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Mid-term review of the European satellite radio navigation programmes

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**REPORT FROM THE COMMISSION
TO THE EUROPEAN PARLIAMENT AND THE COUNCIL**

Mid-term review of the European satellite radio navigation programmes

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Introduction

This report constitutes the annual report and mid-term review provided for by Article 22 of Regulation (EC) No 683/2008 (hereinafter 'the Regulation'). It takes stock of the progress made on the programmes and sets out the challenges ahead.

The figures in this report concerning the period after 2013 are provided for information only. They are without prejudice to the Commission's final decision concerning the ultimate content and structure of the programmes. In 2011 the Commission will table a legislative proposal thereon, in the context of the preparation of the future multiannual financial framework.

The figures presented also assume that the systems will be built to deliver all the services in accordance with Regulation (EC) No 683/2008. Other options will be examined as part of the impact study preceding the legislative proposal concerning the programmes.

The European satellite radio navigation programmes commenced more than 10 years ago on the basis of a political vision to develop and operate a global system that would allow the European Union (hereinafter 'the EU') to pursue the economic and strategic benefits thereof, achieve autonomy with respect to the systems of the USA and Russia and provide satellite navigation services optimised for civil use.

When the key reform of the programmes took place in 2007 the Council and the European Parliament decided to stop the public-private partnership negotiations and reaffirmed the need to establish a European satellite radio navigation system on the basis of full public-sector financing and risk management, emphasised its strategic importance and stressed its added value in economic terms. Ensuring the independence and autonomy of the EU in such a crucial sector is both an imperative and an ambitious goal.

Such a public commitment to high-performance satellite radio navigation services creates major expectations, on a worldwide scale, on the part of users and service providers. The new generations of such services offer substantial prospects in all fields of activity: many new jobs are bound up with the expansion of markets, which have grown at an annual rate of 30% over the past few years. It is estimated that, already, 6-7% of GDP in Western countries, i.e. € 800 billion in the European Union, is dependent on satellite radio navigation. The promotion of this technology, which is a powerful driver for emerging from the crisis, fits in perfectly with the Europe 2020 strategy and policies for sustainable development. For instance, as part of Europe 2020's flagship initiative 'An Industrial Policy for the Globalisation Era' the Commission is responsible for developing 'an effective space policy to provide the tools to address some of the key global challenges and in particular to deliver Galileo'.

The 2007 governance reform was recognised as an innovation in the history of European integration; on the one hand, it entrusted the ownership of the infrastructure resulting from the Galileo and EGNOS programmes, both of which are integral parts of trans-European networks, to the EU, and on the other, it made the Commission, representing the EU,

responsible for managing those programmes. Bearing in mind the scale and impact of the decisions to be taken, both with regard to security and in terms of the international, financial and industrial dimensions, the Commission, as a public institution with political responsibility, was the self-evident choice.

In accordance with its remit the Commission considers that it has sufficient material available to provide useful information for the European Parliament and the Council, via this report, on the progress of the projects.

1. HOW THE PROGRAMMES HAVE DEVELOPED SINCE 2007

When the Commission took over responsibility for managing the Galileo and EGNOS programmes in 2008, they were experiencing significant cost overruns and delays, as well as serious governance problems. Significant progress has been made over the last three years, despite the difficulties involved in managing such projects, as a result of the action taken by the various stakeholders, including partners in industry, and support from the Member States, the European Parliament and the Council.

The Galileo Interinstitutional Panel has monitored the process and ensured close cooperation between the Commission, the European Parliament and the Council, in keeping with the challenges facing the programmes. This panel, together with the various parliamentary committees, has regularly been kept informed of the progress being made with the projects. Given what is at stake, and even though the Commission remains responsible for management, the three institutions must work together as partners, and they share the ultimate political responsibility

1.1. The main achievements

1.1.1. Establishment of the new governance framework

The Regulation lays down a clear governance and financing framework, ensuring effective management of the current phases of the programmes. The Commission is responsible for managing them, and this includes 'all questions relating to the security of the systems'. The two other main players are the European Space Agency (hereinafter 'ESA') and the European GNSS¹ Agency (hereinafter 'the EU Agency').

The role of manager of major industrial programmes leading to the creation of public strategic space infrastructure is a new departure for the Commission. It has had to acquire the requisite expertise and reorganise some of its departments in order to carry out this priority task. It has also called upon a team of independent experts in the field of project management, as it had undertaken to do. In addition, in accordance with Article 15 of the Regulation it has adopted a strategic framework² including the main actions, the estimated budget and the corresponding timetable necessary to meet the objectives laid down by the Regulation.

¹ GNSS: global navigation satellite system.

² C(2008) 8378, 12.12.2008.

The Member States have been closely involved with the management of the projects, through their participation in the Committee on European GNSS Programmes and in various working parties such as the expert group on the security of European systems.

The role of ESA, the technical expertise of which is irreplaceable within the EU, has been defined by two delegation agreements concluded between it and the EU, one on the performance of the industrial work relating to the Galileo deployment phase, and the other to tackle the obsolescence of the EGNOS infrastructure and ensure that this system is regularly updated.

Finally, the new Regulation (EC) No 912/2010 provides a framework for the EU Agency's activities in line with the Regulation. Important tasks such as security accreditation for the systems and management of the security centre now have a firm footing.

1.1.2. Detailed management of each programme

1.1.2.1. The EGNOS programme

EGNOS, which reflects EU expertise in satellite radio navigation, is a completely separate system which will need to exist side by side with Galileo in the long term. It already has several major user communities in the spheres of agriculture, civil aviation, personal assistance, geopositioning in mobile telephony, cartography, etc.

On 1 April 2009 the EU, represented by the Commission, became the owner of all the tangible and intangible assets associated with the EGNOS programme which had hitherto been held by ESA. This acquisition was an essential preliminary to the operation of the system.

The EGNOS open service officially became operational on 1 October 2009. The system has operated since then in accordance with the requisite specifications. It is operated by a service provider (hereinafter 'ESSP') under contract to the Commission. The main subject of the contract is the uninterrupted provision of the open service and of the safety-of-life (hereinafter 'SoL') service.

A milestone was reached in July 2010 with the certification of ESSP under the regulations governing the single European sky. The period for finalising the EGNOS system should be completed in the near future and the SoL service for the needs of civil aviation should be declared open in early 2011.

In addition, it is planned to extend the area covered by EGNOS services gradually to include all the countries belonging to the European Civil Aviation Conference. Studies are also continuing into extending coverage into Africa, the Arab countries and the countries immediately to the east of the European Union.

1.1.2.2. The Galileo programme

Where the development phase is concerned, the two experimental satellites, Giove A and Giove B, are operating very satisfactorily. They have made it possible to validate the technology for the subsequent satellites and ensure the use of the frequencies allocated to the Galileo programme by the international authorities.

In addition, the assembly of the first four satellites in the future constellation, which will be launched in 2011-2012 as ESA has confirmed, is currently being completed. The creation of the terrestrial element of the infrastructure is continuing in parallel; this involves choosing sites and building a large number of stations spread across a number of countries and regions of the world: Belgium, France, Italy, Germany, Spain, the Netherlands, the United Kingdom, New Caledonia, Réunion, French Guyana, Tahiti, Sweden, Norway, the United States, Antarctica (Troll, Adélie Land), etc.

Work on the deployment phase was launched in 2008 and is proceeding actively. This work has been divided up essentially into six packages, each of which is the subject of a public procurement procedure. Competitive dialogue with the tendering firms is a key element in the procedures which have been launched.

As a result, the first four contracts, with a total value of around € 1 250 million, were awarded in 2010; they are for the packages covering system engineering support, satellite construction (with an initial order for 14 satellites), launchers (for the launch of 10 satellites, but with options for additional launches) and operations, respectively. The other two packages, relating to ground infrastructure, will be awarded in 2011. The contracts for additional equipment and facilities will also need to be awarded in the course of 2011. For those contracts where there was competitive supply, savings have been possible with respect to original estimates, whereas this was not the case in monopoly situations.

The work begun under these public procurement procedures already involves several hundred firms, located in most of the Member States, employing thousands of highly qualified staff for that purpose. The Commission has also been keen to comply with the 40% figure referred to in Article 17(3)(c) of the Regulation, which is intended to give a broad swathe of the EU's industrial network the opportunity to take part in the programmes. However, since not all the packages have been awarded as yet, and not all the subcontractors are known, it is not possible to give precise figures at this stage. In any case, a tightly-woven industrial network as well as many scientific communities throughout the EU are now actively involved in all the activities associated with satellite radio navigation and the associated downstream markets.

Finally, where the public regulated service (hereinafter 'the PRS') is concerned, the Commission has tabled a proposal for a decision of the European Parliament and of the Council on the detailed rules for access to this service, focusing on security issues. Adoption of the decision is an essential preliminary to the provision of the service. The Commission, in cooperation with the EU Agency, will also set up pilot projects to test and validate the procedures and mechanisms envisaged by the proposal for a decision, using practical cases selected in agreement with the Member States.

1.1.3. Horizontal action

On the international front, the compatibility and interoperability of the systems are the focus of complex discussions with China, the United States, Russia, India and Japan, and also within the United Nations. With regard to China, the question of the overlay of frequencies is a major problem for the security of the EU and the Member States; despite the commitment of the Member States and the Commission it has not

yet been resolved, and a solution will not be found without political support from those players and from the European Parliament.

The global and regional systems developed by the USA, Russia, China, Japan and India provide a challenge for the European programmes not only in terms of frequency compatibility and interoperability, but also in competitive terms, so that it is now important for these programmes to culminate speedily in the provision of high-quality services in order to ensure efficient market penetration.

Within the European Economic Area, as from 2010 Norway has enjoyed treatment comparable to that of an EU Member State, while negotiations with Switzerland are also making progress.

Where the development of downstream markets is concerned, in June 2010 the Commission adopted a GNSS Applications Action Plan to promote the use of satellite radio navigation in what it considers to be priority fields. It is important to implement it, so as not to establish an infrastructure with no users, which would encourage the continuation of EU dependence on foreign military systems through the applications that they offer.

Global navigation satellite systems make it possible to deliver positioning and timing information worldwide. They are a catalyst for a multitude of economic activities, leading to the creation of wealth in e.g. the fields of personal mobility; civil aviation, particularly at regional airports and heliports; civil protection, emergency services especially in the event of floods, earthquakes and terrorist attacks; humanitarian aid; tracking of ships, trains, trucks and containers; guiding people with reduced mobility; hazard localisation; precision agriculture; search and rescue services; dangerous goods tracking, land plot identification and field measurements, particularly for the common agricultural policy; energy grids and telecommunications network synchronisation; protection of sensitive infrastructure; time-stamping of financial transactions. Moreover, in the context of EUROSUR, there are plans to establish an operational service for the use of earth observation satellites for border surveillance (GMES programme). Galileo and EGNOS could profitably be used to provide information on the exact positioning of inspection teams.

Upstream, the construction and deployment of the European systems are generating direct benefits for hundreds of companies throughout the EU, involving thousands of highly skilled jobs. Downstream, the proliferation of applications associated with satellite radio navigation represents a unique opportunity for growth for firms. The indirect socioeconomic benefits are set out in 2.2.5. below and detailed in the Annex.

In addition to a number of regulatory measures, the action plan also includes research and innovation incentives, particularly for SMEs, and standardisation, coordination and accreditation measures for aviation and maritime transport, among others. It also encompasses information activities targeted at industry and users. For instance, the technical documentation for building Galileo receivers has to be updated on a regular basis. In this connection the Commission expects that as from 2014, as a result in particular of the GPS interoperability agreement, at least 80% of the GNSS receivers in operation around the world will use the European satellite radio navigation system.

With regard to activities relating to applications development and receiver technology, three calls for proposals have been issued under the Seventh Framework Research and Development Programme, with a total value of around € 120 million. The first two calls made it possible to fund around 100 projects, the preliminary results of which were presented in March 2010. The third and final call is currently open.

Finally, ESA is carrying out work, as part of a specific optional programme, on the development of technologies for future infrastructure.

1.2. The experience gained: assessment of overall progress made

The remit given to the Commission by the Regulation goes well beyond its customary activities relating to industrial, infrastructure or research projects, in which it is usually involved only through grants, and not as the main player.

To ensure that the programmes continue to run satisfactorily, the Commission has worked out an approach which is appropriate for the management of an industrial project, on the basis of the work carried out by its various departments and despite the rigid nature of the rules it is required to follow. The experience gained since 2007 will enable it to make further improvements to the management of the programmes and their uncertainties and also to risk management.

1.2.1. Management of the programmes

Internally, the Commission swiftly put in place a structure to manage the programmes in their current phase. In particular, it took over all those members of the EU Agency's staff with the skills needed to carry out its new remit, in order to ensure continuity in running the projects. It absorbed all these teams to manage every aspect of the programmes in accordance with the Regulation. It has also established a delegation agreement with ESA and a management plan, which together govern relations between the two organisations, and has managed to create the requisite synergies between itself, ESA and the EU Agency. It has also called on groups of experts from the Member States.

It should be borne in mind that the Commission has had to fill the highly qualified posts needed to ensure good management of the programmes. There have been limited opportunities for internal redeployment owing to the nature of the activities, and external recruitment procedures have been subject to stringent rules. Most of the staff ultimately recruited have the status of temporary staff with contracts running until 2013. It is essential to ensure their retention thereafter, since it is crucial to keep the acquired expertise for the continuation of the programmes.

The EU budgetary framework, springing as it does from a financial system with a limited time horizon, makes it difficult to carry funding over from one period to another and complicates long-term planning, which is, after all, essential for projects running over several decades. The Commission believes that thought must be given to setting up budgetary mechanisms and instruments to cope with this situation.

Externally, there are questions about the role of ESA and the impact of decisions concerning system security.

First, where Galileo is concerned, ESA has had to espouse a new role as prime contractor, following the disappearance of the ESNIS consortium. The new distribution of responsibilities, under which ESA has become *de facto* an implementing agency acting on behalf of the EU, is proving successful, but it will have to be adapted to programme developments and future operational challenges.

Secondly, with regard to EGNOS, its current operation involves the Commission as the programme manager, ESA as the technical player responsible for system design and development, and ESSP as the service provider. An integrated management model would make it possible to maintain the current teams in a more centralised set-up, in order to improve the understanding of the risks inherent in supplying EGNOS services and to ensure better coordination of the industrial activities which are currently split between ESA and ESSP.

It is also important to ensure that future developments of the system incorporate the experiences of the various user communities, especially the aviation sector, taking into account the work of the SESAR Joint Undertaking and that of the ESA development programme.

Finally, where security is concerned, it needs to be remembered that, while the Commission is responsible for the management and security of the systems under the Regulation, its freedom is constrained in this area in two ways.

- First, in reality it is the Member States which define security needs. The threats which might affect the security of sensitive infrastructure such as that supporting satellite radio navigation are constantly changing, and the design of the systems must constantly adapt to those changes. Covering part of such risks is a matter for the Member States.
- Secondly, the Regulation gives responsibility for accrediting the security of systems to the EU Agency. Separating the functions of management and accreditation in this way reflects good governance, and is standard practice and essential for this type of project.

In both cases the choices made or the decisions taken may have a considerable impact on the programmes' costs and schedules.

1.2.2. *Uncertainties of the programmes*

It needs to be emphasised that the existence of uncertainties is inherent in this type of complex programme. It requires an effective risk management system to be set up, and may result in difficult decisions being taken.

Starting with the Galileo development phase³, the transfer of project supervision to ESA, which was a consequence of the failure of the ESNIS industrial consortium, has led to delays and cost overruns owing to the need to renegotiate some contracts and the requirements associated with actually putting the new arrangements in place.

³ The Regulation defines the development phase as comprising 'the construction and launch of the first satellites, the establishment of the first ground-based infrastructures and all the work and operations necessary to validate the system in orbit'.

In addition, it has proved necessary to launch a second experimental satellite in order to retain the use of the frequencies allocated within the International Telecommunications Union. Finally, the timetable and costs have been revised as a result of technical constraints relating in particular to the finalisation of certain security-related aspects and the delays associated with setting up contracts for the deployment phase.

The additional cost of the development phase amounts to some € 500 million in total. At the request of the Member States the Commission has agreed to bear this cost so as to ensure the continuity of the programme. Validation of the system in orbit is the keystone of the Galileo programme, of course, and a lack of financing would have jeopardised its continuation, with a loss of industrial know-how and of equipment already partly built.

Turning to the deployment phase, the decision to opt for competitive dialogue has proved successful. Competitive tendering has made it possible to keep up competitive pressure on tenderers. However, where this is not the case the monopoly situation in which some players have found themselves has led to increased prices. The price of launch services, for example, has entailed an additional cost of more than € 500 million by comparison with the original budget⁴.

Moreover, the requirements of Galileo's SoL service are having an impact on the programme's funding needs, particularly with regard to the ground infrastructure. Studies to redefine this service are under way in order to adapt it to the new needs of users and new technological developments. The system also needs to be simplified, its risks and costs need to be reduced and its GPS compatibility needs to be improved. The decisions on these issues will have to be taken over the next few years.

Where EGNOS is concerned, maintenance requirements and the need to develop the system have resulted in excessive expenditure, while satisfactory geographical cover of the European zone has yet to be achieved.

To sum up, initial cost estimates have not been kept to because some risks, relating primarily to technical issues, security requirements and the situation in the market-place, have materialised during these very complex phases of the programme.

However, the steps taken by the Commission have reduced the impact of these problems. The ultimate objectives are not being called into question, because the budget available already encompasses the building and launch of 18 satellites, with the associated ground infrastructure, and the supply of the first services from 2014-2015. It also covers the initial operation of the EGNOS services. Studies currently under way are seeking to identify the best ways of carrying out the programmes in line with future budgets. The first aspects of those studies are set out in Section 2.2.

⁴ This situation in the market-place and its consequences will be examined more comprehensively as part of a future Commission communication on the development of European industrial policy for space.

1.2.3. *The risks involved*

The Commission has placed the issue of risk management, the importance of which was highlighted when the governance reform took place in 2007, at the heart of its work. All the risks relating to the programmes are recorded centrally in a register listing, in turn, those associated with the industrial supply chain, ESA, the EU Agency, external factors such as the influence of political authorities and security requirements, and internal factors such as the organisation of the programmes. Each risk is allocated a degree of probability and an impact rating. The risk register also includes a list of measures intended to reduce the probability of a risk materialising. The risks are classified as follows:

- Technological risks: satellite navigation uses leading-edge technology which has yet to be validated and the specifications of which are constantly evolving.
- Industrial risks: establishing the infrastructure involves many industrial players, in a number of countries, whose work has to be coordinated effectively in order to arrive at systems which are reliable and fully integrated, particularly with regard to security.
- Market risk: what has to be avoided is a technical performance that is inferior to that promised having a negative effect among users worldwide, and the infrastructure not being used as a result. In addition, the availability of reliable receivers as from 2014-2015 must be ensured for the various initial services to be offered by Galileo, especially the PRS.
- Timetable risk: any delay in implementation would jeopardise the window of opportunity and would be likely to generate cost overruns.
- Governance risk: governance of the programmes requires various bodies to work together, and an appropriate degree of stability and organisation has to be guaranteed. Moreover, differences of opinion between the various parties involved, and in particular between the Member States, have to be taken into account on several major issues. In this context the sharing of some risks, including financial and security-related risks, among those players who are best placed to cope with them, should be considered.
- Liability-related risk: as with any infrastructure the two European systems may cause direct or indirect losses to their users or to third parties. The analysis carried out by the Commission reveals that the current state of law applicable does not provide an appropriate legal framework ensuring a fair balance between the interests of the victims and those of the owners and operators of the European satellite radio navigation systems. Appropriate initiatives must therefore be taken, both in Europe and worldwide, to remedy this situation by 2014. The Commission is carrying out studies in this connection, in collaboration with other international bodies.

In the light of these risks the Commission is giving priority in its decision-making to meeting the deadline of 2014 for the permanent provision of the first Galileo services. In the longer term the ultimate objective remains, at this stage, the provision of high-quality services which are compatible with the provisions of the Regulation and with users' needs and are comparable with, or better than, those

provided by other systems. The decisions on security issues are being taken in close collaboration with the Member States.

1.3. Financial overview

The EU contribution to the Galileo and EGNOS programmes for 2007-2013 amounts to € 3.4 billion, in addition to which there is, *inter alia*, a contribution from Norway. This budget has been split across the three main activities, namely completion of the Galileo development phase (accounting for around € 600 million), the Galileo deployment phase (€ 2.4 billion), and the operation of EGNOS (around € 400 million).

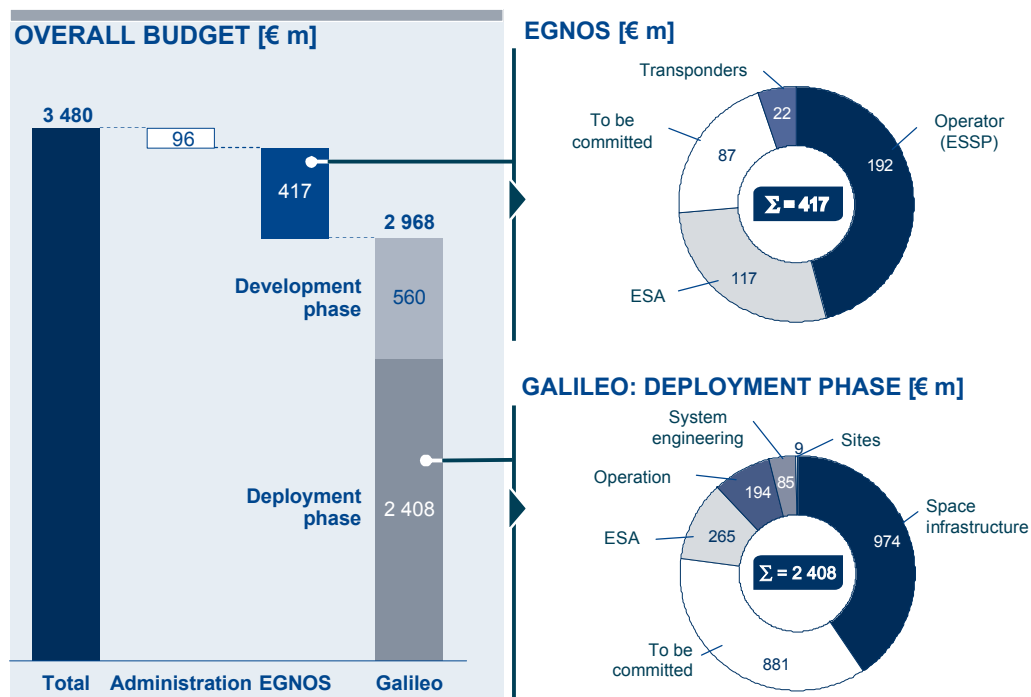
Where the deployment phase is concerned, around two-thirds of the budget has already been committed, mainly in connection with the procurement contracts signed in 2010. Apart from the contingency reserve, the remaining budget will enable the contracts for the last two packages, covering ground infrastructure, to be awarded.

With regard more specifically to the contingency reserve, a detailed assessment is being made of the needs to be covered. The budget headings to be funded will depend on the order of priority of the risks to be dealt with or on their actual occurrence. The main risks identified are connected with significantly reduced performance in the event of a restricted range of 18 satellites⁵ having to continue to be used, the non-availability of launch services, the impossibility of using certain selected sites, a lack of redundancy in the ground infrastructure, or even design and integration defects. Maintenance services will have to be contracted and spare equipment purchased so as to minimise breakdowns and cope with the system's obsolescence.

Where EGNOS is concerned, the budget allocated has essentially been used for the contract with ESSP and the delegation arrangement with ESA, in order to ensure the provision of services and the system's continued existence.

The amounts allocated to the Galileo and EGNOS programmes under the current financial framework are summarised in the table below.

⁵ As a result of satellite losses at launch or in orbit.



2. THE CHALLENGES AHEAD

The task assigned to the Commission by the Regulation consists in establishing the satellite radio navigation infrastructure supplying high-quality services, worldwide and regionally, in addition to the existing services. This ultimate objective remains unaffected, since if the quality of the services were called into question at all the immediate effect might be to destabilise the programme and cause market interest to dissipate.

It should be pointed out that these markets are growing rapidly, and that their annual turnover worldwide is expected to reach around € 240 billion by 2020. Moreover, as a result of the advantages of Galileo and EGNOS compared with the other competing systems, they are expected to generate economic and social benefits worth around € 60-90 billion⁶ over the next 20 years.

However, this assumes that the full Galileo infrastructure will be completed, and that operation of the systems will allow reliable service provision. Taking into account the cost overruns arising in the development and deployment phases (see 1.2.2. above), the Commission considers that additional funding of € 1.9 billion is needed to complete the infrastructure (see 2.2.1. below). The estimated average annual operating costs are around € 0.8 billion (see 2.2.2. below). Appropriate financing mechanisms should therefore be established.

⁶ Source: Market studies by the EU Agency (GNSS market monitoring and forecasting tools, 2010 figures). The total value of the net benefits generated by Galileo and EGNOS over the period 2010-2027 will depend upon the timing of Galileo's full operational entry into service. Each year's delay will decrease the value of the benefits by 10-15% owing to both the loss of revenue generated and the development of alternative solutions and competing systems.

Bearing in mind the current context, the Commission⁷ has not so far proposed the allocation of additional funding for the programmes under the current financial framework. This will entail probable delays of four years in completing the full infrastructure of the Galileo programme, and also additional costs.

In the absence of additional funding before 2014, the deployment strategy for the programmes must be redefined, incorporating the trade-offs between service performance and the associated costs on the one hand, and the need to provide a service of sufficient quality to maintain a place on the market on the other.

2.1. Short-term management of the programmes

In order to meet the expectations of the markets, the Commission has developed an appropriate approach, that of ensuring the launch of services as soon as possible and preparing the operational phase.

2.1.1. The need to launch the first services in 2014-2015

Worldwide annual turnover from products and services directly associated with satellite radio navigation was estimated at around € 130 billion in 2010. The corresponding markets will probably experience double-digit growth rates over the next few years, and the experts consider that they should be in excess of € 240 billion in 2020⁸. This remarkable growth is explained both by the progress made with receiver technology and by proliferating new uses which are generating increased consumer demand.

This strong growth in markets worldwide has been driven hitherto by the American system, GPS, alone. However, other global navigation satellite systems (hereinafter 'GNSS'), particularly the Russian and Chinese systems, are likely to enter service in the medium term. It is vital for the European system to establish itself as quickly as possible as the other major standard GNSS, alongside GPS, particularly where receiver manufacturers are concerned.

2.1.2. The initial operational phase

The public procurement contracts already awarded are enabling the Commission to adjust its approach to meet the deadline of 2014. Accordingly, the development and deployment phases will continue in parallel until 2012, when the development phase will be completed, and the exploitation phase for the first services will start in 2014.

A first stage will be the partial commissioning of the infrastructure (initial operational capability, or IOC) as from 2014-2015 and the provision of the open service, the search and rescue service and the PRS. At this stage, however, accuracy and availability will not yet have reached their optimum levels.

While this first stage will be sufficient to test the services it should nonetheless be as short as possible, because it will not allow the system's full potential to be exploited and will not meet the requirements of all users. This phase therefore needs to be

⁷ COM(2010) 700, 19.10.2010.

⁸ Source: EU Agency (2010) GNSS market monitoring report.

linked to a firm commitment by the Union concerning the completion of the infrastructure, in line with the Galileo programme's objectives, in order to give users confidence and encourage them to invest.

The Commission is also proposing that the EGNOS system be adapted so as also to improve the accuracy of the open service provided by the system resulting from the Galileo programme, in the same way as it is currently improving that of GPS. EGNOS is the only system that the EU will have to provide an SoL service over the next few years.

2.2. Long-term planning

The European GNSS has one prime advantage over other systems: it is the only one designed for civilian purposes and under civilian control. It has other potential advantages which should not be disregarded, such as its commercial service, which might make it possible to authenticate signals and further improve the accuracy of the open service. Finally, its open service complements, and is interoperable with, the American GPS, so that the combined use of the two systems will afford a degree of reliability and accuracy which is likely to fulfil most users' needs worldwide in the mass applications market.

However, most of these benefits will materialise only after the full infrastructure is complete.

2.2.1. Completing the infrastructure

As indicated under 1.2.2. above, € 3 400 million is not enough to complete the infrastructure resulting from the Galileo programme, owing to the increased cost of the development phase, the increased price of launchers, the lack of competition for the award of some packages, additional costs associated with the EGNOS programme and the consequences of funding being deferred until after 2013⁹.

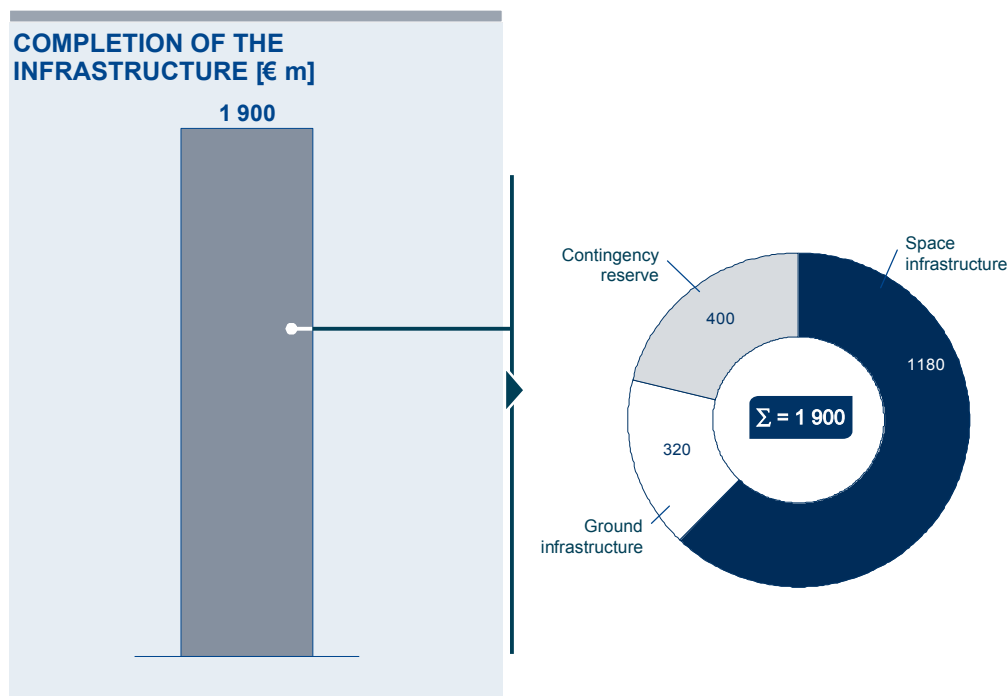
The Commission, after consulting ESA¹⁰, has carried out a number of studies to assess the costs of the systems. These analyses are based on the various possible scenarios for the procurement, deployment and operational cycles concerning the infrastructure, including maintenance and renewal, actual price quotations and experience with other space systems. They show that an additional financial injection of some € 1 900 million will be needed to complete the infrastructure of the Galileo programme. This amount would make it possible to set up a system providing the services defined in the Regulation, based on a constellation of 30 satellites.

This amount is needed to finance the satellites and launchers required to round off the Galileo constellation and complete the ground infrastructure so that the full range of services can be provided. As is customary with this type of high-risk industrial project, a reserve of around 20% has also been included to cover the uncertainties of the programmes, including the technical risks associated with the final integration phase. The table below summarises these funding requirements.

⁹ All these factors combined represent an amount equivalent to the additional funding needs.

¹⁰ Various meetings took place between the Commission and ESA, in particular over the summer of 2010.

It should be noted that additional analyses are being carried out to explore the possibility of limiting funding requirements, in particular by staggering the introduction of service provision and fine-tuning the SoL service.



2.2.2. Operating costs

The costs of operating the systems cover operational management of the infrastructure, management of the services and the replacement and renewal of components with a limited service life¹¹. They also include ongoing improvements to the systems so as to adapt services to the changing needs of users.

The estimates include a contingency reserve based on the risks inherent in high-technology programmes. However, some risks which would have an impact on the budget were they to materialise have not been taken into account, since the probability that they will occur is low. This is the case with changes in the security context, problems of interoperability with the other systems and technological risks such as the service life of the clocks used. Appropriate mechanisms need to be explored in order to avoid having to mobilise the corresponding funding.

Lack of funding for the operating costs would lead immediately to a reduction in the quality of the services or even their total disappearance, which would be incompatible with fulfilling the public service remit assigned to the systems.

The operating costs have been assessed in conjunction with ESA, and the results have been validated by experts from the Member States and other independent experts¹². The assessment shows that average annual operating costs amount to some

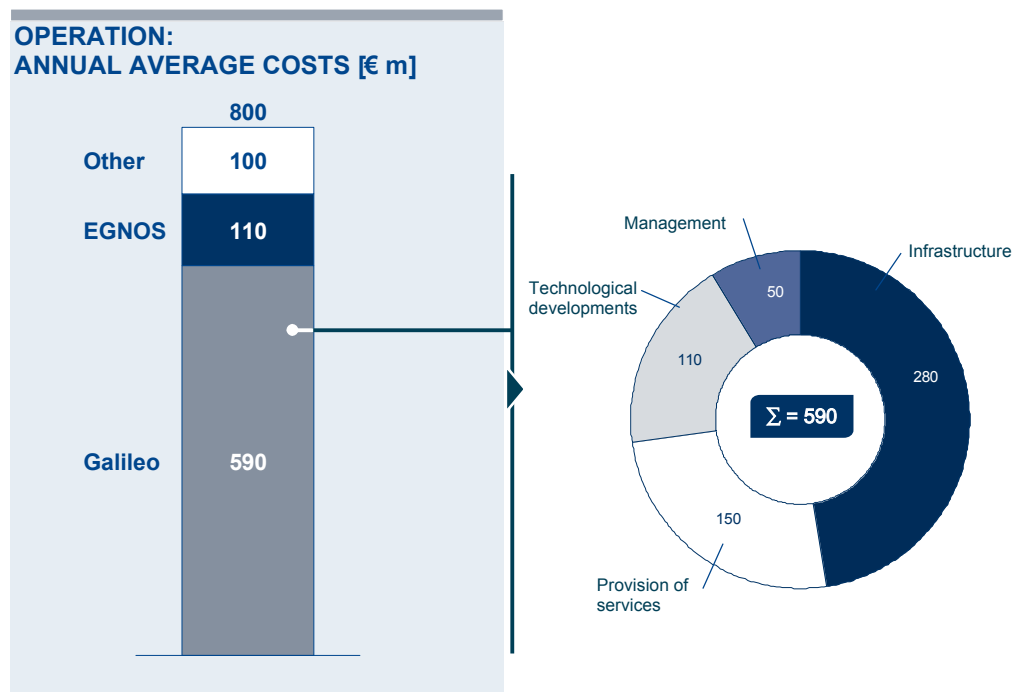
¹¹ The satellites are designed to have a 12-year service life. The service life of the ground infrastructure is shorter.

¹² These consultations took place over the summer of 2010 in connection with the study concerning the operation of the programmes carried out by independent consultants.

€ 800 million at 2010 prices, not adjusted for inflation, of which € 110 million is accounted for by EGNOS; the figure is based on a standard satellite life cycle of 12 years.

It should be noted that these costs will be lower in the early years of operation, after 2014-2015, since services will be introduced gradually as the infrastructure is completed. Consequently, they will cover only the costs of ensuring the satisfactory operation and maintenance of the infrastructure, service provision and the replacement of the first satellites at the end of their service life. Additional costs will arise subsequently from the development and commissioning of the new generations of systems.

The table below summarises the main components making up the average operating costs for the full infrastructure.



2.2.3. Research and development costs

Expansion of the downstream GNSS market lies at the heart of the generation of indirect added value by Galileo and EGNOS. The development and promotion of new applications need to be financed to ensure that European firms have sufficient penetration of, and are strongly positioned on, the markets for goods and services associated with satellite positioning. The requisite funding can be mobilised through instruments such as the Framework Research and Development Programme or the successor to the CIP.

2.2.4. Projected financing and timetable

As indicated above, the estimates made to date point to a requirement for around € 1 900 million in funding over the period 2014-2019 to complete the infrastructure associated with the Galileo programme. Added to this will be the operating costs of the system once it has become operational, i.e. as from 2014-2015.

Despite the use of public procurement procedures, in practice it has proved difficult not only to keep within the budgets set for the various work packages but also to obtain genuinely fixed prices from the industrial partners involved in the programmes. This arises from the complexity and specific nature of one-off systems, the components of which are being developed and built specifically for the EU's needs alone by a very small number of manufacturers. Furthermore, combining those components is a source of potential problems. In this context the need to limit financial slippage means that the main requirement is to reduce risk and adapt governance so as to ensure that the programmes are managed efficiently.

To that end, the Commission has strengthened its risk management system, as indicated above, as well as its controls with respect to costs and timetable compliance. It is essential to enhance the sense of responsibility of all stakeholders in the programmes in order to secure success.

Finally, the fundamentals of a robust governance structure, capable of dealing more satisfactorily in future with the risks of loss of control, are examined in more detail in 2.2.6. below.

In its Communication of 19 October 2010¹³ the Commission put forward an option whereby the EU budget would make a fixed contribution to major projects such as ITER and Galileo in the form of a predetermined annual amount; any overshoot of requirements would have to be covered by other sources of finance.

Where Galileo is concerned the Commission will continue to examine the various funding mechanisms which might be envisaged, taking into account, in particular, the Commission's working methods, the implications of each option for the various aspects of the programmes and the need to ensure that costs are kept under control and that activities continue as they should.

The solutions examined will also need to take into account the fact that the costs of the programmes can be grouped into three main categories:

- first, the costs of building the systems and the expenditure associated with maintaining and operating them; the latter can be estimated fairly accurately once the deployment phase has been completed;
- secondly, the costs relating to the uncertainties inherent in this type of complex programme, which may be covered by a 'contingency reserve' in accordance with normal practice; keeping costs under control during the various phases and making all those involved more aware of their responsibilities should make it possible to minimise such uncertainties;
- thirdly, the costs associated with the materialisation of major risks unconnected with the management of the programmes, such as those arising from serious technical design problems or from non-contractual liability being called into question; there is little likelihood of such risks actually occurring, but if they did the costs involved could not be covered by the reserve provided for.

¹³ COM(2010) 700.

Against this backdrop there are three possible options.

- The first would be to continue to fund the programmes in their entirety solely from the EU budget.
- The second option would entail the first two cost categories referred to above still being financed from the EU budget, with the Member States taking on the risks which are unconnected with the management of the programmes.
- The third option would be based on a fixed contribution from the EU budget, with the Member States being responsible for financing any balance.

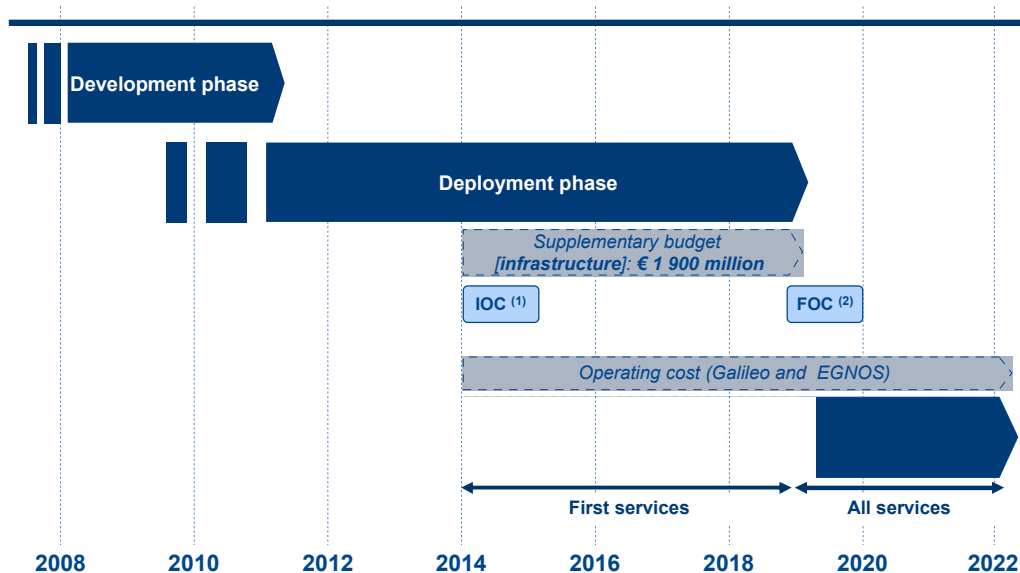
These options will be examined in detail in an impact study, and the solution ultimately chosen by the Commission will be included in the next legislative proposal to amend the Regulation.

At this stage, and subject to the conclusions of the studies referred to above, the Commission takes the view that it is not advisable to have all the costs and risks associated with the programmes borne solely by the EU budget. Bearing in mind the size of the EU budget, this arrangement might actually jeopardise EU funding of other priority projects or programmes. Moreover, the experience gained so far indicates that the option chosen should aim to increase the awareness of all the parties involved of their responsibilities with regard to keeping costs under control.

With regard to the implementation of the Galileo programme, the table below summarises the nominal timetable (without margins) for completion of the infrastructure and for its operation.

Galileo's Full Operational Capability (FOC) should be achieved in 2019-2020. It might change, depending on availability of financing, technical problems and industrial performance.

TIMETABLE FOR STAGES OF COMPLETION OF THE INFRASTRUCTURE ARISING FROM THE GALILEO PROGRAMME AND ITS OPERATION



(1) IOC: initial operational capacity
 (2) FOC: full operational capacity

2.2.5. *The prospects for profitability and indirect benefits*

The prospects for direct financial revenues for the EU generated by the operation of the systems are very limited, as was shown during the negotiations on a public-private partnership which took place between 2004 and 2007. This limited revenue potential undoubtedly contributed to the failure of those negotiations.

- The EGNOS and Galileo open services are not, and will not be, subject to any payment, in accordance with the Regulation and in line with the other systems which are already in use or which will emerge. These services are intended for mass applications, and it is important for them to be adopted by as many users as possible in order to optimise the expected economic and social benefits; this also fits in with the systems' public service remit. Setting a royalty on chips using Galileo or EGNOS signals, as was mooted, would run counter to that objective. The direct revenue that would be generated would be considerably less than the loss to the EU in terms of indirect revenue.
- The search and rescue service provided by the system resulting from the Galileo programme, constituting the European contribution to the COSPAS-SARSAT system, should also be free. There are no charges for using the space segment concerned or for receiving COSPAS-SARSAT alerts.
- Nor should the EGNOS SoL service, which was originally conceived primarily for civil aviation, generate any revenue in the long term. Introducing any form of payment arrangement would be very likely to act as a disincentive for potential users, since similar systems, such as WAAS in the United States, are provided free of charge. However, things might be different in future for the SoL service provided by the system resulting from the Galileo programme, in that part of its technical design would be the outcome of consultation with users to meet specific needs and, in addition, this service and its pricing would match those of GPS.

At this stage, in fact, only the commercial service and the PRS offered by the system resulting from the Galileo programme are likely to generate revenue, the annual amount of which could rise steadily to reach an average of around € 70 million in the long term. Such revenue will be maximised only in the long term. Moreover, the revenue generated by the PRS will depend on what will be essentially political decisions.

While the direct financial revenue generated by the systems seems fairly limited there are, by contrast, substantial economic and social benefits to be gained from these two sets of public infrastructure, comparable in a way to those arising from the spread of free Internet services: they are estimated at an aggregate of between € 60 and 90 billion for the period 2010-2027¹⁴. These benefits arise from the growth in downstream markets, the positive effects in terms of public utility such as greater transport efficiency or a reduction in the number of accidents, and the knock-on effects of the investment made in the whole of the space sector. Since the operation of the systems will constitute a public service, it is in the EU's interest to optimise

¹⁴ There is a correlation between the level of these benefits and the date of completion of the deployment phase. The most recent delays have therefore had a negative impact on the expected returns from the systems. See footnote 6.

these economic and social benefits, rather than to seek to maximise direct financial revenue. It also needs to be remembered that Galileo and EGNOS will have a significant positive impact on economic development and will stimulate growth.

2.2.6. *Governance of the programmes*

2.2.6.1. The Galileo deployment phase

The main purpose of the GNSS Regulation, which was recently supplemented by Regulation (EC) No 912/2010, was to establish a stable and effective governance framework for managing the development and deployment phases, based on an integrated model which included the delegation of tasks to ESA. Quite apart from the fact that this framework has proved satisfactory so far (although it could be improved), it would not be advisable to modify it to any major extent in the short or medium term.

Given that deployment will not be completed before the end of the decade, making any substantial changes to the governance arrangements before then would undoubtedly constitute a risk to the smooth running of the programme. Stability provides an assurance of continuity and consistency, first with regard to the activities of the various parties involved and secondly with regard to the various decisions taken throughout the whole period of operation of the programmes, and it also ensures the programmes' credibility in the eyes of third parties.

In its report published in 2009 the Court of Auditors highlighted the problems created by the over-frequent management changes which took place prior to 2007.

2.2.6.2. Operation of the infrastructure

Operational management, which includes infrastructure maintenance and renewal, has four components: design, construction, operations and service provision. The experience gained with EGNOS shows that management of these four components cannot be compartmentalised; on the contrary, integrated management is a must.

In any event, taking into account the experience gained with managing the programmes, it is already clear that operational management, in addition to bringing together the four components that it comprises, needs to comply with the following principles:

- it must be compatible with the EU's role as owner of the systems and that of the Commission as the organisation responsible for managing the programmes, with the Commission as the sole decision-making body;
- it must be based on a simple integrated model which provides a clear, single approach by the public sector;
- it must ensure a stable long-term framework; afford a degree of flexibility with regard to financial management and staff management; be organised on an effective, reliable and transparent basis; have clear procedures allowing swift decision-making;

- it must be able to retain all the expertise and knowledge built up in the course of the programmes; in particular, ESA know-how must be preserved;
- it must enhance the sense of responsibility on the part of industry and the prime contractor;
- it must ensure the independence of the activities concerning accreditation of the security of the systems;
- it must take due account of the public nature of the services provided
- it must be able to coordinate measures to protect the systems at European level, since they are highly sensitive.

This entails entrusting operational management to a support structure under the Commission's control. In this connection, various possibilities can be envisaged

With regard to EGNOS, the support structure might be ESA, the EU Agency, a new public body or even a Eurocontrol operational entity. The Commission intends to discuss the advantages and drawbacks of each of these options before submitting a detailed proposal to the European Parliament and the Council in 2012. The set-up chosen will need to be established by 2014.

Where Galileo is concerned, the exploitation phase for the initial services will start gradually in 2014. As a result, the deployment and exploitation phases will run in parallel for around five years. During that period, governance of the programmes should gradually adapt to the new needs arising from the provision of the first services.

It also needs to be stressed that the operator will be required to satisfy the requisite conditions for certification as an air navigation service provider, in accordance with the regulations governing the single European sky.

On the basis of the forthcoming discussions on the financial framework, the Commission will submit a proposal to the European Parliament and the Council in good time concerning the various options for the governance structure to be set up to manage operations following completion of the full infrastructure.

Conclusion

The European satellite radio navigation programmes are beyond the financial and technical capacity of individual Member States and therefore fall within the competence of the EU. In addition, and especially given their security requirements, all the EU Member States have to be involved in them.

Since the reform of the programmes' governance in 2007 the Commission has recorded several successes: EGNOS has become operational and is performing excellently, and progress is being made with the deployment of Galileo. Parallel to this, several horizontal measures flanking the deployment of the infrastructure have been taken on the regulatory front, with regard to international aspects and in respect of future uses.

However, the programmes are now faced with fresh challenges arising from the materialisation of a number of risks which were previously identified by the Commission, and the organisation of the programmes must be further fine-tuned in order to increase their efficiency. The project has experienced cost overruns attributable in particular to the increased cost of the development phase, the increased price of the launchers, the lack of competition for the award of some packages and additional costs associated with the programme.

Furthermore, the economic situation of the EU and its Member States has led the Commission not to seek, up to now, the allocation of additional resources within the current multiannual financial framework, even though this is causing delays in completion of the full deployment of Galileo and an increase in overall costs.

A new basis for the work on the European satellite radio navigation programmes needs to be established so that progress can continue without compromising the objectives laid down by the European Parliament and the Council. Accordingly, the recommended approach envisages the present organisation being maintained and improved over at least 10 years, although it will have to evolve in line with the needs of the exploitation phase.

On the political front, several decisions still need to be taken. In a context in which Europe's economic and social progress is heavily dependent on mastering and using leading-edge technologies such as those relating to nuclear fusion, space, air traffic management and life sciences, it is important to reach decisions about the means, including budgetary means, of coping with the risks inherent in such technologies. Conclusions also need to be reached on the development of the EU budget and on how the risks are to be apportioned between the EU and its Member States. The decisions laying down the budgetary and financial principles governing the continuation of the European satellite radio navigation programmes will need to be taken in parallel with those concerning the governance framework. This must seek to make all the players more aware of their responsibilities, in order to ensure an orderly transition to future governance arrangements while at the same time enhancing control of the project and of its associated costs.

The adoption of such political decisions requires time and thought. Detailed proposals will be drawn up by the Commission at a later stage on the basis of the guidelines to be laid down by the European Parliament and the Council in the light of this report.

Annex

Summary table of the expected use and impact of the EU satellite radio navigation programmes

Domain	Description	Effect
Road transport	<ul style="list-style-type: none"> - improve road safety, especially in the event of emergencies, for cars, coaches and the transport of dangerous goods - improve road management and reduce congestion, help drivers with real-time travel, road and traffic information - improve tolling and electronic fee collection - improve level of services for travellers 	Reduce travel time and fuel consumption
Logistics	<ul style="list-style-type: none"> - improve management efficiency with regard to containers in ports or railway stations - improve the level of service for customers 	Cut transport time
Maritime transport	<ul style="list-style-type: none"> - improve traffic management, especially in ports or high-traffic corridors - improve safety of maritime traffic - improve police authority control over maritime transport, making checks faster - provide help for vessels in danger 	Improve port handling capacity Reduce administrative burden and delays
Air transport	<ul style="list-style-type: none"> - facilitate use of less-well-equipped airports by civil aviation - contribute to the general objectives of the Single Sky policy and of SESAR - improve traffic management and safety at airports 	Fewer cancelled flights, improved airport capacity, especially at small ones
Agriculture	<ul style="list-style-type: none"> - improve design and update of land registry information - allow precision agriculture and production monitoring - improve control over the use of EU subsidies 	Increase farmers' productivity by 10-20%, reduce CAP enforcement costs
Fisheries	<ul style="list-style-type: none"> - vessel monitoring 	Reduce administrative burden and delays
Assistance to third countries	<ul style="list-style-type: none"> - provide developing countries with easy-to-maintain infrastructure to cover basic needs, especially in transport 	Additional foreign policy tool
Mobile com.	<ul style="list-style-type: none"> - improve number and quality of services on telecom handsets 	New service offering
Maritime activities	<ul style="list-style-type: none"> - improve search and rescue 	Reduce casualties
Security	<ul style="list-style-type: none"> - help Member States to fight terrorism, crime and illegal immigration 	Increase security
Disabled, sick and elderly people	<ul style="list-style-type: none"> - improve the assistance tools for elderly, disabled and sick people on the move, promoting their mobility 	Improve quality of life

Fisheries and maritime transport	<ul style="list-style-type: none"> - vessel monitoring - monitoring of rescue operations 	<p>Make monitoring possible</p> <p>Limit occurrence and impact of oil spills</p>
Energy	<ul style="list-style-type: none"> - energy transport monitoring - participate in the security of energy plants 	Optimise grid
Environmental and civil protection	<ul style="list-style-type: none"> - improve crisis management, including in third countries - increase safety of rescue teams 	<p>Reduce response time</p> <p>Enhance monitoring</p>

Glossary – List of acronyms

EU Agency: European GNSS Agency.

- Its tasks are focused mainly on security accreditation and preparation for the commercialisation of the European satellite navigation systems (the new legal basis for this Agency is Regulation (EU) No 912/2010 of the European Parliament and of the Council of 22 September 2010 establishing the European GNSS Agency, repealing Council Regulation (EC) No 1321/2004 on the establishment of structures for the management of the European satellite navigation programmes and amending Regulation (EC) No 683/2008 of the European Parliament and of the Council).

ESA: *European Space Agency.*

- The European Space Agency, an international organisation, is Europe's gateway to space. Its mission is to shape the development of Europe's space capability and ensure that investment in space delivers benefits to the citizens of Europe and the world.

CS: *Commercial Service.*

- Encrypted and accurate to the nearest centimetre, the Commercial Service allows for development of applications for professional or commercial use owing to improved performance and data with greater added value than that obtained through the open service.

Cospas-Sarsat:

- The international Cospas-Sarsat programme provides accurate and reliable distress alert and location data to help search and rescue (SAR) authorities assist persons in distress, primarily in the maritime and aviation sectors.
- The objective of the Cospas-Sarsat system is to reduce, as far as possible, delays in the provision of distress alerts to SAR services and in the time required to locate an incident and provide assistance. This reaction time has a direct impact on the probability of survival of a person in distress on land or at sea

EGNOS: *European Geostationary Navigation Overlay Service.*

- EGNOS, the European Geostationary Navigation Overlay Service, is Europe's first venture into the field of satellite navigation. It was developed to increase satellite navigation reliability and accuracy by complementing the American GPS system.
- EGNOS makes existing satellite navigation services suitable for safety-critical applications such as flying and landing aircraft or navigating ships through narrow channels.

ESSP: *European Satellite Services Provider.*

- Founded in 2001, the purpose of this company is to operate the EGNOS system.

FOC: *Full Operational Capability.*

- Full operational capability will be reached when the entire space and ground infrastructure of Galileo is completed.

Galileo:

- Galileo is the global navigation system developed by the European Union. It comprises a constellation of orbiting satellites and the associated ground infrastructure.
- It will provide positioning information with unprecedented accuracy and reliability. In its future configuration Galileo will provide coverage of the whole Earth, with any given point covered by between six and eight satellites at any time. This means full and highly accurate positioning data for the entire planet.

GNSS: *Global Navigation Satellite System.*

- GNSS is the standard generic term for satellite navigation systems that provide geo-spatial positioning with global coverage. By extension, it also includes regional augmentation systems such as EGNOS or its US equivalent, WAAS.

GPS: *Global Positioning System.*

- GPS is the American satellite geopositioning system operating worldwide.

IOC: *Initial Operational Capability.*

- IOC is the minimum system configuration of Galileo ensuring the delivery of its initial services. This step is expected when the first 18 satellites are operational.

OS: *Open Service.*

- With positioning accurate to one metre, the freely accessible Open Service targets the mass market and is intended for motor vehicle navigation and location-based mobile telephone services. Free to the user, it provides positioning and synchronisation information intended for high-volume satellite radio navigation applications.

PRS: *Public Regulated Service.*

- The Public Regulated Service is restricted to government-authorized users, for sensitive applications which require a high level of service continuity. It will be encrypted and designed to be more robust, with anti-jamming mechanisms and reliable problem detection. This service is intended for security and strategic infrastructure (e.g. energy, telecommunications and finance).

Regulation: Refers to Regulation (EC) No 683/2008 of the European Parliament and of the Council of 9 July 2008 on the further implementation of the European satellite navigation programmes (EGNOS and Galileo).

- This Regulation lays down rules for the further implementation of the European satellite radio navigation programmes, including those relating to governance and the Community's financial contribution.

SAR: *Search and Rescue.*

- Galileo's worldwide search and rescue service will help to forward distress signals to a rescue coordination centre by detecting emergency signals transmitted by beacons and relaying messages to them.

SESAR: *Single European Sky Air Traffic Management Research.*

- SESAR is the name of the programme aiming to provide Europe with effective systems for air traffic management in order to upgrade existing systems. This programme is the technological backbone of the Single Sky programme.

SoL: *Safety of Life.*

- The Safety of Life service will automatically inform users within seconds of a failure of any satellite or similar problem affecting performance. This service will be made available for safety-critical applications such as running trains, guiding cars, navigation and aviation. This service also fulfils the requirements of certain sectors for continuity, availability and accuracy and includes an integrity function alerting the user to any failure in the system.

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