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GALILEO AT A CROSS-ROAD: THE IMPLEMENTATION OF THE EUROPEAN GNSS PROGRAMMES

{COM(2007)261 final}

This document has been written by the services of the European Commission, in close collaboration with staff from the European Space Agency, the European GNSS Supervisory Authority, and the European Investment Bank.

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1. INTRODUCTION

The endeavours concerning the establishment of the European satellite navigation programmes Galileo and EGNOS have come to a cross-road and a political choice is required on the modalities of its implementation. The concession negotiations which were foreseen to result in the PPP contract for the deployment and exploitation of Galileo have stalled due to a range of problems that have emerged.

Vice President Barrot reported to Council via the EU Presidency that *".. the delays so far accumulated and the absence of any sign of progress on the concession negotiations must now be considered as a risk for the delivery of the project in the timeline that we envisioned. Moreover, we have to fear significant cost increases which go well beyond the foreseen budget."*

In view of the situation, the Council of Transport Ministers of 22 March 2007 requested the Commission:

- *to assess and report by the June Council on overall progress of the Galileo project, including the outstanding issues listed by the bidding consortium as summarised in the Presidency's report and including the project cost and financing thereof, with a view to the swift progress of the project;*

- *to submit as soon as possible for discussion possible solutions for securing the long-term public financial obligations, as requested in the Council conclusions of October 2006, including a scenario for the earliest possible provision of EGNOS satellite navigation services as precursor to Galileo, and to report to the June Council;*

- *assisted by GSA and ESA, to assess progress in the concession negotiations and to submit alternative scenarios, also assessed for costs, risk and affordability, for the forthcoming June Council meeting.*

This Report of the Services of the Commission complements the Communication of the Commission to the Council and the European Parliament COM(2007)261 of 16 May 2007 and sets out the underlying analysis of technical, financial, legal, programmatic and other factors of importance to the decision on how to proceed with Galileo.

The European Parliament, in its Resolution of 24 April 2007[1], reiterated its support for the Galileo programme, expressed its concerns about the progress, and called on the Commission to come forward with appropriate proposals, based in part on the same points as mentioned by the Council and, in particular, for a strengthening of public governance by ensuring political responsibility and leadership of the Commission.

The report addresses the underlying causes of the current concession negotiations, sets out the most important criteria for the success of the programme, analyses whether the current negotiations could effectively be brought to a successful conclusion and if so, how, when and with which impacts on the programme. A number of reasonable alternatives are analysed.

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[1] EP Resolution PE 386.706 of 24 April 2007.

2. THE BASIC OBJECTIVES OF THE GALILEO PROGRAMME

The European Union took its first political decisions on the programme at the occasion of the Council of Transport Ministers on 19 July 1999 with the adoption of a Resolution setting out an initial political orientation. Since then, a more comprehensive political vision has developed as a result of a number of positions taken in European Councils and in the Council of Transport Ministers.

The EU political vision targets a much broader socio-economic objective than only the mere introduction of a technical system. Its salient points are the following:

POLITICAL

- Galileo will bring about decisive benefits in terms of **Europe's independence in a strategic area**. The European Union can not become dependent on systems and technologies developed outside Europe for applications vital to the running of the society of tomorrow.[2] For the first time, it will be the **owner and have control of a strategic infrastructure[3].**
- Galileo is not a space programme in its own right but is a **showcase of the Lisbon strategy** fulfilling a **broader macro-economic agenda to create employment, increase economic efficiency, and maximise socio-economic benefits[4]**.
- Galileo is **a civil system under civil control[5]** and will be optimised for the use in the commercial and civil markets.
- The Galileo system will be managed and operated in the form of **a concession as part of a public-private partnership (PPP),** a structure allowing the project to be financed by both public and private funds[6]. The main objective of a PPP is to achieve best value for money for the public sector by minimising the cost of the project while maximising the benefits and revenues on the basis of an **equitable sharing of risks[7]**.
- An original and innovative structure, the Galileo project is the first **joint initiative of the European Union and the European Space Agency**.
- **EGNOS is an integral part of the European satellite radio-navigation policy** and contributes to the European Union strategy for employment, economic reform and social cohesion launched by the Lisbon European Council in March 2000[8]

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2 Introduction of Council Resolution of 5 April 2001 on Galileo (OJ C 157, 30.5.2001, p. 1).

3 Council Regulation (EC) No 1321/2004, Article 3 (OJ L 246, 20.7.2004, p. 1).

4 European Parliament Resolution of 28.9.2006; "B. …recognising that Galileo is a strategic project, one of the most important pillars of the Lisbon strategy…".

5 Council Resolution of 5 April 2001: "…points out that Galileo is a civil programme under civil control".

6 Nice European Council Meeting 2000, paragraph 30: "For the implementation of the project and its subsequent management, public-private partnership will be necessary".

7 Council Conclusions of 9/10 December 2004, paragraph 3: ... "GALILEO" programme subject to a risk allocation, including the final costs, acceptable to the public sector…".

8 Council Conclusions of 5 June 2003, paragraph 1.

TECHNOLOGICAL

- Galileo is based on very advanced technologies **developed by the European industry under public sector initiatives**. It will make it possible to exploit and develop this leading-edge know-how, especially as far as its spatial component is concerned, as well as the know-how developed in the context of EGNOS, especially as far as its ground component is concerned.
- Galileo will comprise a **constellation of 30 satellites** divided between three circular orbits at an altitude of around 23000 km to cover the Earth's entire surface. They will be supported by a worldwide network of ground stations. The performance of the system responds to the requirements agreed in the **High-Level Mission Document** (HLD).
- The various service requirements and their associated performance level and security aspects are provided in the form of **five distinct services**: the Galileo **Open Service**, the **Safety-of-Life Service**, the **Commercial Service**, the **Public Regulated Service** and the **Search and Rescue Service**[9].

ECONOMIC

- According to a series of cost/benefit studies, more than 150,000 jobs will be created by the programme. The **economic perspectives opened by Galileo are therefore significant**.
- In addition to the directly awaited positive repercussions of its deployment, Galileo will allow to derive its **qualities of precision and reliability** in a daily growing number of fields: fishing, agriculture, transport, insurance, etc. **All the economic sectors will be able to draw a substantial indirect profit** from the establishment of the system in terms of new services offered, reliability and competitiveness.
- It is important to minimise the cost of the project for the public sector during all phases of the programme[10]. Therefore, it was decided that **during the deployment phase the public sector would participate for a maximum of 1/3 of the costs** while the private sector would assume a minimum of 2/3 of the costs[11].
- The future concession contract needs to foresee **an appropriate reimbursement mechanism for the financial participation of the public sector** to both the deployment and operating phases of the programme, in case the revenues obtained by the concession holder would exceed a certain level in the long term[12].

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9 Council Conclusions of 9/10 December 2004, paragraph 4: "The Council confirms the main characteristics of the system, in particular…".

10 Presidency Conclusions Cologne 3/4 June 1999, paragraph 16: "… with the aim of securing finance largely from private sources".

11 Council conclusions 25/26 March 2002, paragraph 6: "..for the deployment phase...a cost share of at most 1/3 for the Community budget and at least 2/3 for the private sector".

12 Council Conclusions of 9/10 December 2004, paragraph 11: "Underlines that the future concession contract should foresee a suitable reimbursement mechanism of the public financial contribution to the deployment and commercial operating phases…".

Hence, Galileo has become a flagship project for both its strategic value and its important contribution to the Lisbon strategy, and incarnating the political, economic, and technological dimensions of the European Union. This has been emphasised on several occasions by the European Council at their Summits in Cologne, Feira, Nice, Stockholm, Laeken, Barcelona, and Brussels.

Galileo provides important contributions to Community policies in areas, as varied as transport management, transport of dangerous goods, emergency services (eCall), mobile telephony, financial services, energy, navigation in seas and waterways, air transport, civil protection and humanitarian missions, agriculture, fisheries, and surveying. A major and increasing part of our modern economic activity is based on position and timing information. Moreover, Galileo is the pillar of the emerging European Space Policy and signifies Europe's ambitions in space, technology, and innovation.

The added strategic nature of the programme means that the EU needs to take the necessary political, financial, and programme management decisions allowing the programme to proceed towards these broader objectives.

3. THE AGREED PERFORMANCE CHARACTERISTICS OF GALILEO

The performance and main characteristics of the system are decided in the so-called High Level Requirements Document (HLD) the content of which has been confirmed by political decision of the Council in its conclusions of December 2004[13]. These requirements have also been the basis for a total of some ten years of complex design and technical qualification and for the current technical implementation through the development contracts from ESA with the European industry.

The fully deployed Galileo system consists of 30 satellites positioned in three circular Medium Earth Orbit (MEO) planes at 23 222 km altitude above the Earth, and at an inclination of the orbital planes of 56 degrees with reference to the equatorial plane. Once this is achieved, the Galileo navigation signals will provide good coverage even at latitudes up to 75 degrees north, which corresponds to the North Cape, and beyond.

Two redundant Galileo Control Centres will be implemented on European ground to provide for the control of the satellites and to perform the navigation mission management, whilst a third control centre in standby mode may be appropriate. The data provided by a global network of approximately 40 Galileo Sensor Stations will be sent to the Galileo Control Centres through a redundant communications network. The Control Centres will use the data of the Sensor Stations to compute the integrity information and to synchronize the time signal of all satellites and of the ground station clocks. The exchange of the data between the Control Centres and the satellites will be performed through so-called up-link stations. Around ten stations will be installed around the globe for this purpose.

The services which will be provided by the global constellation consist of: an open service, a commercial service, a Safety-of-Life" service, a “Search and Rescue” service, and a governmental service known as the “public regulated service (PRS)

The performances offered by the constellation are characterised by four main characteristics: the accuracy, the availability, the integrity and the continuity.

Typical accuracy offered is in the range of 2 to 5 meters. The availability of the complete constellation is 99.5 %. In addition some services benefits from integrity provisions which allows sending an alert to safety critical users in a 6 seconds time frame.

In parallel, close and fruitful cooperation has been put in place with the US. This has led to an EU-US Agreement[14] on the full interoperability of the GPS and Galileo open signals and a recent joint decision to improve the characteristics of these signals, effectively establishing the global standard for satellite navigation. This is expected to lead to the wide-spread use of combined GPS/Galileo receivers in mass-market applications. Indeed, improved performances are expected from the combined use of Galileo with GPS, especially in terms of availability in low visibility conditions (e.g. urban canyons).

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[13] Council Conclusions of 9/10 December 2004, paragraph 4: "The Council confirms the main characteristics of the system, in particular the services it will offer".

[14] EU-US Agreement on the promotion, provision and use of Galileo and GPS satellite based navigation systems and related applications, June 2004.

4. AN ASSESSMENT OF THE CURRENT CONCESSION NEGOTIATIONS

4.1. Short history of the negotiations

4.1.1. Publication of the call for concession

The concession procedure for the deployment and operating phases of the Galileo programme was managed by the Galileo Joint Undertaking (GJU) until 31/12/2006. It was launched on 17/10/2003 with the publication of a call for concession in the EU Official Journal[15].

The published call for concession foresaw 2 phases for the selection procedure: first, a pre-selection phase and then a phase of so-called "competitive negotiation".

4.1.2. The pre-selection phase

The deadline for submission of the offers was 5/12/2003 and 4 proposals received were valid. Each proposal came from a small number of main partners grouped in a consortium, to which a number of other associated companies were included, covering various domains, notably financial institutions or companies active in the various sectors of applications of satellite navigation.

In February 2004, the GJU selected 3 consortia to participate at the second phase of the selection procedure.

4.1.3. The competitive negotiation phase

During summer 2004, one of the 3 pre-selected consortia decided to step out of the negotiations. Therefore, at the beginning of September 2004, only 2 candidates – the Inavsat and Eurely consortia – sent their detailed proposals.

After detailed analysis of the two proposals, the GJU was not able, in October 2004, to select a "preferred bidder" because, in particular, of too much uncertainty on a number of essential elements, notably in terms of risk sharing. The GJU then decided to extend the analysis until the end of February 2005 to allow both candidates to better clarify their offers.

At the end of February 2005 and following analysis of the new elements, the GJU concluded that it was not possible to settle for one or the other candidate, and it started the negotiations in parallel with both consortia for a 4 month period.

4.1.4. Merging of both proposals

On 10 May 2005, both candidates proposed to the GJU to join their forces and present one common offer. The GJU agreed but only if a certain number of conditions were respected:

- The merging should not pose any difficulties as regards to EU legislation on public markets and competition;

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[15] OJ S 200, 17.10.2003.

- The new proposal should strictly conform to the planned timetable and would not entail any delay in the running of the programme;
- The joint proposal should contain substantial improvements compared with both previous individual offers;
- The proposal should come with a commitment to create a common and adequate legal structure to negotiate the contract and the management of the concession.

On 20 June 2005, both bidders sent their common proposal. After analysing its principal terms, the GJU accepted the offer, noting that the 4 requested conditions had been met. The common proposal was completed by more detailed elements on 21 October 2005.

4.1.5. The current phase of negotiations

The negotiations with the Merged Consortium, since a few weeks called *Euro-GNSS* and located in Toulouse, France, and composed of 8 partners (Aena, Alcatel, EADS, Finmeccanica, Hispasat, Inmarsat, Thales and TeleOp), effectively started in January 2006, following internal industrial disagreements and a mediation of Karel van Miert[16] with regard to the division of role and responsibilities as well as locations of major ground installations of the system. A first series of negotiations resulted on 17 February 2006 in an agreement on the main principles to pursue during the next phase of the procedure.

A second series of negotiations then focused on the Heads of Terms, i.e. the outline commercial elements of the concession contract. A first version was initialled on 20 November 2006. A consolidated version of a more contractual nature was supposed to be signed before the end of 2006 but was not finalised since the negotiations stalled. Consequently, no date can be fixed as to when the final Heads of Terms can be concluded and signed.

4.2. The results so far of the negotiations with the Merged Consortium

The principal milestones of the last two years of negotiation (May 2005 – April 2007) with the Merged Consortium can be summarised as follows:

- Submission of the Joint bid : October 2005
- Agreement of principles between GJU and MC : February 2006
- Heads-of-Terms v.1 signed between GJU and MC: November 2006

The negotiation has focussed on the risks which can be transferred to the Merged Consortium and the associated conditions for the EU. So far the negotiation has provided the following results in respect of the outline terms of an eventual agreement:

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[16] The mediation of ex-Commissioner Karel van Miert resulted in an agreement among the 8 members of the Merged Consortium on 5 December 2005. The Agreement foresees the installation of the concession headquarters in Toulouse (F), the operations headquarters in London (UK), a ground control centre in each Oberpfaffenhofen (DE) and Fucino (IT), and a Safety-of-Life centre and a back-up control station elements in Madrid (SP) together with the acceptance of a number of governance principles and technical details.

Market risk concerns the ability to obtain the market revenues in accordance with an agreed baseline market development scenario. The baseline under discussion with the Merged Consortium presumes an overall market revenue volume of more than 9 B€ over the 20 years of the PPP. This risk has proven to be difficult to transfer due to the absence of track records, the uncertainty of the market assessments, and its far projection in the future and also lack of willingness of the private sector to study these markets. The negotiations so far resulted in a private sector exposure limited only to a portion of the return on equity (8% - 19%) with a 8% underpinning by the public sector in case of no revenues.

Design risk concerns the ability to ensure that there are no inherent problems in the design that result in a faulty or underperforming system: this risk relates foremost to the system performance validation in the transition between IOV-R and FOC-R (Full Operational Capability Technical Qualification Review) and has proved to be difficult to transfer to the private sector.

During the negotiation the Merged Concession holder has indicated that the scope of the IOV is too limited and does not allow validating the design maturity and hence a proper risk transfer. This position puts in question the overall logic of the IOV-FOC articulation, as conceived at the origin of the concession selection process

Indeed the interface between the IOV and the concession phase has inherent limits due to the fact that:

- the parties involved in the two contracts are partially different;
- the IOV contract, due to its nature of an R&D program and the complex nature of the programme does not allow to properly transfer the related liabilities.

The Merged Consortium has been invited to work closely with the ESA project team and has been provided with the full set of technical information, but very little effective transfer of knowledge has taken place. No technical interaction has been organised so far with the project team and no formal step towards the deployment of the Galileo constellation has been initiated with industry.

Completion risk concerns the ability to complete the deployment on time and is closely linked to design risk. Delays have a particular impact on market share and a large macro-economic impact as all those who are awaiting the commence services and applications have to wait. The completion risk is strongly linked to design risk. This risk can be reasonably transferred to the private sector, subject to IOV-R (the formal In-Orbit-Validation Technical Qualification Review) completion and the assumption that the associated design risk can be materially transferred as a result of the negotiation. However no actions have been initiated by the Merged Consortium to date to negotiate realistic completion plans and associated risks sharing with space industry.

Performance risk concerns the ability to deliver the project within the performance criteria and is closely linked to design risk. Any underperformance has a large impact on the ability to capitalise on the value-added of the Galileo design. This risk can be reasonably transferred however the detailed Key-Performance-Indicator (KPI) regime and related financial consequences have not yet been addressed.

Cost overrun risk concerns the ability to keep the costs of the project within the agreed envelopes and is closely linked to design risk. Cost overruns can be significant on a project of this kind. A 10% cost overrun is not unusual and would mean some 0.8 – 1.0

B€. This risk could be reasonably transferred to the private sector; however the deal is suffering from the lack of industry consolidated cost data, the argument of unstable design perimeter, the lack of competitive pressure, and lack of sufficiently early implementation of the specifications in the security domain. The result is that the cost envelope presented in the joint bid on October 2005 could realistically suffer a material increase. Although not officially notified, signals to this effect have been received from parts of the Merged Consortium. To date, the Merged Consortium has not issued a Request for Proposal to the supply industry, and as a consequence is not in a position to firmly commit on a cost of the infrastructure.

Third Party Liability regime concerns the extra-contractual liabilities. This risk has been extensively debated however a final conclusion could not yet be determined. The Galileo project is a forerunner to this regard and a liability regime has to be developed from scratch, also taking into account the insurance market capacity.

A reasonable compromise is expected to be found finally, however the public sector might be asked to establish a regulatory regime (i.e. an international convention or any relevant legislative instrument) to both mitigate the private sector risk exposure and ensure fair compensation to potential victims.

Concession contract finalisation: During 2006 the Merged Consortium has not been able to set-up a dedicated organisation with sufficient resources to interact with the IOV Phase, launch consultations with industry, and effectively support the concession negotiation process. In particular, these last few months (since December 2006) have shown a material lack of engagement by the Merged Consortium which does not allow to plan in concrete terms the negotiation process. The delays in the negotiations are now having a significant impact on the programme and, if it is decided to proceed with the negotiations, risk mitigation is required in the IOV phase in order to avoid further programme implementation delays. The latest written statements of the Merged Consortium (24-04-2007) foresee a timetable with contract signature at the end of April 2009.

In **summary,** in many of the areas where the Merged Consortium has raised major questions, the recorded progress has been very limited.

As evident in the negotiation process and up to date of writing of this document, the organisational set-up of the Merged Consortium has not responded to legitimate expectations. It is doubtful that the situation can be restored if the root causes are not structurally sorted out.

To date, the negotiations have not achieved any significant ability to transfer risks to the Merged Consortium. Design risk, and as a result completion, cost-overrun risk, and performance risk, are expected to be taken by the EU in addition to market risk. In addition the EU is expected to underpin all senior debt.

It would seem difficult to accept that the EU has to remunerate the Merged Consortium on return on equity in the absence of the acceptance of any material risk sharing.

Therefore, the negotiations have yet failed to meet the conditions required by the Council.

4.3. The 12 points raised by the Merged Consortium

In their letter of 9 March 2007 to the EU Presidency and Vice President Barrot, the Merged Consortium raised a number of points that it felt were of top priority to address in the concession negotiations. Below this 12 points are enumerated and commented upon.

Institutional

1. Public Governance
- *Reinforce effective ownership role*
- *GSA capability to lead the concession contract negotiation process*
- *ESA design authority role*
  - *i. progressive system hand-over*
  - *ii. on-going support for system stabilization*
  - *iii. new developments including replenishment*

2. Ensure the EGNOS institutional framework compatible with concession

3. Resolve Dec 5th Agreement implementation

The points raised under the heading Institutional are interpreted to mean issues of which the main responsibility lies with the public sector, i.e. the Commission, the GSA, and ESA. The Merged Consortium raises first and foremost the matter of public governance, in particular the need for clarity on the roles of the three institutions involved. This issue is recognised and addressed in this document. The importance of EGNOS is recognised by all the public sector actors and immediate actions are required, as proposed in this document. However, the lack of technical interest and the absence of proposals from the Merged Consortium on the early introduction of EGNOS services is also worth being highlighted. With regard to the 5 December Agreement, the position in Council[17] clearly reflected a political view that this concerns an industrial agreement among the partners of the Merged Consortium and should be solved by those concerned.

Programmatic

4. Stabilise baseline (MRD & System baseline, including Dec 5th agreement, concession holder add-ons, external interface, security, accreditation and certification process, operational concept…)

5. Redefine IOV scope and system hand-over conditions & schedule

6. Define high level risk transfer & risk mitigation scheme (market, financial, design/completion, certification/accreditation…) and associated liability caps (including 3rd party liabilities)

7. Update program schedule (including realistic negotiation roadmap till Financial Close) and cost model

8. Define EGNOS hand-over conditions & schedule Industry

9. Improve the efficiency of the main industrial actors in the process (GOC, ESNIS, OpCo) by implementing proper governance and organization reflecting shareholders' commitments

Most of the Programmatic issues raised by the Merged Consortium seem a matter for the concession negotiations. The current instability of the technical baseline may be an issue (partially caused by industry requests), as are the outdated programme schedule and the

[17] Council Resolution of 22 March 2007.

EGNOS hand-over conditions, much of which should have progressed as a result of the negotiations. The views of the public sector on them are addressed in this document. However, the redefinition of IOV scope, its hand-over conditions, the high level risk sharing and risk mitigation scheme are issues that ought to be addressed and resolved directly in the concession negotiations. The improvement of the efficiency and competitiveness of the main industrial actors in the process however is an issue that can, and urgently needs to, be addressed by the actors themselves. Despite repeated requests to this effect from the public sector negotiators and commitments in both the 5 December Agreement and in meetings with Vice President Barrot in the middle of 2006, this has not been effectively achieved yet and there are serious doubts that this can be achieved under the current industrial agreements.

Finance

10. Setup of a proper EU financial regulation for the concession (initial deployment grant, Availability Payments Committed, debt underpinning, tax issues)

11. Confirm private funding commitment (equity & target IRR, contingent equity) and establish bankable project finance Market

12. Establish a credible and joint GOC / GSA business development roadmap, in particular for regulated markets, based on the EC Green Paper on Satellite Navigation Applications

Although the EU planned contribution to the deployment and exploitation phase may not be aligned with the expectations of the Merged Consortium, the finance issues seem to be matters for the last phase of the negotiations. Neither the EU nor the Merged Consortium will be in a position to secure its respective financing arrangements until the key risk allocation and financing scheme have been negotiated and the respective financial implications can be calculated to some degree of accuracy. A business development roadmap is certainly a worthwhile exercise but also this is not of first urgency in the negotiations.

In summary, the material reason for this negotiation not progressing is primarily related to the inability of the Merged Consortium to effectively manage the process, agree on a common position, and engage in the negotiation. The details of this are set out in the next section.

4.4. An assessment of the chances of success of the current negotiations

On the basis of the negotiation results achieved so far, there is clear lack of evidence that the negotiation is converging and there is an absence of a credible commitment by the Merged Consortium.

The difficulties with the Merged Consortium are not related to relations with one partner but to the whole consortium. The different partners do not seem to have a common position on the consortium strategy and the situation is complicated by the principle of geographical and/or equity returns.

Among other things, this led to a strong disagreement with regard to the location of major Galileo installations, the roles of the respective industries, and the internal

repartition of work shares. It was the mediation of Karel Van Miert that led to the 5th December Agreement between the members of the Consortium, the implementation of which is now again subject of strong disagreements.

Moreover, extensive use of veto rights of individual members of the Consortium as well as governance and inefficient procurement practices in the joint satellite manufacturer ESNIS[18] that are based on background deals that have had a distinctly negative impact on efficient management and business practices.

This battle for work shares and internal project roles and responsibilities seems to absorb all energy in the Merged Consortium however, without that a conclusion is reached. As a result there is a lack of industrial vision, a lack of a pragmatic approach to come forward with reasonable solutions, and an inability to come to conclusive results.

In addition, the Merged Consortium has not initiated the procurement actions related to FOC and has announced that it will not be possible to provide a firm cost commitment until much later in 2008.

Third party liability risk has been another major issue in the negotiations in part due to the global reach of the Galileo services and the current uncertainty regarding the potential range of Galileo applications which will be available through the Open Service and the Commercial Service. Because of the difficulty in predicting exactly how Galileo will be used and by how many users during the 20 year term of the Galileo PPP, the Merged Consortium has consistently requested a cap on its liability to third parties above a specified level.

However, it has so far not been possible to agree precisely what form the third party risk management structure should take and the extent to which the public sector should be committed to assume third party liability compensation above the ceiling required by the Merged Consortium.

In conclusion, the current situation is a result of the combined effects of continuous, unresolved disputes over share of industrial work, a misjudgement that market risk could be transferred to the private sector, an unresolved negotiation with respect to the transfer of design risk, the technical complexity of the programme, and insufficiently strong and clear public governance. It is therefore very doubtful that the current negotiations can be brought to a satisfactory conclusion, with a balanced sharing of risks, at reasonable costs to the EU, in good time, and with sufficient assurances for efficient private sector governance.

In addition, a combination of the above factors has now also contributed to mismatch of original political positions on public sector financing and the programme realities today.

The political position of Council was based on the assumption that the private sector would assume major market and technology risks. This resulted in the political decision that the EU would contribute to the deployment phase with about one-third in financing, and that a financial contribution would be provided for few years of operational

[18] European Satellite Navigation Industries (ESNIS), formerly known as Galileo Industries, based in Munich and Rome.

expenses. Taken together, it was estimated that the foreseen EU contribution would be 1,000 M€ and be provided in the 3 first years of the concession contract.

During the concession negotiations it became clear that this will not suffice. The financial contribution of the public sector requested by the Merged Consortium, and repeated by this Consortium in its letter of 24 April 2007, amounts to 1,600 M€ during the period 2007-2013. The lack of progress in the negotiations did not allow to verify whether the foreseen EU contribution of 1,000 M€ for the financial period of 2007-2013 would allow a bankable project.

The delays in the negotiations are now the cause of programmatic concerns. In case that a decision would be taken to continue on the basis of the current negotiations, the EU would be required to ensure that the IOV contracts are properly aligned with the next phase and would have to undertake serious risk mitigation actions. These actions would encompass the procurement of some 4 more satellites and associated ground segment, as well as project management costs. This risk mitigation has proven necessary in order to ensure that the industrial teams do not dissolve in the absence of follow-up orders expected later under the PPP, and in order to put in place safeguards against launch failures (otherwise foreseen through the launches of satellites under the PPP contract).

Therefore, the current negotiations can not be completed without significant complementary actions of the public side. These actions are not foreseen within the current budgets and therefore the current negotiations can not be completed without authority of additional expenditure.

5. THE OVERALL CONTEXT OF THE IMPLEMENTATION OF THE PROGRAMMES

This section extends the assessment performed in the previous section by discussing what would be the right approach in addressing the raised outstanding issues while moving forward in a revised scenario.

The analysis presented below is the result of a large number of discussions with many involved in the implementation of the Galileo programme in general and in the concession negotiations with the Merged Consortium in particular.

5.1. Industrial governance

As already described in the assessment of the concession negotiations, the industrial governance is critical to the programme. It will be necessary to avoid that national industrial interests take preference over the overall, long-term strategic aims of the programme in terms of the creation of jobs and opportunities to reap in the emerging global market for satellite services and applications. Recognising the strategic nature and interest of the programme, and the private sector players supplying to it, should not lead to the endless negotiations on roles and work shares that have effectively prevented the programme from progressing on a number of occasions, including at this very moment.

5.2. The market for the concession holder, market risk

Although the downstream market for global satellite navigation services and equipment is promising (predicted to be around 450 B€ annually as from 2025), the upstream market for the concession holder, that is the provision of signals-in-space, appears uncertain. As a result, the market risk associated to the business plan seems too high to be acceptable to the Merged Consortium and the EU has been requested to underpin this risk.

This element was clearly underestimated in the original plans for the Galileo programme. There was always an assumption that the private sector would accept the market risk. It is now clear that the situation is more complex and that the uncertainties of the future market for the concession holder are a major element that requires a re-appraisal of the concession model.

Furthermore, the current delays in the programme and resulting late time-to-market may reduce market share as a result of the competition from other global systems like GPS-III, Glonass, and Beidou/Compass as well as from emerging national and regional systems from Japan and India. As a result, any further delays in the availability of the Full Operational Capability decrease the market share of Galileo and increase market risks.

Moreover, the introduction of new technologies requires careful, detailed, and appropriate preparations of the respective markets that are addressed. Global satellite navigation markets are in their infancy. Although in the last 3-5 years strides have been taken in both the professional markets and the mass-market for, mostly, the GPS open service, very little has been undertaken to define the sophisticated satellite navigation

markets of the future, notably related to Safety of life, Commercial and Public Regulated services.

Lead times in these markets are very different and of differing complexity. As an example, the aviation market is one of the most complex ones. Lead times are in the order of 7-10 years, much awareness raising is required, and detailed and complex standardisation, certification, and establishment of sector specific rules and regulations are required before a new technology is operational. But even mass markets require preparation as there will be considerable variety of service offerings. Lastly, satellite navigation addresses inherently global markets with their different languages, cultures, and states of development.

Market definitions and a roadmap to prepare the global markets need therefore to be undertaken.

5.3. Technical complexity and design risk

One of the most significant problems which affected the concession negotiations has been the technical complexity of the Galileo programme and the untested and unproven nature of much of the technology associated to some critical technologies (e.g. atomic clocks) on which Galileo relies. This, together with the lack of reliable test data for some of the Galileo system components (and the Galileo system as a whole) has been a major difficulty for the Merged Consortium in making its assessment of the technical risks associated with the Galileo Project and its willingness to accept liability for such risks.

Moreover, the concession negotiations have shown that design risk can not be assumed under reasonable conditions at this point in time. It is therefore upon the EU, with assistance from ESA, to develop a strategy whereby the design risk is mitigated before the remaining risk can be transferred. The organisational and legal issues surrounding the design risk are core to the programme implementation.

5.4. Third Party Liability risk

To the extent that Galileo users rely on the signal provided by the Galileo system, there is a possibility of extra-contractual claims being brought against the parties involved in the provision of the data, including the GOC and the GSA. These claims may arise in contract or under the general law applicable to duties owed to third parties (or both), depending on the circumstances and may be brought in different jurisdictions and under different systems of law. The need is recognised for an adequately funded third party risk-management structure to be available throughout the period during which the Galileo system is operational and for the risk management structure to provide the Project participants with a commercially sensible level of risk coverage.

5.5. Delays of the programme and loss of programme logic

When the programmatic frame was designed in 2001, it was foreseen to negotiate and conclude a concession contract in time for the concession holder to provide its input on

design issues related to the "In Orbit Validation" phase. The latter was purposely limited to four satellites, as this figure corresponds to the bare minimum for positioning functionality verification.

It should have been the responsibility of the concession holder to propose additional and new design features as well as design adaptations in line with user requirements, market requests and its own business model. The concession holder would also have initiated the procurement activities in order to take full advantage of the satellite production line built under the IOV phase.

However, no concession holder is in position to either propose sustained changes to the actual design, initiate the required procurement activities for the 26 satellites of the deployment phase, or act as technical counterpart of the IOV managers and prepare for a hand-over. A production line gap is therefore appearing, with several subcontractors putting a halt to their specific Galileo capacities. The cost of resuming such activities is substantial. Furthermore, technical risks could appear, as component and element supplies might disappear and therefore imply re-development and qualification of equipments.

5.6. Public sector governance

The public governance of the programme has shown to be a key element. Whereas there was the belief in the early phases of the programme that the public sector role could be limited to enabling the necessary technological and political elements and the core financing, it is now clear that this was probably overly optimistic.

However, the public sector has a number of key roles to play in the programme with regard to design and system architecture, procurement, financing, international agreements, frequencies, certification, security, enabling legislation, programme management, market preparations, and balancing of industrial roles and responsibilities

The relations between the European Commission, the GSA and ESA are too complex. The complex interaction between programme management of the three executives and the, sometimes incoherent, control of the Member States in three different places (Council, GSA Administrative Board, ESA's PB-NAV)[19] make the decision process even more complicated. And arguably, the Member States have not only taken on the controlling role which is theirs, but have also taken a role in the daily management of the programme.

Furthermore, the timing of the handover of activities from the Galileo Joint Undertaking to the GSA on 1 January 2007 has proven to be suboptimal, based on the earlier assumptions that negotiations would have been completed, as foreseen in the undertakings of the Merged Consortium. The GSA was still in the process of being built up and its relationships with the Commission and ESA not settled.

The lack of clarity of the role of ESA in the further phases of the programme has been cause of expressions of concern. Many view ESA as the architect or design authority of

[19] In addition, the Member States take position on Galileo in the GSB, the TEN-Committee, and the RTD-Transport Committee.

the programme, without having been explicitly attributed such a role. The strategic nature of the programme would however suggest that such a role is appropriate. It is also clear that neither the Commission nor the GSA has the technical expertise or procurement experience of ESA. Hence, there is a clear need to recognise the role of ESA and define the way in which the related responsibilities and liabilities can be exercised by the public sector as a whole. However, clear agreements with ESA are necessary, in particular with regard to the retained level of liability if acting as a procurement agent and/or design authority for the EU.

A further issue relates to the political role and responsibility of the Commission. Whereas the Commission is accountable towards the Council and the European Parliament, it is effectively not able to exercise its responsibility in the daily management of the programme, notably in the control over the GSA. In any new situation, the role of the GSA has to be thoroughly reviewed. Should an alternative scenario be selected, the GSA may in future have tasks, such as: procure the new EGNOS and Galileo concessions; assist the Commission in the development of EGNOS and Galileo applications; and contribute to the supervision of the procurement of the Galileo infrastructure. In order to assure that the Commission can assume its full responsibilities in the development of the programme, it will make proposals to align the governance of the GSA to the new situation.

5.7. The definition, handling, and implementation of security requirements

A strategic infrastructure of the kind of Galileo and the implementation of a Public Regulated Service (PRS) have resulted in the necessity to implement security requirements that are appropriately related to the programme needs and that are based on the political position of the Council on the matter.

The definition of security specifications is the competence of Member States who agreed for the purposes of the Galileo programme to co-operate in the framework of the Galileo Security Board (GSB) chaired by the Commission and the EU Presidency. Participants are further the GSA, ESA, and the SG/HR of the Council. A handover of activities to the System Safety and Security Committee (3SC) of the GSA is currently anticipated.

The security experts of the Member States and participants in the GSB are, in effect, having a considerable responsibility in the programme but as their work is limited to security only, it appears to function somewhat in isolation and is not subject to normal programme management disciplines such as costs, programmatic impact, and timely delivery. In particular any case of disagreement or elevated sensitivities has been the cause of delays and cost in the programme.

The handling of the Galileo security requirements has proven to be very sensitive indeed. Not only is the handling complex as a result of the practical problems in implementing across national borders the security arrangements for such requirements, but also are both EU Member States and the private sector players very sensitive to the access and control over these requirements. There are furthermore also considerable tensions between Member States as a result of different views on the relevance and modalities of certain security requirements.

5.8. Project financing and financial viability

Although the Council has requested that the programme be implemented as a public-private partnership (PPP) model that is based on the assumption of risk sharing, too little consideration has been given to the consequences for the EU in terms of the risks that it may have to underwrite or take wholly or in part such as market risk, design risk, or termination risk. Nor have all the consequences of the EU becoming the owner of this critical infrastructure been understood in the earlier phases of the programme whereas this may have major impacts e.g. on extra-contractual third-party liabilities.

The mentioned monopolistic position of the Merged Consortium coupled to the industrial governance problems may moreover aggravate the financial viability of the programme. Insufficient management controls, a lack of autonomous power to negotiate and control costs of sub-contracts, industrial compromises on the division of roles and responsibilities as well as the number and locations of elements of the programme can only come at a cost. The fundamental question arises whether the public sector can afford such monopolistic structures and questionable private sector governance.

As mentioned above, the management of security requirements has a particular role which could otherwise lead to uncontrolled increases of the programme budget. The absence of a clear and committing time line and the accrual of delays will increase the final cost of the project.

Delays can also cause certain obsolescence impacts of the programme in terms of service provision and applications and thus costs and loss of market share.

Lastly, the length of the foreseen concession period may need to be optimised and adapted to the programme replenishment cycles.

6. OUTLINE OF THE MAIN FEATURES OF THE IMPLEMENTATION SCENARIOS

6.1. The selection of scenarios

The choice of the various potential scenarios has been dictated by the feasibility of those scenarios. As a result of analysis work, six scenarios have been retained and assessed. All of these are based on the PPP model with a variation in the degree of initial public procurement.

Scenarios 1 to 4 start with a public procurement of a certain number of satellites and the associated ground segment required to operate and test those satellites. This public procurement is then followed by a public private partnership covering the remainder of the satellites and the replenishment satellites, as well as exploitation, operations and maintenance of the infrastructure for a determined number of years (20). For all these scenarios the technical characteristics remain as currently agreed under the High Level Requirement Document and its implementation documents.

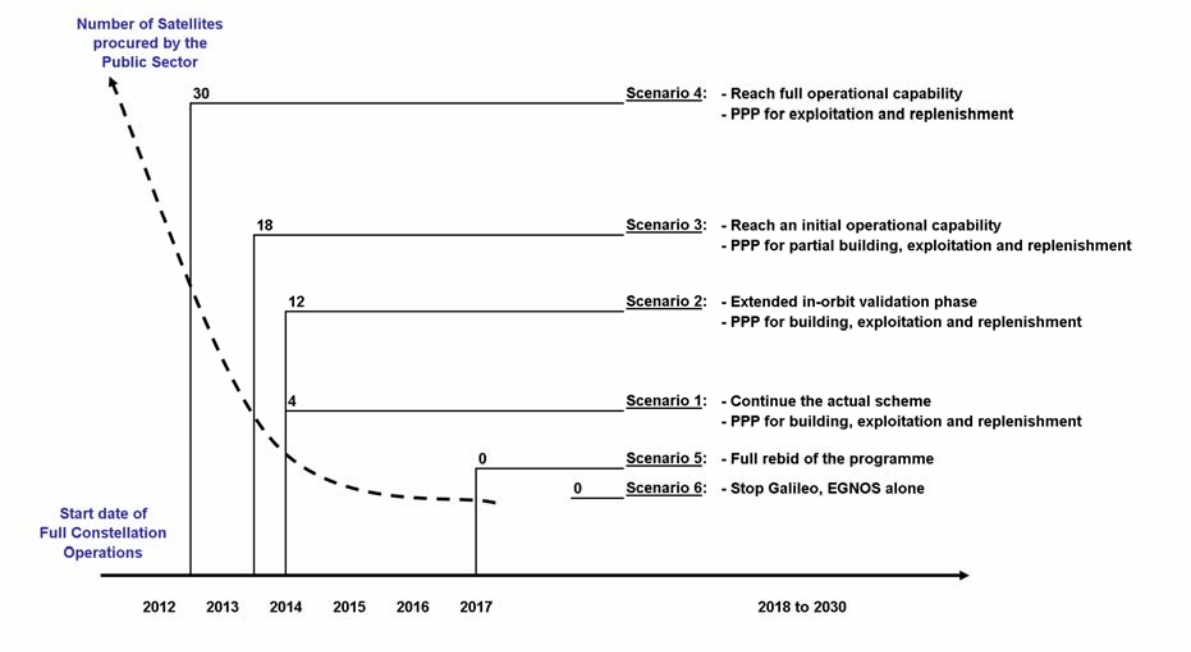
It is underlined that the configuration adopted for Galileo is the result of a multiyear exercise initiated at the origin of the programme and concluded at the end of the definition phase. Many possible configurations have been assessed at that time, giving the opportunity to experts and potential users of navigation systems to express their views, in order to freeze all mission requirements. Design teams, both in ESA and in industry, could define the system in an iterative process and tailor the programme in line with those adopted mission and performance requirements. Since then, neither the basic configuration of the system (satellite constellation, ground segment) nor the definition of the services have been challenged by any stakeholder, demonstrating the validity and the robustness of the Galileo concept.

The possibility of major changes to the design requirements, such as a complete re-scoping of the services (e.g. withdrawing services), changes in the constellation design (other orbital planes and/or number of satellites) and in the coverage (not the entire globe but only parts of it), as well as lower-cost infrastructure (completely different approach, e.g piggy-bagging on other satellite system) and other such approaches would imply loosing all benefits of the previous definition and development phase activities.

Such radical design changes would lead to the cancellation of the actual IOV (In Orbit Validation) industrial contracts and therefore full re-bidding for the entire programme, with associated delays this would involve. All such scenarios are encompassed within scenario 5, which is a complete public private partnership without any initial public procurement (abandoning IOV activities). The possibility of some optimisation in the design or in the exact service definition remains possible in any of the scenarios.

Lastly, scenario 6 is the most extreme approach, with full cancellation of all Galileo activities. EGNOS would in this case remain the sole initiative of Europe in satellite navigation infrastructures. The risks associated with this scenario are mostly political and therefore addressed in the Communication of the Commission that relates to this Document.

The schematic below shows the various scenarios as a function of the number of satellites that the public sector would build and launch.



6.2. Scenario 1: Status Quo - continuation under the actual scheme

This scenario is based on the assumption that the feasibility of the actual scheme is confirmed and the concession negotiations are resumed with the Merged Consortium. The boundary conditions for the tender are not allowed to be changed under EU procurement law.

The main objective of this scenario is to capitalise on existing results and pursue with the concession negotiation as foreseen initially.

The scenario would develop as follows.

- The "in-orbit validation" infrastructure including its four satellites and related ground segment are completed by ESNIS (European Satellite Navigation Industries) and subcontractors under the IOV contract from the European Space Agency. This phase is currently foreseen to be completed by early 2010 at the earliest. It is however noted that cost overruns to this IOV contract are announced by ESNIS and currently assessed by the European Space Agency: these impacts have to be addressed and included in the assessment of the scenario.

- The Merged Consortium and the GSA conclude the concession contract and raise the required funds by July 2009. The public sector covers one third of the deployment cost in the financial perspectives 2007-2013. Final Operational Capability (FOC) can be reached by Mid-2014. The concession contract runs over a 20 years period, i.e. till 2029.

- The Merged Consortium furthermore operates, maintains, and replenishes the system and provides services.

For cost comparison purposes, rather than accepted the results of the PPP in isolation, the actually required and realistic additional risk mitigation and recovery actions are analysed in variation of this scenario, where a set of four supplementary satellites are

added to the core IOV in order to mitigate launch failure risks and to fill the gap between the IOV and the FOC.

6.3. Scenario 2: Reinforce the actual scheme through an extended In Orbit Validation contract

In this scenario, the public sector carries on with the procurement of additional elements of the core infrastructure. As the initial boundary conditions of the call for concession launched in the Official Journal in 2003 are changed, the current negotiations are stopped.

The hypothesis retained in this scenario is that a set of 8 supplementary satellites is procured by the public sector, bringing the IOV asset to a total of 12 satellites.

The main objective of this scenario is to sustain the current industrial production line while negotiations are commenced for a new Public Private Partnership. It effectively reduces the risk of satellite production line gap between the public sector IOV phase and the deployment phase under private sector responsibility.

The level of service performance attained by this extended IOV reduces the IOV-FOC technical transition risks but does not allow satisfactory provision of pre-operational services to users (4 meters horizontal accuracy for 45% availability or 20 meters accuracy for 71% availability).

A new concession procedure is restarted and a contract is established with a new party. The Final Operational Capability is reached Mid-2014. The concession contract runs over a 20 years period, i.e. till 2030. The PPP concession holder furthermore operates, maintains, and replenishes the system and provides services.

6.4. Scenario 3: procurement of Initial Operational Capability (IOC), followed by a partial deployment and exploitation PPP

In this scenario, the public sector finances and procures an operational system with limited performances. This core infrastructure is composed of the minimum required to provide an Initial Operational Service (IOC). The IOC infrastructure would consist in a total of 18 satellites with the associated ground segment.

As in scenario 2, the initial boundary conditions of the call for concession launched in the Official Journal in 2003 are changed; hence a new bidding phase is required for all new contracts that are expected to be placed.

The IOC allows provision of Galileo services for a wide range of users and provides confidence of design robustness to the future concession holder. It provides sufficient evidence for a minimum of Galileo market value. Both positioning accuracy and coverage are just sufficient to introduce early services on the market (4 meters horizontal accuracy for 87% availability or 20 meters accuracy for 98% availability).

In order to complete the full 30-satellites constellation, the remaining 12 satellites are procured by the private sector under the PPP concession scheme. Prices of these could be fixed by an option on the earlier satellite procurement contract. The PPP concession holder furthermore operates, maintains, and replenishes the system and provides services.

The IOC is ready by end 2011, with users getting the possibility to use the early services at that time. The concession contract is targeted for End-2009. This provides ample opportunities for the private sector to be involved in the IOC phase, while gaining experience and insight knowledge of the system. The Full Operational Capability can be reached by end-2013, providing that the PPP contract can be negotiated and put in place in time. The concession contract runs over a 20 years period, i.e. 2010-2030.

6.5. Scenario 4: full system procurement (Full Operational Capability – FOC) followed by an exploitation PPP

In this scenario, the public sector finances and procures the complete operational system with full performances. This infrastructure is composed of a total of 30 satellites with the associated ground segment. The FOC allows provision of all Galileo services for all targeted users and provides full confidence of design robustness to the concession holder. It also brings full evidence of the Galileo market value and incites services and applications providers to invest.

The PPP concession holder not only operates the infrastructure, but also maintains the system, procures the replenishment satellites and infrastructure, and provides services.

The public sector is able to increase gradually the capability to provide services. In an intermediate step, the infrastructure reaches a constellation of 18 satellites End-2011 and the FOC is ready End-2012. The concession contract is negotiated and put in place by 2010 in order for the concession holder to obtain knowledge about the system through a carefully designed period of co-operation and handover, and in time to take over the provision of the early services offered by the 18 satellites infrastructure. The PPP concession contract runs over a 20 years period, i.e. 2010-2030.

6.6. Scenario 5: full project re-bidding

The actual concession negotiation process is brought to a halt. The in-orbit validation activities run by the European Space Agency, funded by ESA and the European Commission, are also stopped.

In March 2008, a complete re-bidding process is launched which includes both the development phase and the deployment and exploitation phase. The resulting PPP contract is concluded in September 2011. The Final Operational Capability is achieved in September 2017. The PPP concession holder furthermore operates, maintains, and replenishes the system and provides services.

The public sector covers one third of the costs, the remainder being covered by the private sector.

6.7. Scenario 6: stop Galileo, EGNOS alone

In this scenario, Europe would limit its abilities in satellite navigation to a space-based augmentation of the U.S GPS system.

EGNOS would therefore be brought to an operational status, while all development and deployment activities of Galileo itself would be terminated. The actual IOV activities would therefore be stopped and the four satellites foreseen would neither be assembled nor launched. In parallel, the negotiation for the Galileo concession would obviously also be terminated.

7. FUNDAMENTAL CRITERIA FOR THE SELECTION OF AN IMPLEMENTATION SCENARIO FOR THE PROGRAMMES

In order to assess the various implementation scenarios for the programme, a set of criteria has been identified that spans four key dimensions, namely the general contextual frame, technical and programmatic, financial, and risk sharing. .

7.1. General issues of relevance in the scenarios

1) Programme logic: This criterion is fundamental as it ensures a coherent framework for all activities. A certain degree of robustness of the programme logic is also required to face unexpected events (e.g. technological problems, new international competitors, financial issues, etc.).

2) Partnership with, and leverage, over the private sector: it is of considerable importance that the public sector achieves a satisfactory level of partnership and keeps the necessary leverage over the private sector to ensure that the programme objectives are met as expected, both in any negotiations and during the execution of the various contracts.

3) Market introduction logic and time-to-market: as stressed by the Council on several occasions, the European GNSS infrastructure has to address user needs and market requirements. The private actors therefore have to ensure proper adequacy between service provision characteristics and market expectations and to develop and implement the work plan leading to the introduction of services. Depending on the respective responsibilities of public and private sectors, the scenarios offer different results. In addition, late time-to-market causes considerable problems in terms of decreasing market share and resulting revenue losses.

4) Competitive supply: experience in the programme has already demonstrated the need for alternative sources of supply in order to reduce dependencies and costs and to increase robustness and efficiencies. Extending this throughout the supply lines is of considerable importance to the programme but the ease of introduction thereof is different for various scenarios as a function of the scope of procurement.

5) Validity of negotiating partner and industrial setup: the interests driving the partners in the concession contract, their interaction, experience and expertise all contribute to the validity of the private sector partner in relation to the overall aims of the programmes. Some scenarios are driven by hardware manufacturers, others by operators or by service providers.

6) International relations: Galileo has set a trend in satellite navigation by its active international cooperation policy framed in bilateral agreements and regional cooperation activities. The partnerships were sought to reduce political, technical and market risks of Galileo's entry into the market. In exchange, the international partners have expectations of a political (e.g. representation, ownership, hosting, influence, funding), technical (joint R&D, compatibility, interoperability) and industrial (e.g. information, procurement, technology transfer) nature. As a minimum, the scenario chosen for Galileo should be compatible with the

international commitments of the EC in this field, i.e. the international agreements.

7.2. Technical and programmatic criteria

7) Timeline to FOC and schedule risk: the timeframe required for availability of a full, complete and operational Galileo constellation is clearly different in the various scenarios. Market expectations are high and the international competition context pleads for a rapid deployment of Galileo. The various scenarios lead to different dates for entry into full operations.

8) Gap IOV-FOC: the current gap in satellite deployment during the in-orbit validation phase and the procurement for the remainder satellites has an important impact, both on the calendar and the costs of the system. If no new orders are placed to equipment manufacturers within certain periods, industries will re-allocate teams, know-how, competence and materials to other programmes and contracts, leading to serious satellite and ground components production disruption, as well as a reduced motivation of industry to complete the IOV within the planned schedule.

   One key element in this respect is the so-called Long Lead Items (LLI's), i.e. parts and components which are so specific and complex that the time to procure them is much longer than for any other elements of the satellites. There is therefore a need to plan for swift ordering of sets of Long Lead Items. Not all scenarios offer the same flexibility in this respect.

9) Technical baseline stability: evolution of requirements and specifications are natural for programmes of the size and complexity of Galileo, spanning a large number of years between design and full operational status. However, the stability of the technical baseline and the robustness with respect to changes is dependent on the actors involved in setting up of the infrastructure. The various organisational schemes of the different scenarios have therefore an impact on this parameter.

10) Handover: the complexity of the handover of tasks, knowledge and management from the public sector to the private sector (eg in handing over a publicly designed, procured, and managed contract) largely depends on the degree of involvement of the private sector in the development, the deployment activities of the public sector, and the amount and intensity of co-operation put in place between the two sides.

11) Impact on IOV: the various scenarios have different effects on the actual IOV activities (e.g. use of the first deployment satellites as backup in case of IOV launch failure)

12) EGNOS integration: the advantage of integrating EGNOS in the overall concession scheme has been highlighted by the Council at several occasions but this has not yet materialised. Some scenarios create better conditions to deploy and integrate EGNOS services in the PPP in a smooth and coherent frame with respect to Galileo services. EGNOS is the frontrunner for new markets and applications.

7.3. Financial criteria

13) Public sector budget commitments: the financial support deemed to be available from the European Union for the Galileo programme is crucial and the demonstration of not only the amount but also the timing of when this financing will be available is necessary. On the basis that "funds today" are worth more than "funds received in the future", the scenarios illustrate the value today (May 2007) of funds discounted for time, i.e. Net Present Value or NPV.

    The total public sector support encompasses the deployment phase, the operation phase, the financial cost to the public sector of the replenishment and any other costs incurred by the public sector for both the Galileo and EGNOS programmes. The public sector contribution net of forecast market revenues over the whole programme period is provided for each scenario for comparison.

14) Affordability: the timing of the public sector funding requirement during the deployment phase has a direct impact on the affordability constraints of the public sector budget allocation for the programme, especially in the financial perspectives 2007-2013.

    For the exploitation phase, the estimated growth in third party revenues forecast reduces the level of ongoing public sector support.

15) Revenues robustness with respect to timeline

    The market window of opportunity for Galileo is not endless. One must take into account that market opportunities are adversely affected by delays in achieving full operational capability.
    As the modernized GPS III infrastructure will be fully operational on a free of charge basis as of 2018, some analysts forecast that Galileo market revenues for the concession holder will be limited to the Galileo-specific services such as the PRS service and the authenticated commercial service. One may envisage that for the first years of delay after 2012, a revenue loss of 10% of the 9.3 B€ base case market has to be taken into account, while the Galileo-specific market would stay relatively unmodified This effect is however not taken into account in the revenue model used for comparison purposes.

7.4. Risk sharing criteria

The extent to which the Public Sector is involved in bearing some risks in each of the scenarios has an influence on the time schedule, the incentives with respect to the market, the level of complexity of the system and the overall costs. The ability of the public sector to transfer key risks and the cost of doing so is, therefore, a core element in the assessment of the value for money of each scenario.

16) Completion risk: this risk is related to the possible delay to delivery of the system that could be caused by several factors such as launch failures, IOV delays, integration problems, certification delays. The degree of involvement of the public sector in the various scenarios impacts the completion risk due to the complexity of the constellation configuration and of the activities (integration,

tests, validation, certification etc) to be carried out under the public sector supervision.

17) Design risk: there are several classes of design risks which have been identified in the programme (e.g. new clock technologies, the extrapolation from IOV into FOC, Safety of Life performances and standardisation process, security accreditation, etc.). According to the degree of involvement of the public sector in the deployment phase, risk mitigation actions will be implemented to reduce design risks and implicitly ease the risk transfer to the private sector. The various scenarios therefore present different design risk profiles.

18) Market risk: the closer to the final operational capability the private sector will take over the infrastructure, the more information it will have gathered on the marketing of Galileo services. Similarly, the deeper the involvement of the private sector in the deployment of the system, the closer the positioning and navigation services will be to the user and market requirements.

19) Cost control capability/risk: it establishes to which extent the public sector can overcome cost overruns (which are mainly due to delays, subcontracting problems, management issues and general governance question). In all scenarios where the private sector is managing the contract on a fixed price basis, the cost overrun is controlled by the private sector.

20) Termination risk: is the risk retained with regard to termination of the contract either by contractor or public authority default.

21) Value-for-money assessment: the overall assessment of the value-for-money, a key parameter for the European Union.

8. DETAILED ANALYSIS OF THE IMPLEMENTATION SCENARIOS

The 6 scenarios presented in section 6 have been analysed against the criteria presented in section 7. A summarised overview of the analysis is given at the end of the section.

8.1. General issues of relevance in the scenarios

8.1.1. Programme logic

The overall coherence of the programme is critical to ensure that the various phases follow a logical sequence with clear milestones which permit the fixing of the start date of each subsequent phase. It is also fundamental that the successful outcome of a given phase is not subject to resolution of an uncertain situation associated with the next phase.

The current scenario (scenario 1) is trapped in this lack of programme logic. Indeed, there is no clear entity in charge of the deployment able to steer the IOV against the identified user requirements. In addition, the actors in the current IOV lack motivation to meet performance and schedule objectives in the absence of clear perspectives (incentives?) for themselves in the FOC.

The reinforced IOV scenario (scenario 2) does not improve this programme logic. One could even argue that it is worse. It is difficult to add additional activities in the IOV without clarifying the future perspectives. The ESA Satellite Programme Navigation Board (PB-NAV) will probably hesitate to contribute to the additional expenses required for the completion of IOV and the implementation of a reinforced IOV in the absence of a sound perspective for the operational phase.

The IOC deployment scenario (scenario 3) establishes programme logic. From the technical and the user perspectives, the Galileo IOC concept offers significant comfort to the market fostered by the tangible performances of the services provided. In addition, the design risks are brought down to a level where most are well known and mastered. However, 18 satellites represent a strict minimum in terms of performance and a perspective towards the final constellation is also a fundamental requirement of the scenario. The mistake of not providing good visibility about the full operational constellation was made by other global navigations systems in the past, with the known negative effect on the users (e.g. case of GLONASS).

The FOC deployment scenario (scenario 4) proposes a new approach with a restored logic: the public sector procures and deploys the system, whereby the concession holder delivers the services, operates and maintains the system. This scheme has been successfully used in other space endeavours (Arianespace, Eutelsat, Eumetsat, Spot Image) and contains a clear division of tasks and responsibilities; the public sector develops the infrastructure while the operator (private or public) will be in charge of the operations and the marketing of services.

Also the re-bidding scenario (scenario 5) is meaningful from a programme logic point of view as it transfers the full control of the infrastructure and of the services to the concession holder from the start. The credibility of such an approach would however be rather doubtful and the IOV investments would probably be lost.

Stopping Galileo (Scenario 6) would be unprecedented and tragic. It is assessed in the conclusions of this chapter.

8.1.2. Partnership with, and leverage, over the private sector and industrial set up

In the current scenario (scenario 1), the public sector is confronted with a number of monopolistic industrial organisations set up on the basis of politically inspired and supported agreements over which it has little leverage. This applies to the levels of the concession (i.e. Merged Consortium), the operations prime (OpCo) and the system prime (ESNIS) with ad hoc consortia (single-project companies) where the players are present with equal shares and the division of work share as the major preoccupation. There is no room for competition at prime and segment level nor is there any clear leader among the industrial partners and consequently the decisions need to be made by consensus, with the induced penalty on schedule and cost.

This weakness of the industrial set up has to be overcome as a prerequisite for any scenario to be selected.

Scenario 2 would hardly offer any possibility to improve the situation beyond the changes to be implemented in the IOV while the IOC and FOC deployment scenarios 3 and 4 can introduce leverage on the private sector:

- Robust and fair competition can be introduced at segment and lower levels on one hand for the infrastructure deployment where a sufficient critical mass exists, authorising dual-sourcing in some suitable cases, and on the other hand for maintenance and operations through regular competitive tendering.

- Decoupling of the infrastructure development part from the service provision part of the overall programme opens the possibility to deal with different categories of industrial teams ensuring that the respective deployment and exploitation phases are led by those who have the right expertise and interest.

The scenario 5 offers the possibility to totally re-open the industrial set up. However, the idea to create one single entity in charge of both the deployment and the service provision would probably repeat the problem of the current scenario, namely that the satellite prime contractors would lead the exploitation, something that they seem to have little interest in.

It is in any case clear that the path chosen by the public sector on the industrial procurement principles and the resulting industrial organisation, has to be consistent for both the public procurement phase and the PPP phase.

8.1.3. Market introduction logic and time-to-market

Scenarios 1 and 2 do not differ in this aspect: in both of them one can expect a strong lead by the space prime contractors as a result of the initial focus on deployment of the satellites and ground infrastructure whereas the room for service oriented industry is likely to be very limited.

The infrastructure being provided by the public sector, scenario 4 and potentially also scenario 3 may offer the possibility to attract a service provider as leader in the PPP, dedicated and focusing all its efforts on service provision. In similar space programmes in the past, Eutelsat or Eumetsat have successfully used the equivalents to the IOC or FOC deployment scenarios. In these two scenarios, one should analyse a differentiated

approach for the service introduction, both in terms of timely introduction (through a staggered approach) and in terms of market segmentation (application oriented service providers) which may offer more flexibility and efficiency than a fully fledged concession holder in charge of all the aspects.

To summarise, in the scenarios of IOC/FOC deployment, the PPP concession scheme is oriented towards the provision of operations and services of an infrastructure mainly procured by the public sector under public procurement scheme. The availability of an EGNOS qualified infrastructure offers the possibility to test in full scale the readiness and efficiency of service provides bidding for the Galileo exploitation.

8.1.4. Competitive supply

Currently, the programme is heavily penalised by the industrial agreements in place, resulting in monopolistic organisation and lack of competition at the levels of the concession holder (MC), system (ESNIS), segment (ESNIS shareholders), and operations (OpCo). The introduction of robust and fair competition and wherever appropriate double-source supply would present major advantages to the programme in terms of ensuring good value for money, procurement flexibility, technological innovation, and robustness due to diversity of supply.

It must, however, be recalled that competition or multiple suppliers may not be possible in all areas of procurement and supply (eg certain components and sub-systems are single sourced as a result of a too small market volume) and a proper balance will have to be found between IOV continuity and re-opening of competition with a view to ensure good value for money without unnecessarily disrupting activities. Whatever the scenario, the industrial set up and the introduction of competition will have a structurally positive effect on the FOC procurement and the concession scheme.

The current scenario offers limited possibility for competition: breaking the current IOV industrial set up without any further perspectives would only increase the confusion and put IOV in jeopardy. Scenario 2 is too limited to allow a real competitive environment, in addition it would be unreasonable to reopen a competition in the absence of a clear perspective on how to finalise the deployment of Galileo. This scenario could therefore de facto reinforce the current industrial set up and thus drastically reduce the possibility for any competitive environment in the future.

Scenarios 3 and 4 on the contrary allow the introduction of competition elements due to the critical mass of additional activities. This approach has many advantages mentioned above but may also induce risks which should be controlled. In any case selecting more than one supplier source requires that the final customer (the procurement agent of the infrastructure) is competent and staffed in order to exercise the system engineering task and organise the competition.

8.1.5. Validity of negotiating partner and industrial set up

In the current scenario the credibility of the merged consortium as a valid negotiation partner has been put in question as explained in the section 3. This credibility may be

recovered provided that the milestones defined by the Council in March 2007 are effectively met.

In the other scenarios a re-bidding of the concession is necessary. Therefore actions can be taken from the start to avoid similar problems as today, particularly in case of competitive offers.

8.1.6. International relations

Two aspects of international relations are of interest for this section: international cooperation and international competition.

International cooperation should serve as a catalyst and an instrument to drive the core interest i.e. Galileo European independence in satellite navigation and not the other way around.

The current scenario is ill suited to delivering on the expectations by the cooperating countries concerning industrial or research cooperation. The concession holder would want to retain full control on its procurement policy and raise the costs to the public sector if the public sector would intervene by e.g. opening up larger parts of work to international competition and/or to earmarking parts to specific non-EU countries. This could partly offset the political benefits and potential cost savings due to increased competition.

Consequently, any change to the current setting could be an opportunity to strengthen international support and commitment for Galileo and help alleviate the concerns expressed by current partner countries on their role diminishing in the programme in the next phase. A stronger role of the public sector (notably the EC) would give a possibility to exercise such control and the leverage to support Galileo.

The second important aspect of international relations is international competition. Competition in GNSS provision has never been so high as of today: GPS is pushing hard its modernisation programme; GLONASS is striving successfully at restabilising an operational system and to modernise it with a focus also on the GNSS mass market; COMPASS is developing at an impressive pace with a new ambition to serve mass market users.

A key differentiator between the scenarios should therefore be the time to market and the credibility of European public sector commitment to revive the Galileo programme. Therefore, as concerns the competition of international systems, Scenario 4 is the most promising for the EU whereas Scenario 5 is the most disadvantageous.

8.2. Technical and programmatic criteria

8.2.1. Comparisons of the scenario schedules

This section will analyse the most likely schedule of each of the scenarios, as well as their main characteristics, notably for what concerns the potential gap between the various phases (e.g., IOV-FOC) and finally, the effective date of the FOC. This analysis will allow to compare the characteristics of the programmatic risks associated to each

scenario notably in terms of continuity of the activities and of smooth transition from one phase to another. It will also provide the schedule assumptions necessary for the financial model used in the next chapter.

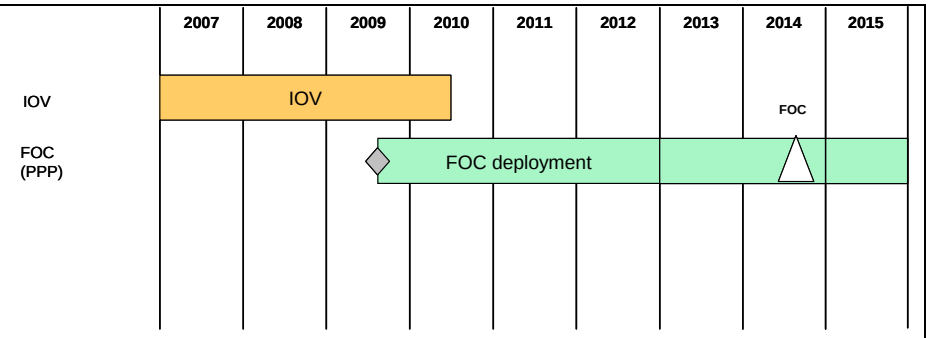
Some underlying key assumptions are:

- The time needed between the ordering of the earliest equipments necessary for the manufacturing of a particular satellite, the so-called Long Lead Items, and the delivery of that satellite ready for launch, is assumed to be three years in all scenarios.

- The maximum feasible launch rate is 12 satellites per year.

An optimisation of the time line to FOC is generally possible if it is possible to procure the satellite long lead items as early as possible in 2007, which heavily depends on the availability of committed budget and on the adopted procurement policy (e.g. selection of the satellite configuration). This aspect will also be used in the analysis.

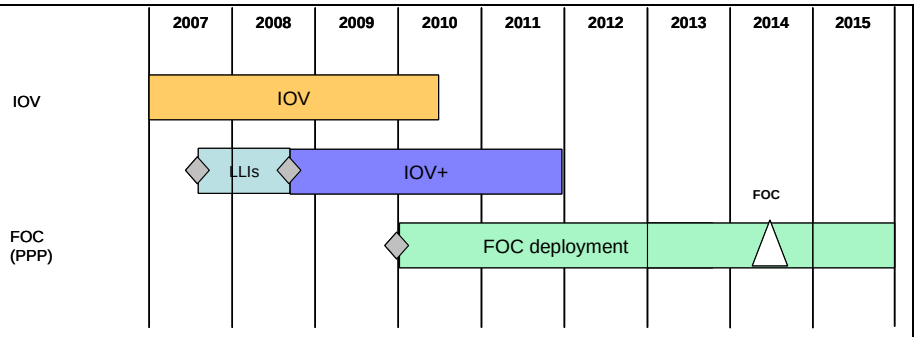
Scenario 1

Baseline schedule	
Main characteristics	- **Gap between IOV and FOC[20] of more than 2 years** - FOC: **mid 2014**
Programmatic risks	- Very high programmatic risks in case of launch failure in IOV (no spare satellites available) - Very negative impact on IOV due to gap with FOC (lack of perspective for IOV completion) - Very limited time for the hand-over (less than 1 year) - Limited leverage to settle the starting date of the FOC procurement (no control on the real gap) leading to very high risk of schedule slippages and cost overruns
Remarks	- IOV will need risk mitigation activities (up to 4 additional satellites) but not all identified, major risks will be adequately

[20] Difference between end of IOV and availability of first satellites procured in the FOC PPP contract.

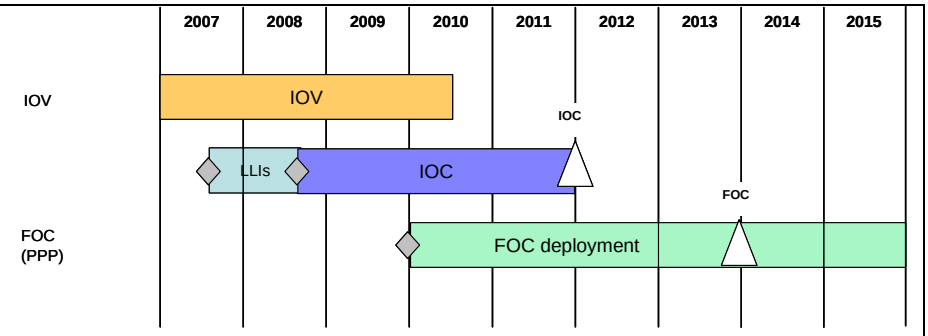
	covered - IOV likely to suffer significant delay and over-cost due to the gap with FOC. - PPP contract not concluded before mid 2009
Possible FOC time line reduction	- revised FOC date with specific effort on long lead items procurement: **Mid 2013**, with **low** probability of success (depends on early budget commitment availability and concession holder commitment)

Scenario 2

Baseline schedule	
Main characteristics	- Continuity between various phases partly achieved (note: launch of 8 additional satellites reduces IOV-FOC gap to 16 months instead of 24 in scenario 1) - FOC: **mid 2014**
Programmatic risks	- Case of launch failure in IOV is addressed by LLI procurement under IOV^{+} provided authorisation is given by mid 2007. Otherwise preventive risk mitigation actions shall be undertaken as part of current IOV by procuring at least LLIs for satellites 5 and 6. - Limited leverage to settle the starting date of the FOC procurement - Perspectives towards FOC depend on an hypothetical success of future PPP negotiations.
Remarks	- IOV may need some adaptation depending on timeline for IOV^{+} decision making and associated commitments with industry (satellites 5 and 6 to mitigate against IOV launch failure) - IOV continuation will be difficult to proceed without perspective towards FOC

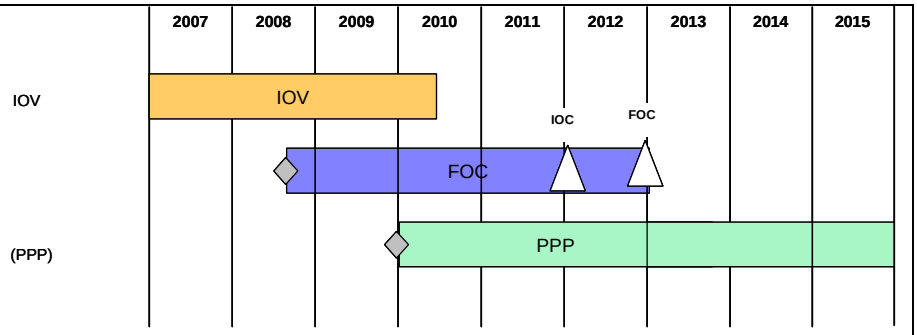
	- "buy time" scenario should be accompanied only if there is a high level of confidence on the PPP contract - IOV^{+} contract started with advanced LLI procurement mid 2007 followed by full IOV+ contract awarded following a 12 month tendering and negotiations process - New PPP contract negotiated and put in place after a 30 month tendering and negotiating process: early 2010
Possible FOC time line reduction	- revised FOC date with specific effort on long lead items procurement: **Mid 2013**, with **low** probability of success (depends on early budget commitment availability and negotiations with new concession holder)

Scenario 3 (IOC)

Baseline schedule	
Main characteristics	- Continuity between various phases achieved, gap with FOC removed - IOC: **end 2011** (subject to early LLIs procurement) - FOC: **end 2013**
Programmatic risks	- Case of launch failure in IOV is addressed by LLI procurement under IOC provided authorisation is given by mid 2007. Otherwise preventive risk mitigation actions shall be undertaken as part of current IOV by procuring at least LLI's for satellites 5 and 6 - Perspectives towards FOC depend on a successful completion of future PPP negotiations.
Remarks	- IOV may need some adaptation depending on timeline for IOC decision making and associated commitments with industry (satellites 5 and 6 to mitigate against IOV launch failure) - IOC advanced LLI's committed by mid 2007 based on current supply chain, followed by full IOC contract awarded following a 12 month tendering and negotiations process: mid 2008

	- New PPP contract negotiated and put in place after a 30 month tendering and negotiating process: early 2010
Possible FOC time line reduction	- revised FOC date with specific effort on long lead items procurement: **end 2012**, with **low** probability of success (depends on early budget commitment availability and negotiations with new concession holder)

Scenario 4 (FOC)

Baseline schedule	
Main characteristics	- Continuity between various phases achieved - (IOC: **end 2011**) - FOC: **end 2012**
Programmatic risks	- Case of launch failure in IOV is addressed by LLI procurement under FOC provided authorisation is given by mid 2007. Otherwise preventive risk mitigation actions shall be undertaken as part of current IOV by procuring at least LLIs for satellites 5 and 6
Remarks	- IOV may need some adaptation depending on timeline for FOC decision making and associated commitments with industry (satellites 5 and 6 to mitigate against IOV launch failure) - FOC contract awarded following a 12 month tendering and negotiations process - New PPP contract finalised after a 30 month tendering and negotiating process: early 2010 - FOC does not depend on the PPP contract

Scenario 5 (re-bidding)

Baseline schedule	- June 07-March 08: tendering preparation - Sept 2011: PPP contract for the full project - FOC: **Sept 2017** (most likely)
Main characteristics	- Unclear until scenario is validated by actual offers
Programmatic risks	- Uncertain schedule of the overall deployment (the reasons leading to the delay of FOC remain unchanged) - impact on the current IOV programme which has to be properly closed down and put on hold until the re-bidding process is complete and the IOV-FOC concession scheme is in place
Remarks	

Scenario 6 (Stop Galileo, EGNOS only)

The schedule aspect of the Galileo programme is rather straightforward. The refocusing on EGNOS will induce additional effort on defining the next phases (modernisation) of EGNOS.

8.2.2. EGNOS integration

It is now clear that the EGNOS integration is not any more compatible with the current Galileo concession schedule. EGNOS will enter in the operational phase in March 2008, at a date when it is impossible to have the Galileo concession mature enough for a proper handover (this handover should have duration of 6 months minimum).

However, beyond this incompatibility in terms of schedule leading to the necessary decoupling of EGNOS and Galileo, scenario 4 seems more appropriate because the nature of the tasks assigned to the concession holder are essentially the same for EGNOS and Galileo (services, operations, replenishment of an infrastructure). It allows an early involvement of the future Galileo concession holder with its initial activities being focused on the early introduction of satellite navigation services based on EGNOS. This opens the way for the selection of a concession holder (or to a set of application specific concession holders) fully motivated and skilled for the service provision, and having demonstrated its motivation on EGNOS.

8.2.3. Technical baseline stability

In scenarios 1 and 2, the fact that the final (FOC) configuration remains in the hands of an entity different from the one being in charge of the initial (IOV) development, is a major source of technical instability as the final user not being in a position to really interact with the IOV.

In scenarios 3 and 4, the deployment is to a significant extent or completely managed by the public sector and therefore the programme technical baseline is at least kept under a single authority's responsibility during the development and deployment phases, namely ESA under authority of the EU.

In scenario 5, the final user and operator is theoretically in a position to merge IOV and FOC into one single baseline. However, the sudden interruption of the on-going IOV technical work and the long delay (several years) to resume with a combined IOV-FOC scenario will inevitably induce a large technical discontinuity, reassessment of services and mission objectives, and a loss of IOV investment so far.

In any case for the first four scenarios a process enabling a close interaction between the public sector and the future concession holder has to be put in place.

8.2.4. Impact on the IOV phase

The current scenario has a very negative impact on IOV. On the one hand the lack of clear perspective towards FOC de-motivates industry to complete IOV on time. On the other hand this scenario generates a high risk of technical instability and a "technical gap" between IOV and FOC. This puts in question the validity of the IOV investment in the context of the overall programme. Scenario 2 alleviates slightly these problems for a limited period of time with a high risk that the same situation occurs in one year from now. In the absence of a clear perspective for the FOC, in both scenarios it is doubtful that the ESA Member States would accept to finance the associated additional activities needed in the IOV.

Scenarios 3 and 4, where the IOC or the FOC is under public sector responsibility, may introduce some very positive effects for the IOV. The expectations related to the future deployment activities may improve the motivation of the industry to complete the IOV in reasonable time and within costs. In both scenarios, the political decision to embark on a complete or almost complete deployment under a public procurement scheme should clear up the future and provide the impetus which is currently missing. The re-definition of the concession scheme along the lines of operations and/or service provision would focus space industry on the IOC/FOC procurement and produce positive effects on the IOV. In these scenarios, IOV is de facto integrated into an overall deployment plan. The transition from the current IOV set up into the overall IOV-IOC/FOC scheme has to be carefully handled in order not to jeopardize the completion of the infrastructure under development within IOV. Introducing elements of robust and fair competition and double sourcing are required for the long-term flexibility and robustness of the programme.

From a cost perspective, although the IOV Phase is controlled by a firm fixed price contract and a clear set of technical requirements, the IOV schedule and cost at completion is in reality affected by the perspective of the various FOC scenarios. The two first scenarios are bound to produce a negative effect on IOV, while scenarios 3 and 4 produce the reverse positive effect. The main difference comes from the fact that a clear FOC baseline (technically frozen and firmly planned) should motivate the industry to perform well and deliver the IOV elements, especially those suppliers potentially to face competition about future work. In the present scenario where the future is uncertain, a delay in delivering the IOV elements is not considered as a very critical issue by industry.

In scenario 5, IOV is put on hold until a complete revised scheme is established. The potential cancellation of the on-going IOV contract and the merging of IOV and FOC in one single contractual framework begs the question of the costs (new industrial structure, potential cancellation costs of the IOV contract etc…) and leads to a serious loss of IOV investment.

8.2.5. Hand-over of the publicly procured parts to the respective PPP´s

In the current scenario, the concession candidate claims that the design risks remaining at the end of the IOV are too high for it to commit today or in the short term on the cost for the whole duration of the programme. These design risks are very often a source of confusion, and it should be recalled that the IOV phase is essentially a design risk mitigation action. For the purpose of comparison, the design risks are defined as the remaining design elements and performance parameters that cannot be verified and validated at IOV.

Scenario 2 does not significantly improve the situation, since the limited number of additional satellites does not allow for a complete verification of the system and services performances. The only advantage of this scenario is that the delay introduced in the concession makes it possible for the concession holder to get the results of the critical design review at segment and system levels before being required to commit its funds to the PPP contract. On the contrary, the IOC deployment scenario 3 (largely) and the FOC deployment scenario 4 (completely) offer a demonstration of the system and services performances. The residual "design risk" to be handed over to the PPP will reside in the limitations associated with the lifetime of certain elements of the system.

However, scenario 4 has a key difference compared to the IOC deployment scenario in the fact that the future concession holder will not get the responsibility to launch additional satellites other than those for maintenance and replenishment purposes. This simplifies significantly the hand-over challenge of this scenario compared to the others.

The hand-over phase will also imply a technical learning phase of the concession holder, where ESA and concession holder teams will work together in order to allow a seamless transfer of competencies and responsibilities. This extended learning phase is a key element allowing both the public and the private sector to better understand and assess the design risks.

As we have seen previously, the current scenario does not provide sufficient time for this staggered involvement of the concession holder, while the extended duration of the public procurement phase in the scenarios with continued public sector procurement makes this phase possible.

8.3. Financial comparison of the scenarios

In terms of judging the financial implications of these scenarios, the financial modelling is based on early assumptions and extrapolation of crucial data and the results need therefore to be viewed as approximate and for comparison purposes. The definitive results will depend on the terms of the respective contracts. The results are shown below and are for comparison purposes only. The figures are without prejudice to the results of

any negotiations and eventually chosen modalities, including in particular the length of the PPP concession.

Scenario	Total number of satellites under public procurement	Public sector support[2]			Total required public sector budget commitment[6]	Start of full operations[8]
		Requested public sector budget in perspectives 2007-2013[3] (for satellites and infrastructure under public procurement)	Availability Payments (underpinning by public sector) for the PPP (until 2030)		2007-2030	
			Fixed part[4]: - operating cost - maintenance - replenishment debt interest	Variable part (depending on number of satellites and infrastructure procured by private sector)[5]: - debt principal - debt interest - return on equity		
		Nominal	Nominal	Nominal	Nominal	
Continue present scheme, and add mitigation actions[1]	4+4	2.4	5.3	3 - 4	11 -12	Mid-2014
Re-inforce the actual scheme	12	2.5	5.3	3 - 4	11-12	Mid-2014
Build an initial operational capability (IOC) followed by a PPP	18	3.0	5.3	2 - 3	10 -11	End-2013
Build the full, first constellation (FOC) followed by a PPP	30	3.4	5.3	0.5 - 1	9 -10	End-2012
Full programme re-bidding	0	0.9	5.3	6 - 7	12- 13	End 2017

1 According to the latest programmatic analysis carried out by the European Space Agency, the accumulated delays imply risk mitigation activities and the construction of four additional satellites to ensure the continuity of the industrial production line between the in orbit validation phase and the first activities of the deployment phase. Moreover, it also implies the need to protect the in orbit validation phase against potential launch failure. This was initially covered by the first satellites of the deployment phase.

2 In the Galileo PPP model, the public sector contributes with grants for the deployment of the infrastructure and with availability payments to underpin the exploitation of the system. The private sector contributes with equity and debt. Both agree on a sharing of risks commensurate with the contributions.

3 The figures include the part of Galileo procurement costs for the public sector, the EGNOS exploitation costs, and the IOV cost overruns. Estimates are based on ESA costing data, validated by existing contracts and the ESA procurement database, and cross-checked against all the submitted bids during the entire concession negotiation phase.

4 The fixed part of the availability payment covers operations, maintenance, and interest of the replenishment debt. This is the same for all scenarios as it concerns the operations and maintenance of the entire constellation and its replenishment. Data is based on cost estimates from the technical and economical studies carried out during the definition phase by ESA and the Commission (GALA, PwC, Comparative System Studies) and cross-checked against all the submitted bids during the entire concession negotiation phase.

5 The variable part of the availability payment covers the debt service (debt principal, interests, fees, etc) and return on equity injected. This is dependent on the debt and equity that is linked to the size of the procurement that the private sector needs to

undertake, and the agreed gearing between equity and debt. The figures shown in the table are indicative and based on the current negotiations and experiences from similar PPP projects.

6 The public sector budget commitment concerns the overall direct costs for the public sector by adding procurement costs (see 3) and availability payments (see 4 and 5). This covers market risk. Termination clauses will be included in the PPP contract which will be triggered if and when the real revenues decrease below pre-defined thresholds. Indirect risks (design, completion, performance, cost overrun, termination, liabilities) that the public sector may accept to retain as its responsibility are not covered by this budget commitment. These risks need to be dealt with, if and when they materialise.

7 Start of full operations is important with regard to the arrival of competing systems. The earlier the starting date of full operations for all services and markets, the higher the market share for Galileo is expected to be.

The assessment of the various scenarios presented in the first column has been performed on the basis of a set of parameters, assumptions and hypothesis.

Constellation: the total number of satellites required for the full Galileo constellation is 30, a part of which is procured by the public sector and the remaining part by the private sector under the PPP. The second column represents the total number of satellites under public procurement. It therefore corresponds to the total number of satellites financed, developed, built and launched by the public sector. The figures shown include the 4 satellites of the actual In-Orbit Validation phase.

Concession period: in all scenarios of the financial model, the end date of the concession is fixed in 2030.

Costing data: The costing figures are based on European Space Agency models, as validated by existing contracts and ESA procurement database. The delta cost with respect to the actual IOV baseline for the various scenarios are:

- 8 satellites: 1.1 B€

- 18 satellites: 2.1 B€

- 30 satellites: 2.9 B€

Inefficiencies: figures include an "inefficiency" factor in case of public procurement.

Revenue profile: the revenue profile is extracted from the financial model in the offer of the Merged Consortium. This model has been validated through an independent assessment of a Consultancy Company for the Galileo Joint Undertaking in 2006. The base-case cumulative value of all revenue sources during the whole concession period is estimated at 10 B€. The revenue profiles are identical in all scenarios. Net figures do account for the sharing of revenues between the public sector and the private sector. Time adjustment with respect to the final operational capability (FOC) date is implemented by sliding the revenue profile accordingly. However, the estimate of revenues should be considered with caution as the commercial risk remains high. In this respect, it has to be highlighted that the arrival of GPS-III on the market in 2018 with some equivalent services free-of-charge could not be modelled. In order to take this uncertainty into account, a calculation has been made of the total public sector commitment if commercial revenues were zero. This provides an upward boundary to the net costs for the public sector.

Total public sector commitment: this figure is the addition of the investment of the public sector for the deployment of the infrastructure (in the form of grants) and the availability

payments (AP) for the exploitation of the system. It somehow gives an indication of the maximum public sector commitment in case that no revenue would materialise at all.

The grant includes, where appropriate, the direct community contribution to the deployment of the infrastructure (channelled through the European Space Agency as procurement agent) and/or the contribution to the private sector to support its effort in building up the remainder of the full infrastructure.

– The availability payments cover:

  – operating costs,

  – debt service (principal, interest, fees, etc.),

  – return on base case equity injected by the private sector over the PPP contract period,

  – cost of the replenishment debt (interests).

It is noted that termination clauses will be included in the concession contract which will be triggered if and when the revenue profile decreases below pre-defined thresholds.

The figures are here expressed in nominal values, i.e. in current values, not discounted.

Requested public sector budget in the frame 2007-2013: this figure represents:

– the grant during that period which includes, where appropriate, the direct community contribution to the deployment of the infrastructure (channelled through the European Space Agency as procurement agent),

– and/or the contribution to the private sector to support its effort in building up the remainder of the full infrastructure,

– the cost of EGNOS operations and maintenance,

– the over cost of the IOV phase IOV over cost. It is noted that in the IOC scenario, part of the over cost is absorbed in the public procurement of the system and in the FOC scenario, the whole over cost is absorbed in the public procurement.

It is noted that the effect of the cost of public resources is not modelled in the financial calculations. Even if public resources are provided in the form of grants, economically these grants have not a zero cost, since ultimately they will require public borrowing (in the range of 4%). However, as this applies to all scenarios, it affects only the difference between 3.4 B€ and 2.4 B€ (i.e. on 1 B€). In this context, the outcome is marginal and covered within the range of the total required public sector commitment over the whole period.

Start of full operations: this indicates the moment at which the infrastructure becomes fully operational, allowing provision of all Galileo services for all targeted users and provides full confidence of design robustness. It is also described as the "final operational capability" (FOC).

Return on Equity: in order to finance its part, the private sector raises some senior debt and injects a certain amount of equity. The amount of equity is commensurate to the total investment the private sector is required to do in the PPP. The equity is rewarded according to the level of risk it takes. It is also noted that both the level of equity and the level of equity return are adjusted to reflect the risk sharing achievable in the scenarios.

Replenishment: in all scenarios, the replenishment capital expenditure is assumed to be financed by raising additional debt within the PPP. The financial costs (interests) of this replenishment debt are covered under the availability payments. The amount of the outstanding replenishment debt is therefore not included in the total public sector contribution figures computed for all scenarios. At the end of the concession period, the PPP hands back to public sector a fully functioning constellation, together with the replenishment debt. This long term approach is consistent with the fact that the infrastructure will be re-introduced into a new concession at that stage.

In light of the evaluation of the various scenarios, the procurement by the public sector of the full constellation is the most advantageous. Effectively, as the trend shows in the table, the more the private sector is requested to provide financing for the infrastructure, the higher the part of the availability payment that underpins debt, debt interest and the return on equity.

This needs to be off-set against the risks that are retained under the various scenarios. Normally, the higher levels of underpinning of the public sector are compensated by a transfer of risk to the private sector. However, as the current concession negotiations have shown, this risk transfer is currently not negotiable at reasonable conditions for the public sector and, in effect, in all scenarios the public sector retains most of these risks. As a result, the effect of underpinning of debt, debt interest, and return on equity plays a major role in the overall value-for-money assessment.

The assumption has been of a baseline revenue return over the period 2007-2030 of a total of 10 B€. However, most of this will be available towards the end of the period. Therefore the total costs for the public sector are not a simple subtraction of revenues from the total nominal costs but is it necessary to calculate a so-called Net Present Value (at a discount rate of 6%) of the total public sector costs. It is the standard method for the financial appraisal of long-term projects. The result is presented in the table below.

Scenario	Total Public Sector Costs NPV
Continue present scheme, and add mitigation actions	~ 1.8
Re-inforce the actual scheme	~ 2.0
Build an initial operational capability (IOC) followed by a PPP	~ 2.2
Build the full, first constellation (FOC) followed by a PPP	~ 1.0
Full programme re-bidding	~ 1.8

The public sector contribution expressed in Net Present Value, which takes account of the sharing of revenues between the public and the private sectors, is most advantageous in the FOC scenario with a value of around 1.0 B€. In return however, a larger investment is necessary in the Financial Framework 2007-2013.

8.4. Risk assessment of the scenarios

The assessment of the potential risk transfer among the different scenario is complicated because each option has a different risk profile and consequently a different cost envelop (risk pricing) which is difficult to estimate a priori.

Moreover, a comparative analysis has unavoidably a subjective appreciation of the different potential scenario and in particular on the results which might be achieved through the negotiation process.

The underlying assumption as concerns risk transfer assessment has been that the value-for-money principle is respected, that is to say that risk should be retained by the party best capable of managing it. Of course, a risk transfer comes at a price and this is reflected in the value-for-money assessment.

The analysis has been carried out in qualitative terms, on the basis of the following sub-criteria:

(1) Completion risk:

An effective risk transfer is strictly related to the design risk transfer. Risk transfer to the private sector is decreasing with the involvement of the Public Sector in the deployment phase.

(2) Design risk:

With the progress of the development phase, the design risk is reduced. Thus the more the constellation is deployed at the handover to the private sector, the more the risks are mitigated (and taken by the public sector), the more confidence the private sector has in the system and less residual risk there is. Consequently, the degree of risk transfer depends on one side on system development/deployment and on the other side on the private sector degree of involvement in the development/deployment phases. At the same time, the more involvement of the public sector, less design risks are to be transferred to the private sector.

(3) Market risk

There are two aspects to be taken into account:

- the point in time when the contractual commitment has to be taken vis-à-vis the market entry.

- the possibility to modify the design in order to better respond to user requirements.

(4) Cost control (cost overrun risk)

The more (sooner) the private sector is involved and the cost overrun risk is transferred to the private sector side, the better the costs are controlled. Experience has shown that the public sector is rather inefficient in controlling costs. Cost control over the operational phase is the same for all the analysed scenarios.

(5) Termination Risk

Concerns the potential costs that the public sector faces in cases that the contracts will be terminated for either authority or contractor default.

In the absence of a party other than the public sector, able to take responsibilities on risks, the assessment is based on the ability of the responsible actors to accept and manage the risks in each scenario.

Scenario 1

The current status of the negotiations has shown the unwillingness of the private sector to undertake design risk. This does not mean that it is impossible to transfer design risk under this scenario. However it means that such a risk transfer is likely to come at very high prices and to represent poor value for money for the public sector. In addition, the amount of market risk which the private sector is ready to undertake under this scenario is very limited.

Completion risk	This risk is well transferred to the Private Sector.
Design risk	The targeted amount of design risk transfer is significant. The public sector ability to effectively transfer it has resulted to be very little in the negotiation so far.
Market risk	The risk transfer is in this case limited.
Cost control (cost overrun risk)	This risk is reasonably transferred to the Private Sector.
Termination risk	Contract cancellation has a high, negative impact for the Public Sector

Overall value-for-money assessment: Very limited.

Scenario 2

No substantial difference to scenario 1a. Due to the limited deployment by the public sector, the design risk for the completion and exploitation phase remains relatively high and may be difficult to transfer.

Completion risk	This risk is transferred to the private Sector.
Design risk	The risk transfer is in this case very limited.
Market risk	The risk transfer is in this case very limited.

Cost control (cost overrun risk)	This risk transfer is reasonably transferred to the Private Sector
Termination risk	Contract cancellation has a high, negative impact for the Public Sector

Overall value-for-money assessment: Very limited

Scenario 3.

The substantial retention of design risk by the public sector in this scenario is not making major differences in terms of design risk allocation with respect to scenario 1 and 2 where actually the public sector ability to transfer it has demonstrated to be rather little unless a very high price is paid to the private sector. On the other hand the better knowledge of the market and the early operational capabilities of the system at the time of IOC should represent a sufficient incentive for operators bidding for the PPP contract under competitive environment to undertake market risk. For these reasons the value-for-money for the public sector is likely to be improved with respect to scenario 1.

Completion risk	This risk is substantially retained by the Public Sector.
Design risk	This risk is substantially retained by the Public Sector.
Market risk	Better prospect to transfer market risk as compared to scenario 1
Cost control (cost overrun risk)	This risk is substantially retained by the Public Sector for what concerns the deployment phase.
Termination risk	Better prospects compared to scenarios 1 and 2

Overall value-for-money assessment: Fair.

Scenario 4

In relation to design risk transfer the same considerations made for scenario 3 are applicable. As far as market risk is concerned this scenario is likely to provide the best possibilities to transfer market risk as compared to scenario 1, 2 and even of scenario 3 given that at FOC there will be full knowledge of the system performances and of the market situation. The competition between private sector contractors interested in delivering the Galileo services when the system deployment will be completed is likely to produce the best market risk allocation for the public sector transfer as compared to scenario 1, 2 and 3.

Completion risk	This risk is retained by the Public Sector.
Design risk	This risk is retained by the Public Sector but the remainder should be easily transferable in the PPP.
Market risk	Better prospect to transfer market risk as compared to scenario 1, 2 and 3
Cost control (cost overrun risk)	This risk is substantially retained by the Public Sector for what concerns the deployment phase.

Termination risk	The impact of cancellation of the PPP has the lowest impact of all scenarios

Overall value-for-money assessment: Good.

Scenario 5

The main issue seems to be the uncertainty how the private sector would deal with the accomplishments of the current IOV phase. Either they would not retain much of the IOV design and then risk loosing many years in re-design and re-qualification, or they may choose to use substantial parts of the current IOV design but there is a high probability that they would not want to accept the design risk for those parts. As a result, although there is a possibility to transfer risk, the costs for such a transfer may be very high.

Completion risk	This risk is theoretically transferred to the Private Sector, however it has a high probability to come at a high cost.
Design risk	This risk is theoretically transferred to the Private Sector, however it has a high probability to come at a high cost.
Market risk	The risk transfer is very limited.
Cost control (cost overrun risk)	This risk is theoretically transferred to the Private Sector, however it has a high probability to come at a high cost.
Termination risk	Contract cancellation has a high, negative impact for the Public Sector

Overall value-for-money assessment: Very limited

In summary, the overall value-for-money assessment shows that the combination of ability to transfer risks and the conditions at which this is likely to happen is fair for scenario 3 and good for scenario 4, while is only limited or very-limited for the other scenarios.

8.5. Summary overview of the analysis of the implementation scenarios

grades '++', '+', '-', '--' are relative the current scenario; '0' means an equivalent situation to the current scenario

Criteria	Scenario 1: Current with risk mitigation	Scenario 2 (IOV+)	Scenario 3 (IOC)	Scenario 4 (FOC)	Scenario 5 (rebidding)
General issues of relevance					
Programme logic	0	-	+	++	+
Partnership potential with private sector	0	0	+	++	0
Market introduction logic	0	0	+	++	--
Competitive supply	0	0	++	++	0
Validity of negotiating partner and industrial set-up	0	+	+	+	+
International relations	0	+	++	++	-
Technical/Programmatic					
Timeline to FOC	0	0	+	++	--
Gap IOV-FOC	0	+	+	++	++
Technical baseline stability	0	+	+	+	--
Handover	0	+	+	++	++
Impact on IOV	0	+	++	++	--
Egnos integration	0	0	0	+	0
Financial					
Budget commitment 2007-13/overall	0/0	0/0	-/+	--/++	--/-
Affordability	0	-	-	++	0
Revenue robustness with respect to timeline	0	0	+	++	--
Risk sharing					
Completion risk	0	0	-	-	0
Design risk	0	0	0	+	0
Market risk	0	0	+	++	0
Cost control risk	0	0	-	-	0
Termination Risk	0	0	+	++	0
Value-for-money	very limited	very limited	fair	Good	very limited

The results of the various criteria have been summarised as follows: the best scenario is scenario 4. It is followed by scenarios 3 and, on a shared position, 1 and 2. Scenario 5 is the last while scenario 6 was not ranked as it lacks the Galileo component (EGNOS only) and is thus not comparable.

Summary

Scenario 4 (FOC public procurement followed by an exploitation PPP) is the superior, alternative, implementation scenario due to its affordability, value for money, its higher programmatic certainty (schedule independent of a future PPP), earliest possible time-to-market, its fully fledged program logic (essential for a smooth hand-over to a concession holder), its best re-use of IOV investment (restores confidence and motivates the industrial teams), the better leverage over the private sector (the only scenario which restores competition and provides better control by the public sector both over the deployment and the exploitation phases), and the best possibility to change the boundary conditions in such a way that a PPP becomes a negotiable proposition at reasonable conditions for the EU.

The argument about the PPP providing financing security and therefore superior cost control may be true in simpler projects like building a toll road, however, not in a complex program where due to difficulties of establishing a clear business plan, the public sector is requested to underpin all costs/risks.

Scenarios 2 and 3 answer partially to the problems of the current scenario with scenario 2 improving the situation only very marginally.

Scenario 3 (IOC public procurement followed by a deployment and exploitation PPP) could be an acceptable alternative on the condition that a clear perspective towards FOC can be guaranteed through this scenario (fall back to 4).

Scenario 5 would amount to a considerable loss of investment (a large part of the 1.5 B€ already contracted).

Scenario 6 would create a negative political and economic impact without a precedent as the EU would withdraw the project that cited as a flag bearer of the Lisbon strategy. Abandoning Galileo would recreate and significantly increase the dependency on GPS[21] and potentially Glonass (Russia) and Compass/Beidou (China). All these systems are of a governmental, dual use nature, constructed and operated entirely on the basis of public funding. Europe would be the only major economy without such a strategic asset. This will have further important political impacts for the European Union as our co-operation with third countries will lack an important asset. This would mean that the European Union would be dependent on systems and technologies elsewhere for applications vital to the running of the society tomorrow. Not implementing Galileo, but only proceeding with the implementation of EGNOS, would not only be a major technological drawback for Europe but would cause a major loss of macro-economic opportunities for European manufacturing and services industries. In the absence of resident technical expertise, the European private sector would be in a bad position to reap the benefits of the world-wide market of satellite navigation services and applications of 450 B€ annually by 2025. The European private sector has indicated that it counts on achieving a one-third market share thereof, equivalent to 150B€ annually. Last but not least, Europe has already engaged 2.5 B€ in the development of the European GNSS programmes[22] to date. The direct financial

[21] EGNOS augments, and is based on, GPS signals by means of a, currently only regional, European ground infrastructure.

[22] The total of the IOV contract (1.5 B€), the EGNOS costs (0.7 B€) and ESA and EU research over the years.

losses would be similar to those in scenario 5. Not pursuing Galileo would limit the momentum created in Europe and discourage industries from investing in navigation and space technologies.

Timing of a political decision on how to proceed is now critical as in the absence of a clear decision by mid 2007, the Galileo programme will be confronted with major difficulties, in particular with regard to the existing IOV contracts.

In any case the absence of a clear decision, i.e. a determined choice for one of the recommended scenarios) would have the following consequences:

1. The European GNSS programmes will enter into a period of turbulence thereby seriously complicating, if not paralysing, the role of the GSA, the day-to-day management role of ESA, and the work of the industry under the IOV contracts. Downstream industry worldwide would refocus their priorities to other projects.

2. The IOV contract with ESNIS is unlikely to be able to be remedied and put back on the rails and that at considerable costs (estimated at 20 M€ per month).

3. It is very doubtful if a delayed or no decision, or even a decision to continue with the current Merged Consortium, would improve the situation of the current concession negotiation. The analysis shows that the changes of success of the current negotiations are very low indeed.

Due to the drawbacks of a lack of decision, the period for a political decision of the implementation scenario as well as the period for the final go-ahead should be very limited in time.

9. GOVERNANCE

Under any of the scenarios set out, the current governance structure of the public sector needs a drastic improvement defining clear chains of responsibility, as well as clear reporting channels, with ultimately the Council being in charge of defining the overall policy of the programme.

The role of the GSA as defined in Regulation 1321/2004 has to be reviewed in particular as its nature is affected in most of the scenarios. The role of ESA, which is little mentioned in the GSA Regulation, in the coming phase of the programme, needs also to be better defined and recognised given its increased longer term responsibility in most of the scenarios.

In addition, the issues of programme management and programme oversight need to be untangled and clarified as, arguably, the Member States have not only taken on the controlling role which is theirs, but have also taken a role in the daily management of the programme. At the same time, further policy definition and development is required on a number of aspects of the programme and this work needs to be advanced at a quicker pace.

9.1. Problems encountered

Initially, the GSA was created for a situation where the development phase is finished and the concession contract signed, i.e. where all questions of principle have been resolved and the GSA has mainly to ensure the respect of the concession contract and related technical matters. That is why a high level of independence was given to the GSA Executive with, at that stage, such contractual and very technical decisions in mind.

Earlier on however, the GJU Executive, which was responsible for the development phase (with ESA) and the concession negotiations, was put under much closer control by the Commission and ESA (via its Executive Committee) given the important decisions of principle it had to take.

The underlying problem is that, due to the programme delay, the GSA has now to deal with the former tasks of the GJU, but with a structure that has not been created for this purpose. To be noted in particular that, according to its present statutes, GSA has to:

– conduct concession negotiations which involve long term strategic decisions for the Community in financial, budgetary and security terms.

– supervise the development phase conducted by ESA, which pre-determines a number of elements for the concession contract and the longer term development of the system and involves close cooperation with ESA.

The same problem applies to ESA. According to most scenarios it will bear the responsibility to procure parts or all of the 30 satellites, thus exercising a role that is much more important than initially planned, without this role being reflected in the present institutional set-up.

The Galileo management structure needs to be adapted to this unintended situation (the earlier amendment to the GSA regulation only dealt with the transfer of tasks but did not

address the management structure). A mechanism where the Commission can exercise control over the GSA and ESA on behalf of the European Communities needs therefore to be established.

9.2. Review of the role of the GSA

The following paragraphs stand in particular for the case where either scenarios 3 or 4 would be retained by the Council, i.e. where all or large parts of the satellite and ground infrastructure would be procured via ESA.

The additional activity required for these scenarios obviously lead to a need to re-focus the priorities of the possible tasks of the GSA, namely:

- procure the EGNOS and Galileo concessions;
- assist the Commission in the development of EGNOS and Galileo applications;

In order to assure that the Commission can assume its full responsibilities in the development of the programme, an agreement is needed so as to align the governance of the GSA to the new situation.

9.3. Review of the role of the ESA

ESA is currently in charge of the Galileo development phase. The link with the EU, including the GSA and the Commission, is not sufficiently clear and too complicated. For example, the GSA-ESA Agreement does not address several critical areas. The link with the Commission is lost in this set-up.

In the recommended scenarios, the role of ESA remains similar to the one of the development phase, i.e. procurement agent and design authority. However, it is highly advisable to further address the following elements:

- ESA needs to act under the rules and the control of the EU. This should be addressed in a contract with the EU. This contract should notably address the issue of the liability of ESA with regard to cost overruns and design, completion, and performance risks, as well as the procurement rules to be followed by ESA.
- ESA needs to be adequately staffed to ensure a successful implementation of the FOC contract, notably in the case where more competition is introduced, transferring in effect the role of prime from ESNIS to ESA.
- The role of ESA in the period following the procurement needs to determined, notably as the Galileo design authority.

9.4. Conclusions

In view of the above analysis, the conclusion is that there is a need for the strengthening and restructuring of the public governance of the European GNSS programmes on the

basis of political responsibility and leadership of the Commission, on the basis of proposals by the latter.

This should be agreed and put in place as soon as possible in order to re-establish public sector leadership, clear lines of responsibility, an effective programme management, and a clear role of the Member States in terms oversight and policy definition.

As the owner of the system, the EU has the responsibility, in particular, to: ensure that its political commitments and vision are implemented, determine and agree on the overall specifications and requirements for the system; to be able to monitor and control the strict adherence to such requirements throughout the construction, deployment, and exploitation phases; to oversee the different phases of the programme in order to avoid further delays and cost overruns; and providing the conditions for coherent, efficient, and harmonious private sector governance wherever relevant.

With regard to the need for an efficient and sound programme management, the European Commission needs to be able to run the programme with adequate programme management controls and tools, fully respecting the political vision and conditions of the European Union as a whole.

The European Space Agency (ESA) should be retained as the procurement agent and designing authority on behalf of the European Union. This means that ESA will have to exercise its technical expertise under EU rules and subject to overall EU management of the programme. Also in view of the approach taken, a clear procurement agreement with ESA is necessary, in particular with regard to the retained level of liability if acting as a procurement agent and/or design authority for the EU.

Such an agreement should be based on, *inter alia*, the following principles:

- Recognition of the strategic nature of the Galileo programme and the critical role of broad-based European industrial supply and private sector participation therein;
- Competitive tendering in contract batches for all space and ground segment elements;
- Dual-sourcing wherever possible to improve efficiency and decrease dependencies;
- Due account to existing achievements and investments and of agreements as far as relevant;
- Firm and fixed price contracts;

In the new situation, the role of the GSA has also to be thoroughly reviewed. The GSA may in future have such tasks as: procure the new EGNOS and Galileo concessions, and assist the Commission in the development of EGNOS and Galileo applications. In order to assure that the Commission can assume its full responsibilities in the development of the programme, an agreement is needed so as to align the governance of the GSA to the new situation.

Preparation of markets is also necessary through an early implementation of EGNOS and through actions in standardisation, certification, and market awareness-raising. These measures may also reduce the risks of revenue short-falls for the concession holder at a later stage and therefore of costs to the EU. Whilst maintaining the system as a civil system significant revenues could also come from military users. There have been

considerable discussions on the use of the PRS signal over the past years, this need to be continued[23].

The design risk of Galileo is managed by the public sector as a result of the past decision to develop the system on the basis of a public procurement by the European Space Agency of two experimental satellites[24] and the first four operational satellites and related infrastructure[25]. It is therefore the role of the EU, with the assistance from ESA, to develop a strategy whereby the design risk is mitigated before the remaining risk can be transferred. The organisational and legal issues surrounding the design risk are essential aspects of the programme implementation.

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[23] In the context of the recent proposal for a European Space Policy COM(2007)212, the Commission took the view that civilian space programmes, such as Galileo, have a multiple-use capacity and may have military users.

[24] Giove-A satellite launched in December 2005 and Giove-B satellite be readied for launch late 2007 or early 2008.

[25] The In-Orbit-Validation (IOV) or development contract put in place by ESA and financed by ESA and the EC.

10. EUROPEAN GEOSTATIONARY NAVIGATION OVERLAY SERVICE (EGNOS)

10.1. Introduction

Initiated in the nineties[26], EGNOS is the European pioneer in terms of satellite navigation. The infrastructure has been developed under the aegis of the European Tripartite Agreement signed by the European Commission, Eurocontrol and the European Space Agency[27]. It is currently owned by ESA and has been financed by the Trans-European Networks, the European Space Agency, the EGNOS Operators and Infrastructure Group (EOIG) and Eurocontrol. The EGNOS system not only provides users with a GPS-like signal transmitted via geostationary satellites, but also broadcast differential information for increased positioning performance and an integrity information to protect users against underperformance or malfunctions of GPS.

The European Space Agency is currently finalising the qualification of the operator and the deployed infrastructure. The funding of the technical activities is ensured until the Operational Qualification Review in 2008, at which ESA is committed to bring EGNOS to a qualified pre-operational state with a system compliant with the specifications.

Therefore, it is now important to develop and agree on the framework, in terms of legal and economical framework, service provision, financing and governance, which defines the future of the EGNOS infrastructure after the pre-operational state has been achieved.

It was initially foreseen to include EGNOS directly into the Galileo public private partnership contract[28]. However, as the negotiations for the concession have not evolved according to the initial planning, it is essential to put in place a new approach for EGNOS.

10.2. The drivers and key principles

As EGNOS represents a key asset in the European satellite navigation programmes, there are three basic principles which guide the approach described here.

First of all, the ultimate goal is a seamless and coherent integration of EGNOS into the European Global Navigation Satellite Systems (European GNSS), comprised of Galileo and EGNOS[29].

Secondly, it is essential that a coherent and solid path for the introduction of EGNOS services is secured in the shortest timeframe. This is true in particular for the aviation community, which has invested on its development and has developed clear expectations related to the delivery of services compliant with the Standards and Recommended Practices (SARPS) of the International Civil Aviation Organisation (ICAO). In this frame, certification of the service provider has to be initiated as soon as possible.

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[26] COM(94) 248; Council Resolution of 19 December 1994 (OJ C 379, 31.12.1994, p. 2).
[27] Council Decision 98/434/EC of 18 June 1998 (OJ L 194, 10.7.1998, p. 15).
[28] Council Conclusions of 5 June 2003.
[29] Council Regulation of 5 April 2001 on the Galileo project, OJ C 157, 30.5.2001; Conclusions of the Transport Council of 26 March 2002 on the Galileo programme; Conclusions of the Transport Council of 5 December 2002 on the Galileo programme.

Finally, an urgent, short term solution needs to be found to ensure programmatic continuity after March 2008 in order to support the first two objectives.

10.3. The activities allowing the system to work

Six tasks have to be performed in order to operate and exploit the EGNOS infrastructure: operations, maintenance, networking, certification, service provision, and research and technology.

The first three tasks (operations, maintenance and networking) aim at maintaining the product in operation in order to provide EGNOS signal and data, in line with customer requirements and expectations and under economically sustainable conditions. These tasks are commonly referred to as "Signal in Space provision".

EGNOS certification encompasses all activities to be undertaken and completed before EGNOS can be used operationally by civil aviation.

The EGNOS service provision task is the direct link with navigation service customers accompanied, where appropriate, with service guarantees as required by the market. In the aviation domain, the Single European Sky regulation requires that the service provider has the means to guarantee service delivery (e.g. through control of infrastructure design and maintenance).

Eventually, EGNOS research and technology work aims at keeping pace with GNSS technology evolution and international competition. Its purpose is to deliver enabling technology for the satellite navigation market.

The public sector, which remains owner of the infrastructure, needs to maintain a in-depth knowledge over EGNOS,. The public sector has to maintain the required means and tools to ensure that the infrastructure configuration is kept in line with required evolutions and applicable standards. It further ensures that the system remains competitive in its performance, functionality and operability.

Up to now, the European Space Agency has been responsible for all tasks but certification and service provision, while the GSA has so far been coordinating certification activities and has received GJU-initiated R&D activities related to receivers and applications, complementary to R&D activities of ESA in relation to GNSS infrastructures.

It is noted that, due to technical aspects and the need to ensure a smooth transition towards operational status, there is, in the short and medium terms, a "single source" in the market capable of providing three of the tasks mentioned above, namely operation, maintenance and networking.

10.4. The recommended approach

A staggered approach is recommended for EGNOS, first with ESA in the lead and ensuring continuity, then with an EGNOS Economic Operator (EEO) that provides certified services, and eventually full integration into the Galileo concession.

10.4.1. Short term

In order to ensure a clear and stable frame for EGNOS in the short term, ESA will, during 2007, prepare, negotiate and conclude with the single source the appropriate contract necessary for the "Signal in Space provision" tasks.

The awarding of this contract will be carried out by ESA on behalf of the GSA, in compliance with the public procurement rules set forth in the EC regulation.

This contract is foreseen to cover a maximum of six year period starting April 2008 and will be funded by the EU. This contract will include a provision whereby the contract can be assigned by the European Space Agency to another contracting party at a later stage and, in any case, as soon as an EGNOS economic operator is in place. This short term phase will therefore last only as long as it is necessary to put in place the next phase. Meanwhile, ESA will pursue its role as design authority and continue R&D activities.

ESA will also prepare, negotiate and conclude in the appropriate time frame the contracts necessary to implement the required short term infrastructure evolutions encompassing the replacement of the geostationary transponders. Awarding of such contracts will be carried in compliance with public procurement rules set forth in EC regulations.

10.4.2. Medium term

In 2007, the GSA and ESA will negotiate and conclude on the EGNOS assets transfer of ownership taking into account the investors. In the same year, the GSA will launch a call for tender for an EGNOS Economic Operator (EEO) to cover all tasks (with the exception of the "design authority" task) to operate and exploit the EGNOS infrastructure. For operations, maintenance and networking, the tender will impose the use of the single source contractor and relevant contract which will have been assigned by ESA. The contract between the GSA (as an EU agent) and the EEO is foreseen to be in place as soon as the bidder has been selected and the contract negotiations concluded.

The EGNOS Economic Operator will be responsible to obtain certification in the shortest time possible in order to allow service provision to, in particular, the aviation community. Services provision to other user communities will also be developed by the EGNOS Economic Operator.

For R&D tasks the EGNOS Economic Operator will follow and support the various research activities of the 7th framework research programme run by the GSA, the evolution programme of the European Space Agency, and Member States projects. A specific framework will be put in place between all relevant parties to ensure an efficient use and transfer of research outputs into an evolutionary EGNOS infrastructure.

The public sector will keep a suitable knowledge level on EGNOS in order to allow its transfer in the frame of the Galileo concession at a later stage. This task will remain with ESA, under contract to the GSA.

In order to ensure stability towards users, the EGNOS Economic Operator will remain in charge for a minimum period of six years as from the beginning of its contract, with a view of it being transferred into the concession afterwards. Provisions in the contract will therefore foresee this transfer to the Galileo concession.

10.4.3. Long term

At the end of the contract with the EGNOS Economic Operator, conditions should be in place to allow a smooth and timely hand over to the Galileo PPP contractor.

For this purpose the contract with the EGNOS Economic Operator will have to encompass appropriate provisions to rule terms and conditions of the hand over phase.

10.5. Key issues

10.5.1. Service provision

All potential users, which have already had the opportunity to make use of the early EGNOS signals available through the EGNOS testbed, have indicated the need for a swift evolution towards an operational service provision.

It is expected that the "open service" of EGNOS, i.e. the simple "GPS-like" signal, can be made available on an operational basis rather rapidly after the qualification review is finalised.

The commercial service of EGNOS also falls into the same category of service that can become operational as soon as the EEO is in place, and after some marketing activities have been performed.

The Safety-of-Life service, instead, requires a slightly longer period before introduction on an operational basis, as certification steps have first to be implemented.

The EEO contract will therefore include suitable terms to enable downstream exploitation of EGNOS services. The EEO will therefore be motivated to generate appropriate user revenues from the various services it can exploit through a suitable risk/revenue sharing scheme.

While the EGNOS Open access service is expected to generate substantial "utility" benefits, particularly in the downstream user segments, it is not likely to generate any direct user revenues for the EEO. The GSA will therefore undertake specific activities designed to support the Open Access market development.

10.5.2. Financing

As the revenues stemming from the provision of EGNOS services are expected to be very limited during the mentioned short and medium term periods and do not cover the incurred costs for the various operations and exploitation tasks, financial coverage has to be foreseen by the public sector.

The annual cost to operate, maintain, exploit and replenish the system amounts to about €50 millions. A provision of about €300 million is therefore required for six years. It is underlined that the availability of funding is important as there is currently no financial coverage beyond March 2008.

User revenues and potential improvement in the cost structure are likely to reduce total annual costs over the contractual period. User revenues will emerge from the market exploitation of the Safety of Life service and Commercial Data Distribution Service (CDDS).

10.5.3. Liability

Once the EGNOS system undergoes its Operational Qualification Review, the services can be provided on an operational basis. Therefore, the service liability chain has to be clearly defined. Firstly, the EEO will take its responsibilities up to a pre-defined level, as determined in the contract with the European GNSS Supervisory Authority. The public sector, as owner of the infrastructure, will have to assume the ultimate liability for EGNOS. This commitment shall appear in the appropriate legislative acts and appropriate arrangements shall be negotiated.

10.5.4. Master Plan

In order to provide clarity in terms of responsibility, planning, service provision, financing and operations, the role and responsibility of the various EGNOS stakeholders, a Master Plan will be issued by the European Commission, in co-operation with ESA and the GSA, Eurocontrol and the Air Traffic Service Providers once the overall GNSS approach has been decided by Council.