileo, ktorý buduje EÚ v spolupráci s ESA. Pretože satelitné navigačné systémy GPS a Glonass sú vojenské, Galileo sa buduje pre civilné používanie. Galileo bude kompatibilný so súčasnými systémami. Súčasťou bude definovaná tzv. navigačná výkonnosť a z nej vyplývajúce požiadavky na presnosť, integritu, spojitosť a dostupnosť signálu, ktorá je požadovaná v dopravných aplikáciách. Galileo bude poskytovať štyri druhy navigačných služieb a piata bude pre záchranu a pátranie. Tieto služby pokryjú všetky ľudské aktivity hlavne v doprave, kde v cestnej doprave sa očakáva najväčšia expanzia.

KĽÚČOVÉ SLOVÁ

GPS – globálny polohový systém, Galileo, Egnos, Diferenčný globálny polohový systém

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