

OVERVIEW OF RESULTS FROM GNSS RESEARCH UNDER THE FP7 R&D PROGRAMME (2007-2013)



From Research Applications to Market



European
Global Navigation
Satellite Systems
Agency

More information on the European GNSS Agency is available on www.gsa.europa.eu

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INTRODUCTION

FP7 delivers for European GNSS

For Europe, maintaining a competitive edge in a global economy and a high standard of living for its citizens requires the fullest exploitation of its superior know-how and cutting-edge technologies. This entails a firm commitment to advanced and sustained research programmes to deliver useful and marketable products and services for the 21st century.

The 7th Framework Programme, the European Union's main research funding instrument for the period 2007-2013, supported R&D and innovation in the field of GNSS – aimed at accelerating the development of a European market for satellite navigation applications and creating new opportunities for European industry.

In July 2010, the EU launched the first in a series of three calls for proposals covering topics in the area of satellite navigation. Under the delegation from the European Commission, the GSA has been responsible for managing most of the available budget.

By the numbers

The total budget¹ for the FP7 GNSS applications R&D programme was €66.5 million. The value of funding increased successively over the three calls – €12.5 million for the first call, €25 million for the second call, and €29 million for the third call.

A total of 86 projects were selected for funding out of a total of 299 proposals, – 18 projects were selected under the first call, 29 under the second and 39 under the third call for proposals. On average, projects received €0.8 million in EU funding, accounting for nearly two-thirds of total project costs (average €1.2 million). The average project duration was 24 months.

LBS and Road Transport-related projects were the most frequently funded, with 41% of all projects originating in these sectors, reflecting their importance as highlighted in the GSA's GNSS Market Report and in its market development strategy.

Other sectors and activities included: Precision, Professional and Scientific Applications; International Cooperation; Maritime and Rail; Aviation; Education and Innovation; Agriculture; and the Public Regulated Service (PRS).

Altogether, EU-funded GNSS research projects drew partners from 48 different countries. There were a total of 425 organisations involved. Three to six partners was the most common format, while groups of up to 13 were occasionally seen.

Impact on GNSS market and technology

FP7 GNSS-related funding generated a significant amount of new knowledge, while dissemination efforts were also successful, exploiting strong links among EU partners, bridging gaps between research and market communities and improving relations among businesses and end-users.

The most common research outputs were prototypes, product innovations, proofs of concept, trademarks and patents, process innovations and successful trials.

The FP7 R&D programme has also had a considerably positive impact on the GNSS market, evidenced² by the 45 commercial products or services, 80 prototypes and 13 patents/trademarks registered. In the frame of the FP7 projects, 115 demonstrations were organized in order to validate and to present the developed EGNSS solutions.

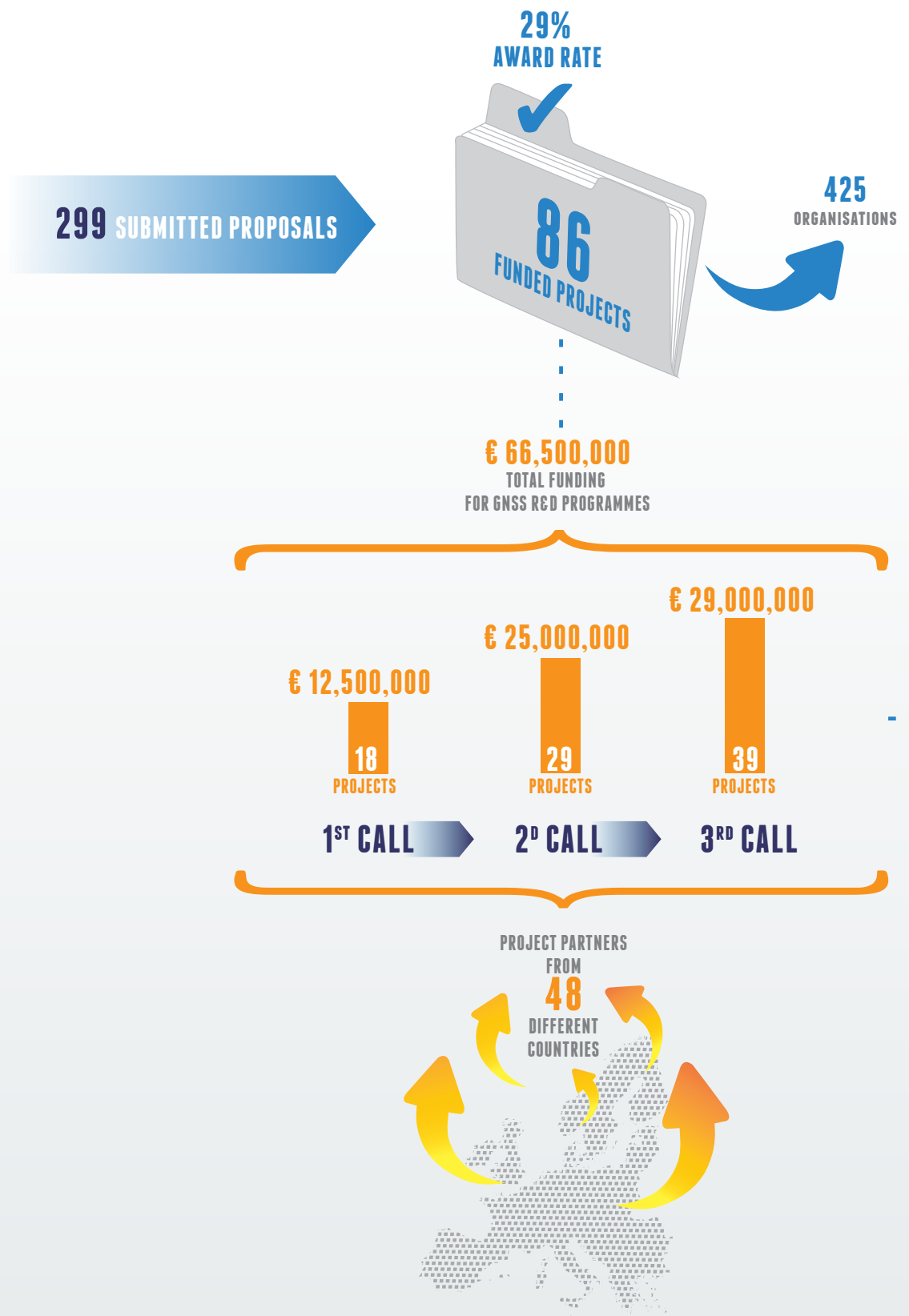
This impressive performance is at least in part the result of the strong steer of GSA's market development strategy, focussing on the most significant sectors for current and future growth according to its GNSS Market Report.

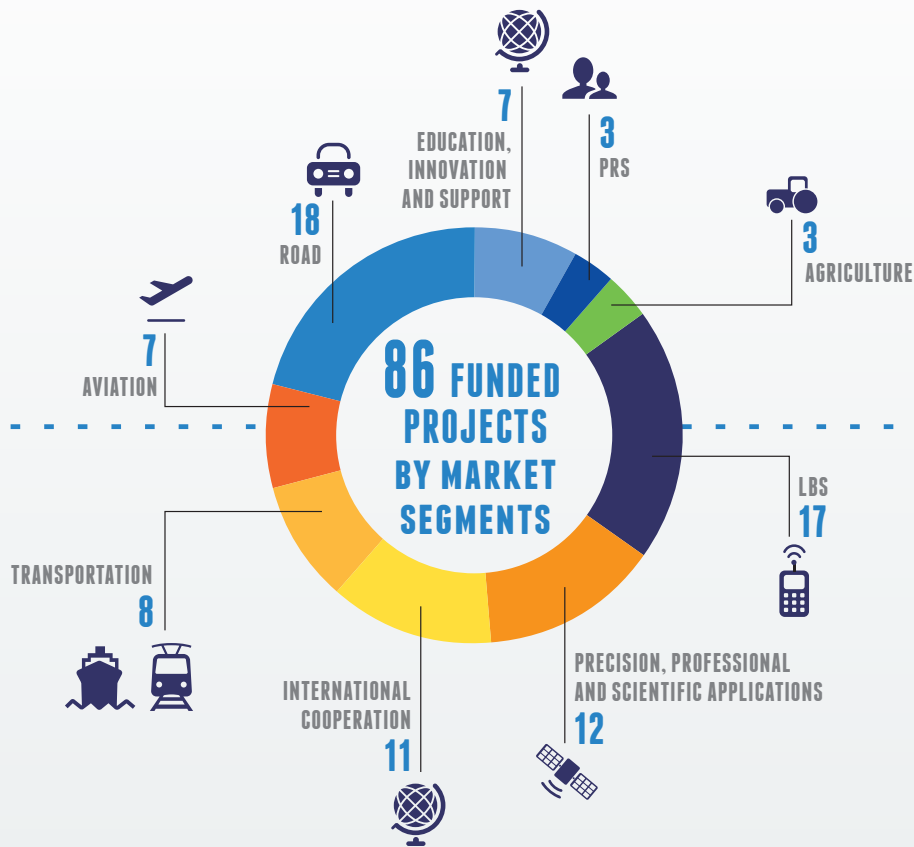
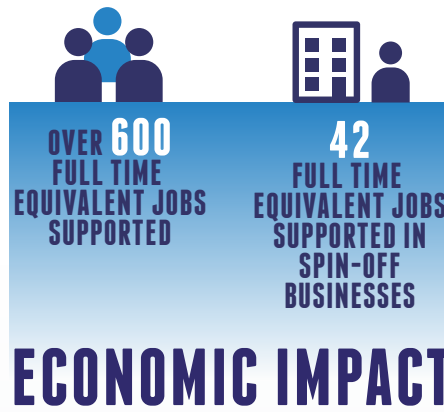
Now, thanks to the EU R&D funding, cutting-edge research in the field of GNSS is likely to continue to bear fruit for businesses and citizens into the foreseeable future.

¹ Note that this budget includes only non-tender projects which were managed by the GSA










² By the date of publication of the FP7 brochure, 10/01/2015

FP7 IN FIGURES





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With its ability to augment existing GNSS signals, EGNOS offers enhanced vertical precision and integrity, i.e. a 'reliable signal', for the aviation sector. This means pilots can rely on it for safe approaches to difficult airstrips or under adverse meteorological conditions.

EGNOS enables optimised approaches, even with curved segments, , delivering increased air transport capacity, operations efficiency, fuel savings and lower noise in populated areas – all to the benefit of airports, airline operators and flying passengers.

EGNOS-enabled receivers are widely available, and the system is fully compatible with the US Satellite Based Augmentation System (SBAS), WAAS, and with Japan's MSAS.

With an on-board EGNOS receiver and a suitable approach procedure, no additional investments in ground infrastructure costs are necessary. Eventually, EGNOS could make it possible for some airports to eliminate expensive ground-based nav aids and other infrastructure.

To see the entire list of innovative projects in this area: Take a look at p.24 or visit <http://www.gsa.europa.eu/r-d/gnss-project-portfolio#aviation>

EGNOS FOR THE AVIATION SECTOR

The future air traffic management system envisaged by the International Civil Aviation Organisation (ICAO) sees GNSS playing a central role. In this context, satellite-based navigation encompasses not only satellites in space, but also aircraft receivers and system integrity monitoring, augmented as necessary to support the required performance for various flight phases.

The aim of the **GIANT-2** project was to promote the introduction and adoption of EGNOS in the aviation sector. It continues the work initiated under the GIANT project, which promoted the introduction of EGNOS within selected niche markets, pushing for integrated avionics on board fixed-wing aircraft and rotorcraft and performing pre-operational flight demonstrations.

GIANT-2, the next step forward, has worked to promote and accelerate the adoption of EGNOS-based aviation applications in remaining key niche markets.

Among the specific goals of the project is accelerating the adoption of EGNOS by regional airlines, corporate and general aviation, and in helicopters. GIANT-2 has also identified testing and operational practices necessary for successful EGNOS integration.

Knowledge building and dissemination of information were key activities, targeting a Europe-wide network of aviation community members with a strong interest in GNSS technologies.

This involved convincing potential end users of the economic and operational benefits, including optimised use of all resources, reduced operating costs, fewer delays and greater flexibility in the planning and management of flights.

Finally, GIANT-2 successfully demonstrated EGNOS end-to-end approach and landing applications, performing flight tests using GNSS as the primary positioning technology.

<http://giant2.ineco.es/giant2/html/main.html>

<http://www.gsa.europa.eu/egnos-adoption-aviation-sector-0>

Total Cost: € 1 765 649

EU Contribution: € 1 070 603

Start Date: 15.01.2009

End Date: 14.10.2011

Duration: 33 months

**Coordinator: Chocano Luis,
Ingeniería y Economía del Transporte
luis.chocano@ineco.es**

MAKING MORE AIRPORTS EGNOS-READY

The certification of EGNOS for 'Safety-of-Life' (SoL) applications has made it possible to introduce new airport landing approaches. So-called LPV/APV approaches, with vertical guidance, feature a high level of precision – without the need for new infrastructure.

But before this is possible, airports need to establish specific EGNOS landing procedures for their runways and aircraft need to be equipped with EGNOS-enabled receivers.

The **ACCEPTA** project aimed to encourage the adoption of EGNOS in the regional airline and corporate aviation sectors, considered to be among the niche markets with the most to gain from EGNOS.

The project has helped airports, airlines and operators with funding to develop and publish EGNOS-based airport approach procedures and to equip aircraft to fly those procedures.

One key to success has been making sure potential users, and especially Air Navigation Service Providers (ANSPs), know about all the real benefits of EGNOS, including enhanced vertical precision and integrity, safer approaches and easier access to small or remote airstrips, and safer landings under difficult weather conditions.

Elaborating the business case for EGNOS has also been an important part of the education process. A critical factor is what experts call 'disruptions', meaning flight delays, diversions and cancellations – all of which are costly.

EGNOS can help reduce air transport disruptions, which is not only good for business, but also for the flying public.

With its improved vertical guidance, EGNOS reduces approach 'minima', allowing pilots to get closer to the ground before having to decide whether or not to abort a landing. The end result is safer approaches and more on-time and on-target flights.

<http://accepta.ineco.es/accepta/html/main.html>
<http://www.gsa.europa.eu/accelerating-egnos-adoption-aviation>

Total Cost: € 4 530 345
EU Contribution: € 2 670 398
Start Date: 15.04.2010
End Date: 14.12.2014
Duration: 48 months
Coordinator: Chocano Luis,
Ingeniería y Economía del Transporte
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EMPOWERING HELICOPTERS WITH NEW GNSS CAPABILITIES

Today's helicopters perform key services for businesses and citizens, from search and rescue to fire fighting to offshore transport in the petrochemicals industry. But while fast and manoeuvrable, helicopter flights are often curtailed by bad weather and poor visibility.

The **HEDGE NEXT** project is targeting the operational implementation of EGNOS-based rotorcraft approach procedures and carrying out research and development to derive new concepts for EGNOS- and Galileo-based applications for the sector.

Continuing the work of the HEDGE project, which promoted the uptake of EGNOS by helicopters and general aviation through a series of flight demonstrations, HEDGE NEXT is now working to see the implementation of rotorcraft APV procedures through to completion.

The project is undertaking a comprehensive programme of R&D towards the full exploitation of EGNOS services in the rotorcraft sector, in coordination with some of the world's leading rotorcraft manufacturers.

Working on a multinational level, together with key Air Navigation Service Providers (ANSPs) and the main rotorcraft emergency service operators, HEDGE NEXT partners are demonstrating EGNOS-based approaches with vertical guidance (APV) for rotorcraft in selected sites in Spain, Poland and Switzerland.

The project is also developing new routes for offshore helicopter flights in the North Sea and developing and testing curved approaches for helicopters using GPS and EGNOS.

Finally, the project will enumerate enhanced visual flight rules (e-VFR) aimed at improving navigational safety in marginal-visibility conditions based on EGNOS and, later, Galileo services.

<http://hedge-next.pildo.com/>
<http://www.gsa.europa.eu/helicopter-deploy-gnss-europe-next#overlay-context=helicopter-deploy-gnss-europe-next>

Total Cost: € 1 370 431
EU Contribution: € 791 965
Start Date: 01.02.2012
End Date: 30.06.2014
Duration: 29 months
Coordinator: Santiago Solay, Pildo Labs
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ROAD TRANSPORT

The European satellite navigation systems, Galileo and EGNOS, represent important new implements for economic and social change in Europe and are powerful tools in the drive to meet such key global challenges as the demand for safe and smart mobility.

While steadily increasing road traffic in Europe has a significant down side – namely traffic congestion, accidents and increasing pollution – the road sector is also one of the largest and most dynamic markets, representing a major business opportunity for GNSS technology applications.

GNSS receivers, now regular equipment in car and other vehicles, are providing new services for road mobility, from energy-saving route guidance to electronic toll collection, and ensuring the secure freight of hazardous materials.

With the projected 2018 worldwide market for road GNSS receivers and services now estimated at a core revenue of 44 billion core revenue, the future for EGNOS and GALILEO-related road applications looks very promising indeed.

To see the entire list of innovative projects in this area: Take a look at p.24 or visit <http://www.gsa.europa.eu/r-d/gnss-project-portfolio#road>

DEMONSTRATING EGNOS FOR WIDE-SCALE ROAD USER CHARGING

With GNSS-based road charging, there are no tollbooths and there is no need for new infrastructure. Each and every road can be covered, no matter how small or in what kind of environment.

The **GINA** project designed and tested a system for the accurate location of vehicles and for recording the distance they travel, laying the groundwork for GNSS-only road pricing.

The project looked specifically at how EGNOS corrections could enhance GPS positioning. It undertook large-scale feasibility tests, including positive location and tracking of vehicles with respect to fixed 'geo-objects', both in urban environments and on the open road.

A high degree of accuracy is a prerequisite for correct charging. Operators must know with certainty that a particular car is driving on a particular road and not a nearby parallel road.

GINA activities included an unprecedented, large-scale, nationwide test of a GNSS-based road-pricing scheme in the Netherlands, designed to meet specific requirements defined by real end-users.

For such a scheme to succeed, the system must be easy to use and the public must feel confident about its reliability.

The test succeeded in demonstrating improved tracking accuracy for GPS plus EGNOS when compared to similar systems using GPS alone. More so, the system was reliable, simple and affordable.

Ultimately, the GINA project showed that GNSS and EGNOS present economically viable and fair solutions to help reduce the negative impact of road transport, including congestion and roadside infrastructures.

<http://www.gina-project.eu/>

<http://www.gsa.europa.eu/gnss-innovative-road-applications-0>

Total Cost: € 2 198 088

EU Contribution: € 1 307 363

Start Date: 22.01.2009

End Date: 21.05.2011

Duration: 28 months

**Coordinator: Sara Gutiérrez-Lanza,
Grupo Mecánica del Vuelo Sistemas
ssgl@gmv.es**

LAYING THE GROUNDWORK FOR EGNOS IN THE TRANSPORT OF DANGEROUS GOODS

Nowhere is the need for accurate and verifiable location more keenly felt than in the transport of dangerous goods and materials. Transporters need to know the exact positions of their vehicles at all times in order to ensure a high level of safety and to be able to exchange reliable information with relevant authorities.

The EU-funded **SCUTUM** project delivered a crucial new document that laid out technical specifications for the operational adoption of EGNOS in the transport of dangerous goods. The CEN Workshop Agreement (CWA 16390) defines a technical specification for data output for mass-market receivers, enabling application developers and service providers to easily design their own software solutions.

The document specifies what GPS/EGNOS receiver data and formats can be used to generate value-added services. It defines architecture- and technology-independent technical specifications applicable within existing ITS systems and mobility-related applications.

SCUTUM's groundbreaking CEN Workshop Agreement has been endorsed by several European institutions and by stakeholders from industry and the research community, as well as by some national Transport Ministries.

When SCUTUM completed its work in December 2011, ENI, a leading oil company, had already elected to use EGNOS in real operations to track and trace its transport fleet throughout Europe. Its decision was based on the results of tests carried out under the project. Initially, this entailed more than 300 tankers being monitored using the EGNOS signal, transporting hydrocarbon and chemical products. Today, SCUTUM's solution monitors around 1,100 tankers are monitored in Austria, the Czech Republic, France, Hungary, Italy, Romania and Slovakia.

Clearly, SCUTUM has provided a real contribution to future regulatory and standardisation processes with respect to EGNOS and, eventually, Galileo.

<http://www.gsa.europa.eu/securing-eu-gnss-adoption-dangerous-material-transport>

Total Cost: € 2 249 937
EU Contribution: € 1 407 188
Start Date: 18.01.2010
End Date: 17.12.2011
Duration: 23 months
Coordinator: Antonella Di Fazio, Telespazio
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OPTIMISING DRIVER BEHAVIOUR WITH ENHANCED ACTIVE GREEN DRIVING

Reducing the amount of energy consumed by road vehicles has been and remains a central concern for EU researchers. One thing that can help drivers to operate their vehicles in a more efficient manner is the ability to anticipate what's coming around the next bend. After all, a smoother driving style with fewer abrupt accelerations and decelerations means lower fuel consumption.

The aim of the **GAIN** project has been to develop a so-called Enhanced Active Green Driving (Enhanced AGD) system for real-time optimisation and reduction of fuel consumption and CO2 emissions.

The system essentially represents the further development of the previously deployed Active Green Driving AGD prototype vehicle, which has already been tested in several cities and on rural roads and highways.

The AGD vehicle uses a simple on board GPS unit for positioning, but the GAIN project's Enhanced AGD system goes a step further, enabling accurate positioning based on EGNOS/EDAS.

The new system also integrates other key data, including dynamic information about other vehicles on the road through vehicle-to-vehicle communication and real-time information about traffic and weather conditions.

Together, all of this information is combined to derive an 'Electronic Horizon' for the driver, displaying recommended speed limits for the road ahead, as well as projected paths of the vehicle.

With mobility now a common requirement for so many professional activities, GAIN partners see a significant demand – and thus a significant market – for Enhanced AGD-based products. By answering this need, the project hopes to spread the benefits of greener transport to both citizens and the economy.

<http://www.gsa.europa.eu/galileo-interactive-driving>

Total Cost: € 3 591 399
EU Contribution: € 2 018 486
Start Date: 01.02.2012
End Date: 31.07.2014
Duration: 30 months
Coordinator: Carlo Liberto, Centro Ricerche Fiat
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GNSS is now widely seen as a key component of the next-generation European Rail Traffic Management System, an EU initiative aimed at boosting cross-border interoperability and enabling railways to run more efficiently.

Europe's many low-density secondary rail lines, which comprise a high percentage of the total network, pose particular problems, including special operational requirements and high maintenance costs.

GNSS can be an invaluable tool for train localisation, fleet management, monitoring speed and low-density line signalling – all at a significantly lower cost than conventional solutions.

To see the entire list of innovative projects in this area: Take a look at p.26 or visit <http://www.gsa.europa.eu/r-d/gnss-project-portfolio#othertransport>

GNSS-BASED ODOMETRY FOR RAIL SAFETY AND MANAGEMENT

Knowing how fast a train is moving is an obvious and fundamental necessity for safe and efficient rail transport. Traditionally, train speed was calculated by counting the number of turns of the train's wheels, with adjustments made for errors caused by sliding and slipping on the rails. Today's systems often rely on speed control at specific spots along the track, including ends of sections, curves and station platforms.

Under the EU-funded project GRAIL-2, researchers have been testing, validating and seeking certification of a new GNSS-based subsystem to replace existing train odometry systems.

Maintaining the correct speed is important for getting trains to their destinations on time, but also for making sure they stay on the track – especially on tight curves. Carrying on the work of the original GRAIL project, which defined user and system requirements, **GRAIL-2** started by reviewing, adapting and completing these requirements.

Current odometer sensors include tachometers, inertial navigation sensors and Doppler radar. GRAIL-2 believed GNSS can help solve certain weaknesses in these systems, especially on high-speed lines.

Validation of the GRAIL-2 prototype, with its interfaces with existing onboard equipment, has involved an extensive test campaign, with particular attention paid to safety issues. The consortium has also developed a crucial roadmap towards certification.

Finally, studies carried out under the project point towards the cost-effectiveness of such a system, particularly in the context of Europe's low-density rail lines, delivering a measurable increase in safety at a lower cost than all other available solutions.

<http://www.gsa.europa.eu/gnss-based-enhanced-odometry-rail>

Total Cost: € 2 052 974
EU Contribution: € 1 279 347
Start Date: 01.09.2010
End Date: 31.12.2013
Duration: 30 months
Coordinator: Alvaro Urech,
Ingeniería y Economía del Transporte
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MODERN RAILWAY OPERATIONS WITH GNSS-BASED LOCALISATION

European railways are under pressure to expand capacity and improve efficiency and interoperability. The sector needs new solutions, and Europe's satellite-based navigation systems EGNOS and Galileo can help.

The goal of the **GALOROI** project was to develop a certifiable, GNSS-based, onboard train localisation unit. The unit will deliver data with high accuracy, integrity, availability and Safety Integrity Level (SIL), sufficient for safety-relevant localisation within train control systems.

The localisation unit was installed and tested successfully on a real operational vehicle running on a line near Opava, Czech Republic.

Although the unit can function as part of an automatic train control system that no longer requires additional trackside railway signalling technology, one of the objectives of the project was to make the system compatible with other train control systems.

Essentially, the system allows a continuous localisation even where conventional trackside technologies are limited or absent, thereby increasing overall coverage and capacity.

Not only has GALOROI provided an important demonstration of the power of GNSS in general, but also of the EGNOS augmentation system in particular, with EGNOS corrections playing a key role in the increased accuracy of localisation signals.

With the future advent of Galileo's Safety-of-Life service, the system will provide an even more powerful tool for rail safety and reliability.

Finally, the unit eliminates high manufacturing, installation and maintenance costs because it only needs to be installed on trains. Requiring no trackside equipment, the unit makes a strong case for itself in terms of potential commercial exploitation.

<http://www.galoroi.eu/>

<http://www.gsa.europa.eu/galileo-localisation-railway-operation-innovation>

Total Cost: € 1 539 220

EU Contribution: € 916 450

Start Date: 01.01.2012

End Date: 30.06.2014

Duration: 30 months

Coordinator: Uwe Becker,

Institute for Quality, Safety and Transportation

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GNSS FOR LOW-TRAFFIC RAIL LINES

Have you ever stood on a remote rail station platform and wondered 'where is my train'? No technology is better at telling you where something is than GNSS – and it can be particularly useful on Europe's less-travelled rail lines.

The EU-funded **SATLOC** project is developing and demonstrating innovative GNSS-based safety-of-life applications for train control, speed supervision, traffic control and traffic management on secondary rail lines.

The project includes the development of a new, integrated rail operational concept, including software, hardware, services and datasets, compatible with the current evolution of rail signalling and standards.

After the integration of the system's main hardware components and a series of lab-based trials, SATLOC researchers developed a real-scale demonstrator, consisting of three running trains and a traffic control centre with GNSS localisation and train speed determination.

High fix integrity and a high-level of safety were assured by close-loop integration of train traffic and movement control via the control centre. Real-life pilot runs took place on the Brasov-Zarnesti line, part of the RCCF-TRANS rail network in Romania. The project consortium says a high degree of innovation in terms of integrated train-track behaviour allowed them to achieve very high safety performance.

Fully compatibility with the European Train Control System (ETCS), the SATLOC system provides signalling, control and train protection and is designed to replace the many incompatible safety systems currently used by European rail operators, especially along many secondary lines.

A market assessment undertaken by the project indicates a positive future for the SATLOC system, paving the way for GNSS introduction as a formidable tool in the rail transport sector.

<http://satloc.uic.org/Project-summary>

<http://www.gsa.europa.eu/satellite-based-operation-and-management-local-low-traffic-lines>

Total Cost: € 2 616 436

EU Contribution: € 1 269 323

Start Date: 01.01.2012

End Date: 30.04.2014

Duration: 28 months

Coordinator: Gheorghe Barbu,

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The world's oceans and waterways are by far the most widely used means of transporting goods, so the efficiency and safety of maritime transport are critical for sustainable economic growth and prosperity worldwide.

The maritime navigation sector was an early adopter of satellite technologies and has always been quick to embrace new navigational developments. EGNOS applications are already helping to improve maritime navigation, seaport operations, inland waterway transport and many related activities.

Examples of the importance of GNSS technologies in the maritime sector are provided by the international e-Navigation initiative and the EU e-Maritime initiative, both who use GNSS to promote safety of life, protection of the environment, energy efficiency and the effective use of marine resources.

European GNSS can be a vital means of achieving all of these aspirations, with leading-edge systems Galileo and EGNOS are primed to play central roles.

To see the entire list of innovative projects in this area: Take a look at p. 26 or visit <http://www.gsa.europa.eu/r-d/gnss-project-portfolio#othertransport>

SAFE PORT OPERATIONS USING EGNOS SoL SERVICES

European seaports are being pushed to the limit in terms of how many ships they can handle, with the overload of traffic making normal operations more dangerous than ever.

At the same time, declining numbers of maritime personnel and an increasing number of vessels in service mean the seagoing experience among crews is plummeting. Indeed, recent statistics show that today ships are twice as likely to be involved in a serious incident as they were just five years ago.

Traditionally, port authorities solved the capacity problem by simply expanding onto new land, but real estate is at a premium these days, with environmental concerns taking centre stage and industrial sites and human populations encroaching on available land.

The EU-funded **SAFEPORT** project has developed a GNSS-based Active Vessel Traffic Management and Information System (A-VTMIS) to manage vessel movements, ensuring that ships stay safe when at port and improving the efficiency of all port operations.

The project has also developed a navigation aid called 'SafePilot', which helps pilots safely and efficiently navigate courses provided by the A-VTMIS.

The European GNSS augmentation system, EGNOS, with its accuracy, reliability and safety-of-life features, is critical to the new SAFEPORT system. And it provides authentication mechanisms to support identification and safe recognition of ships, cargo and other assets.

The project takes its cue from the aviation industry, which has addressed traffic-related safety issues through increasing automation and the use of sophisticated traffic management systems, including GNSS components.

SAFEPORT's A-VTMIS and SafePilot have now been launched on the commercial market where consortium members say they are experiencing some success.

<http://safeportproject.com/>
<http://www.gsa.europa.eu/safe-port-operations-using-egnos-sol-services>

Total Cost: € 2 720 824
EU Contribution: € 1 930 228
Start Date: 01.03.2010
End Date: 31.05.2012
Duration: 27 months
Coordinator: Rory Doyle, BMT Group
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MARINE PARK LBS SYSTEM BENEFITS A RANGE OF USERS

EMarine parks represent unique and irreplaceable ecosystems. Their users, including operators of leisure boats and commercial and public vessels, are subject to stringent restrictions. Within the beautiful Archipelago La Maddalena National Park in Italy, users are required to obtain a permit to navigate, but the area is immense and resources for patrolling the park are limited.

The **MEDUSE** project is working to develop a prototype service infrastructure for location-based services within restricted-access maritime areas. The system is based on the Galileo Commercial Service concept, with accuracy and integrity enhanced by EGNOS. The project is also helping to preserve the environment and increase safety. To accomplish this, MEDUSE is combining authenticated positioning services (such as EGNOS) with certified systems already in use, such as the Automatic Identification System (AIS). As a result, where there is an app, terminal or other device, the system makes it possible for marine park authorities to use technology to preserve the natural beauty of Europe's coastlines.

Project researchers envisage a number of specific user groups that could benefit from this kind of service. Institutional users, for example, could use the service for monitoring restricted area access and possibly for the implementation of a pay-per use policy. Park authorities could plan and monitor the itineraries of tourist boat fleets, or receive alerts from cooperative users about wild fauna or hazardous spills.

Private users could benefit from a number of location-based tourist services, including social networking, special tips from park managers and booking of mooring buoys, all based on their actual location.

Commercial concerns could use the system to deliver weather alerts or traffic-based routing services. Finally, law enforcement officials could employ the system to monitor infringements of navigation rules.

The MEDUSE system has been successfully demonstrated in the Archipelago La Maddalena National Park. It consists of a service and control centre, several marine apps targeted to different users, and a dedicated marine terminal prototype for supporting pay-per-use and law enforcement services.

<http://www.meduse-project.eu/>
<http://www.gsa.europa.eu/marine-park-enhanced-applications-based-use-integrated-gnss-services>

Total Cost: € 467 107
EU Contribution: € 368 775
Start Date: 01.02.2012
End Date: 30.09.2013
Duration: 20 months
Coordinator: Massimo Pichini, NEXTANT

COOPERATIVE SATELLITE NAVIGATION FOR MARINE WEATHER FORECASTING

A limiting factor for meteorological modelling and forecasting is the availability of accurate and 'certified' data sets. The problem is especially critical over the oceans, where the special sensors required are very expensive and few are available to cover the vast surfaces.

Researchers in the EU-funded **COSMEMOS** project wanted to find a way to use ships on the move as a distributed meteorological sensor network capable of retrieving data, via satellite and/or off-line, on sea surface conditions and in combination with accurate EGNOS-augmented GNSS.

While certified weather sensors are few and far between on the ocean's surface, there are thousands of 'uncertified' weather sensors crossing the seas every day in the form of commercial and private vessels – most of which are equipped with GNSS.

The COSMEMOS system uses an advanced data fusion technique to extract information of sufficient quality from non-certified signals transmitted by private ships and boats. This data can then be used to produce high-resolution forecasting models.

In addition to pre-voyage route planning, the service can provide innovative guidance, including optimised speed and course, based on weather forecasts and real-time 'nowcasts' enabling informed en-route corrections. With more accurate knowledge of weather conditions, fuel economy and safety are also improved.

The initially proposed COSMEMOS service focuses on the needs of leisure and sporting navigation. It provides weather-related assistance to yachts, improving navigation safety and optimising routes for pleasure cruising and during coastal and offshore regattas. This research, however, is not limited to leisure boats but will also enable a strong increase of the meteo-marine related information obtainable from commercial and private vessels through the cooperative scenario.

In more general terms, the system is a high-value added resource for the weather community, greatly improving the quality of local forecasting and 'nowcasting' services.

<http://www.cosmemos.eu/>
<http://www.gsa.europa.eu/cooperative-satellite-navigation-meteo-marine-modelling-and-services>

Total Cost: € 1 676 462
EU Contribution: € 942 540
Start Date: 01.03.2012
End Date: 31.05.2014
Duration: 27 months
Coordinator: Enrico Barro, Vitrociset Belgium
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AGRICULTURE

USER FORUM ON NAVIGATION-BASED INNOVATION FOR FARMERS

Precision agriculture is the site-specific management of production resources, including soil, seeds, water, fertilizer and chemicals. With precision agriculture, European farmers can increase labour, economic efficiency and crop yield. At the same time, when resources are managed, less residues are released, fewer pesticides are needed and irrigation water usage becomes more efficient – all having a positive impact on the environment.

Under Europe's Common Agriculture Policy (CAP), GNSS signals are routinely used to verify farmers' declarations of land parcel size. EGNOS delivers an improvement in such surveys compared to GPS alone while its high signal reliability reduces the risk of having to repeat the process. Farmers were the first group to use European GNSS, discovering the EGNOS correction signal before most people even knew it was operative. As a result, farmers are eager to receive specific information from E-GNSS, including EGNOS performance assessments and effective coverage area, and Galileo up-to-date information. That's how important the ability to map fields and identify their characteristics is to Europe's farmers.

Today, with costs on the rise and environmental demands increasing, efficient and sustainable farming is needed more than ever – and EGNOS and Galileo stand ready to deliver.

To see the entire list of innovative projects in this area: Take a look at p.24 or visit <http://www.gsa.europa.eu/r-d/gnss-project-portfolio#agriculture>

Although GNSS is already delivering benefits to the agriculture sector, it can still do much more to deliver better and more efficient farming practices. But first, farmers who use GNSS, including EGNOS, need to agree on what they want and expect from developers and service providers.

The EU-funded **UNIFARM** project aims to bring together all parties with an interest in precision GNSS-based agriculture. From farmers' groups to regulatory authorities, researchers and scientists and GNSS service providers, the project brings these parties together to discuss, share best practices, ask questions and – most importantly – find answers.

The project organises stand-alone events and also participates in events organised by other networks and organisations, all with the aim of assembling a comprehensive set of real user requirements, as well as case examples.

In addition, an online system has been developed to aid in the collection of user requirements from those who are not able to attend project events. This feature is enhanced by the use of social media as a means of disseminating information and engaging end users on the use of GNSS.

The project then takes this information to key national and EU GNSS policy makers in the space and agriculture sectors.

Ultimately, UNIFARM partners hope to seed a fully functioning European network of GNSS-based innovation initiatives involving farmers, government, industry and science.

UNIFARM has been active in disseminating information to a broader audience, in particular through its groundbreaking 'vision papers'. Its GNSS-for-agriculture best practices, road-maps, harmonised user cases, and user requirements are now widely circulated and used in advisory services and education programmes aimed at increasing awareness beyond the 'early adopters'.

In summary, UNIFARM is spreading the word about how GNSS technology can help farmers and their businesses.

<http://project-unifarm.eu/>
<http://www.gsa.europa.eu/gnss-user-forum-navigation-based-innovation-farmers>

Total Cost: € 679 000
EU Contribution: € 679 000
Start Date: 25.01.2012
End Date: 24.04.2014
Duration: 27 months
Coordinator: Tamme van der Wal, AeroVision

GNSS-BASED AGRICULTURAL LOGISTICS

EGNOS no longer represents a technological opportunity, but rather a necessary infrastructure for successful precision agriculture. With most new high-end combine harvesters now equipped with EGNOS-enabled receivers, farmers can save significant operating costs, thanks to more time-efficient operations and reduced fuel, oil and maintenance costs.

Making EGNOS work for farmers is the aim the **GEOPAL** project. The project is developing a GNSS-based planning system to support in-field and inter-field agricultural logistics activities. It uses satellite navigation technologies to ensure tractors and harvesters, trucks, other transport vehicles and even people, all work together in a coordinated and efficient way.

GEOPAL has developed a GNSS-based planning system for agriculture logistics, encompassing all of the harvesting and distribution functions of bio-production related supply chains. The project's innovative software package includes in-field route planning modules for harvesting machines and transport units.

Under conventional agricultural practices, vehicle drivers plan their own paths over a field either manually, based on experience, or by drawing lines using a guidance system. The GEOPAL system can calculate and optimise the path through the field for the driver, and it can guide other transport units to a machine that is working at a precise location in a field.

Finally, an innovative street-and-track navigation system calculates routes to bridge the last leg between the street and the field.

GEOPAL addresses a number other elements, including resource efficiency, greenhouse gas emissions, sustainable production, automation of production and economic competitiveness – all aimed at streamlining both the harvesting and distribution functions of the bio-production supply chains.

<http://www.geopal-project.eu>

<http://www.gsa.europa.eu/gnss-based-planning-system-agricultural-logistics>

Total Cost: € 1 259 176

EU Contribution: € 729 385

Start Date: 01.04.2012

End Date: 31.10.2014

Duration: 31 months

Coordinator: Andre Kluge, CLAAS Agrosystems
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EGNOS-EQUIPPED AIRBORNE IMAGING PLATFORM

The use of unmanned aerial systems is on the rise, and the agriculture sector is no exception. These small, remotely piloted flying vehicles with cameras and GNSS-based positioning systems can provide fundamental information for water stress monitoring, detection of nutrient deficiencies and crop diseases, and other applications.

The EU-funded **FIELDCOPTER** project has integrated EGNOS receiving capability onboard a highly stable helicopter-like platform to deliver on-demand, very-high-resolution maps of agricultural fields.

Along with its EGNOS receiver, the FIELDCOPTER vehicle is equipped with cutting-edge optical and thermal cameras. The EGNOS augmentation system improves aerial positioning, enabling the creation of more accurate image mosaics, as well as improving safety performance.

The extreme stability of the platform, combined with EGNOS' augmented positioning and navigation capabilities, make it easier and faster to process composite images.

Finished maps can be provided within 48 hours of a survey, allowing for the timely application of crop-protecting chemicals, fertilisers or water.

Market research has shown a potential interest in the FIELDCOPTER service for such high-value crops as potatoes and wine grapes. Thus, one crucial field test, performed in the Netherlands, was aimed at assessing the application of haulm killing agent, an essential element in potato harvesting. A second demonstration involved water stress monitoring in the winegrowing region of Catalonia.

Meanwhile, the project has also been formulating recommendations on critical upcoming UAS regulations.

Altogether, FIELDCOPTER represents a real push for the commercial use of EGNOS within the European agricultural community. At the same time it contributes to the more efficient and effective use of precious resources like chemicals, fertilisers and water.

<http://fieldcopter.eu>

<http://www.gsa.europa.eu/fieldcopte>

Total Cost: € 967 959

EU Contribution: € 616 979

Start Date: 01.01.2012

End Date: 31.03.2014

Duration: 27 months

Coordinator: Paul van der Voet, Terrasphere
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SURVEYING AND MAPPING

Mapping, on the one hand, consist of plotting such things as location and points of interest onto a map. Surveying, on the other hand, is a high-precision sector that uses quantitative estimates for measuring such natural and manmade features as mountains, rivers, buildings and utility lines. Both, however, depend on GNSS technology such as EGNOS.

The availability of reliable maps of routes and paths is a critical issue when using GNSS for outdoor applications – and the accuracy of these maps is highly dependent on high-quality surveys.

On its own, field survey data is essential for a wide range of businesses, across private and public sectors and from land, water, marine and built resources to heritage, tourism, health, transport, construction, mining, planning, environment – and many more.

From the 1980s onwards, traditional surveying techniques were first supplemented — by satellite positioning technology based on GNSS. The role of GNSS receivers in the surveying equipment market not only demonstrates the added value that satellite positioning brings to optimizing survey operations, but also to other land measurement technologies like laser scanners and photogrammetric/LIDAR cameras.

The wide use of EGNOS in mapping applications, which demand sub-meter accuracy, is opening the door to new opportunities in the demanding high-precision surveying sector. Here, applications will benefit from Galileo and its interoperability with GPS – which together will improve both surveying measurements and the quality of the resulting data.

To see the entire list of innovative projects in this area: Take a look at p.24-28 or visit <http://www.gsa.europa.eu/r-d/gnss-project-portfolio>

A BETTER GALILEO RECEIVER FOR TAILORED LAND MANAGEMENT

Despite recent advances in the mapping and surveying of fields, in many parts of the world the surveying of real estate can still be a complicated affair. In Brazil, for example, where there is an increasing demand for topographical surveys of rural areas, commercially available GPS receivers are either too limited or too expensive.

The EU-funded ENCORE project is working to introduce Galileo-ready receivers and applications into the Brazilian land management market, including capabilities for geo-referencing and cadastre.

There is currently an important performance gap between affordable mass-market versus expensive professional-grade GNSS devices. On the one hand, mass-market receivers using pseudorange observables can deliver accuracies of only up to five meters. On the other hand, more complex professional receivers deliver data with errors below one decimetre.

Land management applications require precision and accuracy levels somewhere in the middle – from a few to several decimetres. So mass-market receivers can't deliver the needed accuracy, and professional-grade receivers deliver more accuracy than needed and at an exorbitant cost.

The ENCORE project wants to develop a new device that is just right, specifically tailored to Brazilian needs.

To solve the riddle, **ENCORE** is creating a new land management application based on an innovative, low-cost GNSS receiver that uses novel characteristics of Galileo signals. It is also designing algorithms for signal acquisition and tracking, along with specific positioning algorithms.

The European-Brazilian consortium behind the project includes technology companies, application dealers, research centres, universities, and geo-information providers. Together, they expect to undertake a successful commercial launch of the ENCORE system first in Brazil and, eventually, in other South America countries.

<http://www.encoreproject.org/>

<http://www.gsa.europa.eu/enhanced-code-galileo-receiver-land-management-brazil>

Total Cost: € 952 708

EU Contribution: € 590 000

Start Date: 01.02.2010

End Date: 31.07.2012

Duration: 30 months

Coordinator: Pedro Freire Silva, Deimos Engenharia S.A.
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EGNOS NAVIGATION FOR UAV-BASED SEARCH AND RESCUE

When a small plane crashes in a remote area or a fishing boat is lost at sea, search-and-rescue teams must scramble together every available resource to scan potentially vast areas for evidence of victims or wreckage. With wide areas to be covered and the mobility of ground searchers limited, unmanned aerial vehicles (UAV) are often used to provide crucial imagery over the search zones.

The **CLOSE-SEARCH** project is developing a system for locating victims of man-made or natural disasters. It can be operated in inaccessible areas and, of significant interest, it works day and night because it relies on the detection of body heat.

The project is integrating a thermal imaging sensor and a multi-sensor GPS-EGNOS-based navigation system onboard a small, unmanned and remotely piloted helicopter equipped with an autonomous integrity monitoring capability. The system will support search-and-rescue operations in remote, difficult-to-access areas or in time-critical situations. The resulting hardware and software prototype will demonstrate end-to-end functionality.

A central goal of CLOSE-SEARCH is to demonstrate the added value of a future multi-constellation-augmented GNSS configuration, like Galileo/GPS-EGNOS. Two key target attributes of the proposed system are ultra-safe navigation and overall low cost.

CLOSE-SEARCH researchers envisage a simple piece of equipment available to ski resorts, tourist areas, mountaineering clubs and local civil protection authorities – manageable, safe and inexpensive to operate.

The resulting system will be marketed commercially, but partners believe the social and economic impact, in terms of lives and property saved, is likely to outweigh any commercial value.

<http://www.close-search-project.eu/>
<http://www.gsa.europa.eu/accurate-and-safe-egnoss-sol-navigation-uav-based-low-cost-sar-operations>

Total Cost: 449 385 €
EU Contribution: 307 878 €
Start Date: 22.02.2010
End Date: 21.08.2011
Duration: 29 months
Coordinator: Colomina Ismael, Institut de Geomàtica
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HANDHELD DEVICE FOR HIGH-END GNSS APPLICATIONS

Advancements in both satellite signalling and GNSS receiver technologies now allow for highly accurate surveying operations, typically involving the use of a fixed base station and a separate roving antenna. So far though, no one has managed to develop an all-in-one handheld device with a built-in antenna capable of providing high-end, survey-grade, professional GNSS positioning.

The EU-funded **HANDHELD** project aimed to assess the possibility of developing a portable, fully stand-alone, professional-level system to exploit the capabilities of precise positioning offered by GNSS generally and, specifically, the EGNOS and Galileo systems.

The project targeted a small portable device that could do the same job as a conventional survey set-up, which generally entails a high-performance antenna on a pole and a separate receiver and controller.

For the device to work, researchers would have to develop a small, innovative GNSS L1-E5 antenna with electronically adjustable matching, suitable for integration within a handheld device.

Other important elements would include a new stand-alone housing with interfaces, an incorporated means of wireless communication like Wi-Fi or Bluetooth, and new application software.

The antenna, controlled by the receiver, would require strong filtering to prevent interference from the Bluetooth and WLAN transceivers within the device.

Working within these constraints, the project produced a first prototype that provided good overall results.

Ongoing antenna-related research and development has been promising and partners believe a fully functional device can eventually be achieved.

Next, a thorough business case will be carried out, followed by a launch on the commercial market – one of the other central objectives of the project.

<http://fp7handheld.eu>
<http://www.gsa.europa.eu/handheld-device-innovative-compact-antenna-professional-gnss-applications>

Total Cost: € 883 526
EU Contribution: € 557 000
Start Date: 04.01.2012
End Date: 03.10.2013
Duration: 21 months
Coordinator: Alain Suskind, Septentrio
alain.suskind@septentrio.com



LOCATION-BASED SERVICES

The integration of accurate GNSS receivers within smartphones, tablets, laptops, notebooks and other computing devices, cameras and video recorders, is bringing EGNOS and Galileo services – directly to individuals. In other words, GNSS is driving a fundamental transformation of the way we live and work.

In terms of size, Location-Based Services, also known as LBS, have been identified as the main market segment for GNSS. Within this segment, in fact, a broad range of applications can benefit from Galileo service, including ‘mobile Yellow Pages’ or ‘proximity services’ that provide users - wherever they are – with information about the nearest businesses and services.

Dedicated positioning devices that leverage Galileo’s performance will be available for tourists or hikers, for amusement park and museum visitors, and for the disabled – all of this with a correspondingly massive economic impact.

To see the entire list of innovative projects in this area: Take a look at p.25 or visit <http://www.gsa.europa.eu/r-d/gnss-project-portfolio#lbs>

PERSONALISED MULTI-MODAL URBAN TRANSPORT

Today, information on most forms of public transport is available online, usually supplied by local operators. In some cities, more advanced GNSS-based services allow users to track bus delays or assess real-time traffic conditions.

But what if you want to combine different public transport modes or use a combination of public and private transport to get to your destination?

The **OPTI-TRANS** project has created a mobile GNSS-based platform that enables travellers to plan trips in a most efficient manner, using a combination of public and private transportation. The ‘Journey Planner’, a personal LBS application for mobile phones, interfaces with existing public transport databases.

The system merges information from different transport authorities – including timetables, routes and delays – to tailor optimal multi-modal solutions to a particular traveller’s needs and based on his or her actual location.

Exploiting the strengths of EGNOS and EDAS in enhanced positioning information, Journey Planner navigates users through a city in the fastest and most cost-effective manner, displaying the optimal routes and transport combinations.

The platform can also bring together ad hoc peer-to-peer groups, allowing a number of travellers with similar destinations to share modes of transportation.

OPTI-TRANS encompasses established ‘transport-on-demand’ and other car-pooling and ‘passenger-on-the-curb’ services that allow privately owned vehicles to be shared with other subscribers.

The project stands as a clear demonstration of how citizens can efficiently navigate across Europe’s urban landscapes using existing and innovative transport arrangements with a little help from European GNSS. A future step beyond project’s conclusion is to standardise interfaces and databases to enable similar applications to link the entire European urban and rural transportation zone.

<http://www.optitrans-fp7.eu/>

<http://www.gsa.europa.eu/optimised-transport-system-mobile-location-based-services-0>

Total Cost: € 1 645 752

EU Contribution: € 1 139 639

Start Date: 05.01.2009

End Date: 04.04.2011

Duration: 27 months

**Coordinator: Thomopoulos Stelios, NCSR Demokritos
scat@iit.demokritos.gr**

MOBILITY-IMPAIRED REAPING THE REWARDS OF LBS

Getting around in cities can be a difficult prospect, with people and businesses facing traffic safety issues, problems linked to congestion, and limited access to public transport. For the mobility-impaired, a tour around the city becomes even more daunting, raising issues as wide-ranging as personal autonomy, freedom, equality, human relationships and quality of life.

The EU-funded **INCLUSION** project explored how satellite navigation can help the physically disabled. Specifically, it is developing a guided wheelchair with integrated GNSS and Wi-Fi systems that can choose the best routes and avoid barriers by itself.

Previous research efforts to develop positioning applications for the disabled using stand-alone GPS have been held back by the system's lack of accuracy and reliability. These limitations have been addressed within the project by making use of EGNOS and EDAS.

It is a matter of fact that people in wheelchairs move in limited areas, typically near their homes. Just how limited these areas are is determined in part by the presence of physical barriers. But psychological barriers also play a role, such as fear and uncertainty about accessibility.

INCLUSION's location-based service gets disabled travelers where they want to go. It knows where the accessible routes are so users can feel confident and enjoy their newfound freedom.

While those with mobility impairments will be the main beneficiaries, their families, friends and care-takers will also reap rewards. If successful, the new system may also have a positive economic impact within the burgeoning LBS market.

<http://www.gsa.europa.eu/innovative-lbs-socialpublic-dimension>

Total Cost: € 1 672 419
EU Contribution: € 1 034 983
Start Date: 16.02.2010
End Date: 15.04.2012
Duration: 26 months
Coordinator: Giovanni Guarino
giovanni.guarino@thalesalieniaspace.com

USER-POWERED WEB RESOURCE FOR MOUNTAIN TRAIL MAPPING

Finding the next new walk, hike, bike or running trail is worth pure gold to the weekend outdoorsman – or woman. And it can mean life or death to someone waiting for rescue services on a remote mountainside.

The **WALKEGNOS** project has developed a new online platform, www.walkegnos.net, that helps users find their way in the mountains, whether just for fun or for more serious business.

The online platform allows hikers to share their GNSS-generated 'walks', but the core and most important service is the provision of accurate, EGNOS-augmented routes, representing a significant upgrade when compared to common GPS-only routes.

The new service answers a real need, particularly among professional users, including map providers, mountaineering associations, civil protection agencies and mountain rescue teams.

The system is built around the post-processing of data provided by the users themselves, augmented by EGNOS corrections for greater accuracy and reliability.

A basic user who wants an 'EGNOS-powered' record of his or her mountain hike needs only a basic GNSS receiver to log positions and raw measurements. Once back from the hike, the user can go to the WALKEGNOS online platform, upload his or her route and obtain the corrected results.

A key feature of the online platform is its 'Web 2.0' approach, where users are the motivating force – they provide new data every time they use the site, making the site a more powerful resource in turn.

In order to leverage this 'user-centric' feature, interactive links have been forged with other similar online platforms and social networks.

<http://walkegnos.net/>
<http://www.gsa.europa.eu/walkegnos-social-web-20-mapping-solution-generating-and-leveraging-brand-%E2%80%99EGNOS-powered%E2%80%9D>

Total Cost: € 450 853
EU Contribution: € 296 980
Start Date: 04.01.2012
End Date: 03.01.2014
Duration: 24 months
Coordinator: Istituto Superiore Mario Boella
pini@ismb.it



PROFESSIONAL AND SCIENTIFIC APPLICATIONS

The scientific community has been actively and intensively using GNSS since its advent. Satellite Navigation by itself has revolutionised certain areas of activity, such as surveying techniques, and has enabled scientists to realise applications that had not previously been feasible.

Galileo and EGNOS services represent a huge leap forward for scientific research in meteorology and geology in the field of geodesy, providing for the ability to track pollutants, dangerous goods and icebergs, to map the oceans and to study tides, currents and sea levels.

Both scientific and business communities will reap the benefits of high-accuracy Galileo timing signals, allowing precise adherence to international time standards, calibration of atomic clocks, and the most accurate time-stamping available anywhere.

EGNOS and Galileo's accuracy and integrity will add a new dimension of certainty and reliability to the most important of human scientific and professional endeavours.

To see the entire list of innovative projects in this area: Take a look at p.27 or visit <http://www.gsa.europa.eu/r-d/gnss-project-portfolio#prprscap>

A GNSS RECEIVER FOR SAFE INFORMATION RETRIEVAL

The loss of sensitive information stored on portable devices such as laptops and USB keys can have costly consequences. Businesses can lose the trust of their customers, governments can have classified documents revealed and individuals can have their identities stolen and their bank accounts emptied.

Passwords, cryptography and biometrics are among the means for preventing data from falling into the wrong hands. The EU-funded **TIGER** project is adding to this arsenal, creating a new security token with a built-in satellite navigation receiver that allows users to access information based on their location.

The 'Trusted Receiver' authenticates and protects the integrity of the data and signalling type so an attacker cannot get to confidential information.

For both positioning and authentication functions, the TIGER system uses Europe's EGNOS – and, in the future, Galileo – systems as both provide the necessary level of accuracy and authentication.

The result is a system that allows users to access information only if they are at a specified place, such as an office, home or event. If a person is travelling, access to content can be automatically activated on arrival at a predetermined location.

In addition to location-based access control, the system provides such functions as geo-encryption, an additional security layer that adds position, velocity and time to data encryption, a digital signature with location and time information, and an attestation or proof of position.

Other potential applications for the technology include improving security in road tolling applications, pay-as-you-go schemes, border control for sea vessels, and tracking hazardous materials. Banks, the military and governments are among the potential user groups.

<http://www.gsa.europa.eu/trusted-gnss-receiver-0>

Total Cost: € 389.986
EU Contribution: € 301.011
Start Date: 01.01.2009
End Date: 30.09.2010
Duration: 21 months
Coordinator: Alessandro Pozzobon, Qascom
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EXPLOITING GALILEO E5 FOR SCIENTIFIC ACCURACY AND PRECISION

While the wide availability of GNSS signals has been a boon to scientists around the world, the current paradigm among that community requires data from two-frequency receivers and prefers the use of carrier phase measurements for precise positioning applications.

The reasons are straightforward: using at least two frequencies can help eliminate errors created by ionospheric delays, while carrier phase measurements are resistant to such multipath effects as those seen in built-up urban environments.

Galileo will offer a dedicated signal superior to all other space-based signals – the E5 broadband signal – featuring low noise in the centimetre range, as well as the lowest multipath error impact ever observed, as low as a couple of centimetres.

The central goal of the **SX5** project was to develop software applications for precise positioning and ionosphere monitoring based on an E5 Galileo receiver, primarily targeting scientific users.

Parallel to the development of the scientific application software prototype, an E5 receiver adaptation based on existing receiver technology was undertaken. This led to a new reference receiver as well as a software-based receiver that synthesises E5a and E5b signals.

The project validated the new positioning solution using different stations in Europe and Africa.

The results show Galileo E5 data processing achieving positioning results with precision down to a few centimetres. Contrast that with results using the GPS L1 signal, which revealed only decimetre-level accuracy under the same conditions and processing methods.

Even more promising is a new E5-based position change detection application, making highly accurate landslide or glacier monitoring possible for the first time.

<http://www.gsa.europa.eu/scientific-service-support-based-galileo-e5-receivers>

Total Cost: € 882 942

EU Contribution: € 665 486

Start Date: 01.02.2010

End Date: 30.04.2012

Duration: 27 months

**Coordinator: Torben Schueler, Universitaet der Bundeswehr Muenchen
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GRAVIMETRIC SURVEYING WITH ADVANCED EUROPEAN SATELLITE TECHNOLOGIES

Gravimetry is the measurement of a gravitational field's strength. Scientists use gravimetric measurements to map the deep structure of the Earth's mantle, for example, or to probe hazardous volcanic regions. By combining gravity data with information about sea surface height from satellite systems, scientists can track the direction and speed of geostrophic ocean currents.

The aim of the EU-funded **GAL** project has been to include EGNOS and GOCE differentiators to develop a state-of-the-art method for building precise and high-resolution gravity field models based on airborne surveys.

GOCE is the Gravity Field and Steady-State Ocean Circulation Explorer, the first of the European Space Agency's Living Planet Programme satellites intended to map in unprecedented detail the Earth's gravitational field.

Airborne gravimetry is considered an efficient and cost-effective means of providing accurate high-resolution gravity data. The GAL project has shown that by using Galileo, EGNOS and GOCE, the accuracy of these surveys can be greatly improved.

The valorisation of European assets, namely GOCE, EGNOS and Galileo, for the development of innovative methods for precise and high-resolution gravity measurement is of strong scientific and public interest. It will allow new and poorly covered areas to be surveyed in an effective way, delivering new insights into the behaviour of oceans and Earth.

Over the past decade, the particular limitations of the GPS system, including the need for dense ground infrastructure, have strongly curtailed the operational exploitation of GNSS in airborne gravity surveys, so the GAL project truly represents a major step forward in this important field.

<http://www.gal-project.eu/>

<http://www.gsa.europa.eu/gal-galileo-gravity>

Total Cost: € 1 358 218

EU Contribution: € 864 000

Start Date: 01.01.2012

End Date: 14.02.2014

Duration: 26 months

**Coordinator: Angelo Amodio, Galileian Plus
aamodio@galileianplus.it**



EDUCATION...

European investment in GNSS is creating a raft of economic opportunities as new navigation products, applications and services come on stream.

More than ever, it is vital that the education system that will leverage the opportunities offered by Galileo and EGNOS is provided to the young engineers and entrepreneurs.

Europe needs to remain at the forefront in GNSS education, supporting more intensive collaboration across research groups at universities, research institutes and in industry.

...AND INTERNATIONAL COOPERATION

The EU is currently supporting a number of satellite navigation-related activities beyond its own borders, confirming its commitment to the deployment and exploitation of European GNSS worldwide.

EU-funded projects involve training and demonstration activities geared towards the benefit of Europe's potential international partners, while seeking to expand existing cooperative actions that will solidify Europe's place on the GNSS landscape.

To see the entire list of innovative projects in these areas: Take a look at p.25 or visit <http://www.gsa.europa.eu/r-d/gnss-project-portfolio#edinsu>

TRAINING AND COLLABORATION IN SOUTH-EAST ASIA

South-East Asia is one of the most dynamic economies in the world – a position it looks set to maintain into the foreseeable future. Although the region is already benefiting from the advent of new GNSS-based technologies having an impact on a whole range of commercial and public sectors, the countries in the region lack their own satellite navigation capabilities and thus depend on other national or regional systems.

The EU-funded **SEAGAL** project aimed at setting up a European GNSS collaboration centre dedicated to answering educational, commercial and technical needs in South-East Asia, particularly with respect to EGNOS and Galileo.

The International Centre for Satellite Navigation Technology R&D in South-East Asia, also known as 'NAVIS', is based Hanoi, Vietnam. The Centre's mission is to serve as a link between Europe and South-East Asia, and it has quickly developed into a key asset for the promotion of European GNSS technology across the entire region.

NAVIS undertakes research, training and awareness initiatives done in collaboration with a growing network of international institutions from South-East Asia, Asia-Pacific and Europe.

NAVIS also provides support to regional policy makers on GNSS technical issues, with particular attention given to the development of regulations and standards.

<http://www.g-navis.eu/>

<http://www.gsa.europa.eu/south-east-asia-centre-european-gnss-international-cooperation-and-local-development-0>

Total Cost: € 544 594
EU Contribution: € 459 476
Start Date: 15.03.2009
End Date: 14.11.2010
Duration: 20 months
Coordinator: Gabriella Povero,
Istituto Superiore Mario Boella
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SUPPORT FOR EUROPEAN COURSEWORK IN GNSS

European institutes of higher learning, universities and technical schools offer a wide range of GNSS-related courses for budding technicians and engineers. However, until recently, there has been a lack of training for professionals, meaning that compared to North America and Pacific Rim countries, fewer European doctoral-level students choose to study GNSS.

The objective of the **G-TRAIN** project is to strengthen GNSS-related education in Europe, and in particular higher education.

The project promoted better coordination and upgrading of already existing educational initiatives, and it helped create new opportunities for networking among students and teachers.

G-TRAIN supports a range of educational opportunities at different levels to cover the diverse needs of all GNSS sectors. As a direct result, Europe's GNSS-related academic programmes now differ in scope and characteristics, coverage and focus, complexity and organisation.

Concrete achievements include the creation of a 'Master of Science in GNSS' qualification, support for a 'Specialising Master's' qualification for long-term professional education, and support for PhD training and networking.

The final result is a fully-fledged and working network of universities offering courses in satellite navigation and encompassing educational institutions extending well beyond the initial project partnership.

<http://www.gsa.europa.eu/g-train-supporting-education-and-training-gnss>

Total Cost: € 558 587

EU Contribution: € 543 736

Start Date: 18.01.2010

End Date: 17.01.2013

Duration: 36 months

Coordinator: Dovo Fabio, Politecnico di Torino
fabio.dovo@polito.it

JOINING FORCES FOR GNSS INNOVATION

The European Satellite Navigation Competition (ESNC) is a leading platform for new GNSS business ideas and applications at regional and European levels. The awards are prestigious and highly visible and the event serves as the innovation launching pad for satellite navigation in Europe.

Meanwhile, the European Network of Living Labs (ENoLL) stands as a collection of unique, open, innovation platforms helping to support the development, prototyping and testing of new products and services.

Enter the EU-funded **GAINS** project, which cleverly brought the two initiatives together by creating a special Living Lab Prize within the European Satellite Navigation Competition, with three winning submissions getting the opportunity to conduct a 'reality check' trial in a suitable Living Lab.

Since its introduction in 2010, the Living Lab prize has been awarded to the best ideas for new businesses that respond to actual market needs.

The aim is to create a veritable 'innovation highway', guiding a stepwise process of coordinated Galileo downstream innovation – from idea recognition to product and services development through to new venture creation.

The joining of ESNC and ENoLL closes the gap between idea generation and application development, facilitating the performance of pilot tests in real-life settings.

<http://www.esnc.info/index.php?kat=special-prizes.html&anzeige=llp.html>
<http://www.gsa.europa.eu/galileo-advanced-innovation-services>

Total Cost: € 1 104.880

EU Contribution: € 877.684

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GNSS PROJECT PORTFOLIO

AVIATION	
GIANT-2	EGNOS Adoption in the Aviation Sector [FP7 - 1 st Call]
HEDGE	Helicopters Deploy GNSS in Europe [FP7 - 1 st Call]
ACCEPTA	ACCElating EGNOS adoPTion in Aviation [FP7 - 2 nd Call]
CLOSE SEARCH	Accurate and safe EGNOS-SoL navigation for UAV-based low-cost SAR operations [FP7 - 2 nd Call]
FilGAPP	“Filling the gap” in GNSS Advanced Procedures and operations [FP7 - 3 rd Call]
HEDGE NEXT	Helicopter Deploy GNSS in Europe – NEXT [FP7 - 3 rd Call]
LOGAM	Low cost GNSS attitude and navigation system with inertial MEMS aiding [FP7 - 3 rd Call]
SHERPA	Support on Pre-operational Actions in GNSS [FP7 - 3 rd Call]

AGRICULTURE	
FieldCopter	FieldCopter GPS-EGNOS based Precision Agriculture using unmanned aerial vehicles [FP7 - 3 rd Call]
GEOPAL	GNSS-based Planning system for Agricultural Logistics [FP7 - 3 rd Call]
UNIFARM	GNSS User Forum on Navigation based Innovation for Farmers [FP7 - 3 rd Call]

ROAD	
GINA	GNSS for INnovative road Applications [FP7 1 st Call]
GSC	GNSS-enabled Services Convergence [FP7 1 st Call]
GALAPAGOS	GALileo-bAsed seamless and robust Positioning Applications for loGistics Optimation proceSses [FP7 1 st Call]
GSW	Galileo Speed Warning [FP7 1 st Call]
SIGNATURE	Simple GNSS Assisted and Trusted Receiver [FP7 1 st Call]
SCUTUM	SeCUring the EU GNSS adopTion in the dangeroUs Material transport [FP7 2 nd Call]
COVEL	Cooperative Vehicle Localization for Safe and Sustainable Mobility [FP7 2 nd Call]
GNSSmeter	GNSS-based metering for vehicle applications and value added road services [FP7 2 nd Call]
ERSEC	Enhanced Road Safety by integrating Egnos-Galileo data with on-board Control system [FP7 2 nd Call]
GENEVA	Galileo / EGNOS Enhanced Driver Assistance [FP7 2 nd Call]
PUMA	Precise and secUre autoMative trAcking [FP7 2 nd Call]
DETECTOR	Detection, Evaluation and Characterisation of Threats to Road applications [FP7 3 rd Call]
Easy-OBU	Enhanced (EGNOS/EDAS) Accuracy SYstem with GNSS Outage Bridging Unit [FP7 3 rd Call]
GAIN	GAIN - Galileo for Interactive Driving [FP7 3 rd Call]
OCD	OpenCarData [FP7 3 rd Call]
QualiSaR	Development of a Qualification Procedure for the Usage of Galileo Satellite Receivers for Safety Relevant Applications [FP7 3 rd Call]
TACOT	Trusted Multi-Application Receiver for Trucks [FP7 3 rd Call]
TAXISAT	A new TAXI application guided by SATellite [FP7 3 rd Call]

LBS	
MUGGES	MOBILE USER GENERATED GEO SERVICES [FP7 1 st Call]
OPTI-TRANS	Optimised Transport System for Mobile Location Based Service [FP7 1 st Call]
IEGLO	Infrastructure-based EGNOS/Galileo receiver for personal mobility [FP7 1 st Call]
ImaGeo	ImaGeo: Accurate geotemporal coding in Photos [FP7 1 st Call]
MetaPos	MetaPos: a meta-service integrating diverse position determining technologies for LBS [FP7 1 st Call]
TIGER	Trusted GNSS Receiver [FP7 1 st Call]
LIVELINE	Live ICT Services Verified by EGNOS to find Lost Individuals in Emergency situations [FP7 2 nd Call]
PERNASVIP	PERsonal NAVigation System for Visually disabled People [FP7 2 nd Call]
LS4P	Livesailing For Professionals [FP7 2 nd Call]
INCLUSION	Innovative LBS for social/public dimension [FP7 2 nd Call]
ATLAS	Autenticated Time and Location for Location Based Application and Services [FP7 2 nd Call]
SMART-WAY	Galileo based navigation in public transport systems with passenger interaction [FP7 2 nd Call]
CEWITT	Low Cost and low Energy GNSS-based Wireless Tag for asset Tracking and monitoring [FP7 3 rd Call]
I-Going	Setting the path for mass market use of Indoor Galileo Operations [FP7 3 rd Call]
POSSUM	Position-based Services for Utilities Maintenance teams [FP7 3 rd Call]
STON	Security Technologies based on location [FP7 3 rd Call]
WalkEGNOS	WalkEGNOS: a social web 2.0 mapping solution generating and leveraging on the brand EGNOS Certification Inside [FP7 3 rd Call]

EDUCATION, INNOVATION AND SUPPORT	
PEGASE	Provision of Expertise to GSA And Support to Enabling activities [FP7 1 st Call]
GACELA	GALILEO Centre of Excellence for Latin America [FP7 1 st Call]
SEAGAL	South East Asia centre on European GNSS for international cooperation And Local development [FP7 1 st Call]
G-TRAIN	G-TRAIN: Supporting Education and Training in GNSS [FP7 2 nd Call]
GAINS	Galileo Advanced INnovation Services [FP7 2 nd Call]
GENIUS	GNSS Education Network for Universities and Industries [FP7 3 rd Call]
SUNRISE	Strengthening User Networks for Requirement Investigation and Supporting Entrepreneurship [FP7 3 rd Call]
AiA	Awareness in Africa: Disseminating Knowledge on EGNOS and Galileo in Africa to Foster Local and Regional Development [FP7 3 rd Call]
CALIBRA	Countering GNSS high Accuracy applications Limitations due to Ionospheric disturbances in Brazil [FP7 3 rd Call]
EEGS2	EGNOS extension to Eastern Europe: Applications [FP7 3 rd Call]
GNSS.asia	GNSS in Asia - Support on International Activities [FP7 3 rd Call]
G-NAVIS	Growing NAVIS [FP7 3 rd Call]
SATSA	SBAS Awareness and Training for South Africa [FP7 3 rd Call]

OTHER TRANSPORT

GRAIL-2	GNSS-based ATP System for Railway Low Density Lines [FP7 2 nd Call]
SafePort	Safe Port Operations using EGNOS SoL Services [FP7 2 nd Call]
CoSuDEC	Coastal Surveying of Depths with EGNOS to Enhance Charts [FP7 2 nd Call]
GaLoROI	Galileo Localization for Railway Operation Innovation [FP7 3 rd Call]
GLOVE	Joint Galileo Optimization and VANET Enhancement [FP7 3 rd Call]
GSP	Galileo Signal Priority [FP7 3 rd Call]
MEDUSE	Marine Park Enhanced applications based on Use of integrated GNSS Services [FP7 3 rd Call]
SATLOC	Satellite based operation and management of local low traffic lines [FP7 3 rd Call]

RECEIVERS*

PRECISIO	Professional Receivers via Software Radio [FP7 2 nd Call]
ART-X	Advanced Receiver Terminal Extension to Technoly and Market Evolution [FP7 2 nd Call]
ATENEA	Advanced Techniques for Navigation Receivers and Applications [FP7 2 nd Call]

PRECISION, PROFESSIONAL AND SCIENTIFIC APPLICATIONS

GalileoCast	Innovative Forecast and Broadcast Applications with Galileo [FP7 1 st Call]
MOW-BY-SAT	MOWing the lawn BY SATellite [FP7 1 st Call]
GOLDEN-ICE	ImprovInG the efficiency Of saLt-spreaDing (de-icing) sERVICES and emergeNcy call managment on winter professional vehiCles using Egnos [FP7 2 nd Call]
CIGALA	Concept for Ionospheric-Scintillation Mitigation for Professional GNSS in Latin America [FP7 2 nd Call]
ENCORE	Enhanced Code Galileo Receiver for Land Management in Brazil [FP7 2 nd Call]
ASPHALT	Advanced Galileo Navigation System for Asphalts Fleet Machines [FP7 2 nd Call]
SX5	Scientific Service Support based on GALILEO E5 Receivers [FP7 2 nd Call]
I2GPS	Integrated Interferometry and GNSS for Precision Survey [FP7 2 nd Call]
COSMEMOS	COoperative Satellite navigation for MEteo-marine MOdelling and Services [FP7 3 rd Call]
E-TRACK	EGNOS and EDAS Enhanced Tracking of Animal Movement and Behaviour [FP7 3 rd Call]
GAL	Galileo for Gravity [FP7 3 rd Call]
Handheld	Handheld device with innovative compact antenna for professional GNSS applications [FP7 3 rd Call]

PRS

ARMOURS	Antenna and Front-End Modules for Public Regulates Service applications [FP7 3 rd Call]
PREMISE	PRS receivers with EMbedded hardware Intrinsic Security Enhancements [FP7 3 rd Call]
ULTRA	Ultra Low Cost PRS Receiver [FP7 3 rd Call]

* Projects managed by the EC

SYSTEM INFRASTRUCTURE & EVOLUTION

EEGS	EGNOS Extension to Eastern Europe [FP7 2 nd Call]
EESA	EGNOS Service Extension to South Africa [FP7 2 nd Call]
SIRAJ	SBAS Implementation in the regions ACAC and ASECNA [FP7 2 nd Call]
GSARSED	GALILEO SAR Service Early Demonstration [FP7 2 nd Call]

NOTES



For a detailed description of the projects, download the App:
www.gsa.europa.eu/rd-for-galileo-egnos-app



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www.youtube.com/user/egnos1



<http://www.gsa.europa.eu/r-d/gnss-project-portfolio>

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