Galileo and the issue of public funding

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In the Yearbook on Space Policy 2006/2007, Serge Plattard presented a complete summary of the evolution of the Galileo programme since it was induced in the late 1990s.[1] It provided a clear analysis of the encountered problems and included useful chronologies and tables. This paper will pick up where he left off by presenting the dramatic recovery of the programme since summer 2007 – how the funding and governance of the programme were fixed, how this may affect future European programmes and how meanwhile, development of the technology for Galileo has been progressing. In addition, the paper will explore a wider issue touched by Galileo, that of the public funding of space programmes. Most space programmes rely to some degree on public money for setting up primary space and ground segments. The idea behind this is that space programmes will later on become profitable and be taken over by the private sector. Yet how efficient is this financing model and why do governments continue to fund space when it is not?

1. Galileo finally on track

Perhaps for the first time ever in the life of the Galileo programme, observers can now be optimistic about the outcome of the project. This comes after the early years when Washington challenged the very legitimacy of a European navigation system and a dispute arose about the potential military use of the programme. More recently, European actors wasted two years with their inability to agree on a proper Public-Private-Partnership (PPP). In those years, the termination of the programme always remained a looming possibility. Not so anymore – the past year has seen decisive moves forward for Galileo.

1.1. Galileo under EU governance

2007-2008 saw momentous choices and evolutions for Galileo. This was mostly the merit of E.U. Transport Commissioner Jacques Barrot, who in the spring of 2007 demanded that the Public-Private-Partnership (PPP) effort be halted.[2] The failure of the PPP funding model was due to several causes, among them the lack of a definite business case upon which companies could base their budget forecast and decide how much to invest, and also the lack of a single strong authority for the management of the programme.[3]

1.1.1. Timeline from June 2007 – July 2008

Evolutions in the life of the Galileo programme mostly follow the rhythm of the Transport Councils, held every three months. The Transport Council of June 2007 acknowledged the incapacity of the different actors to set up a PPP. It endorsed a fully public funding scheme for the construction and deployment phases of the Galileo programme. However, no decision was made regarding the funding modalities. The participants of the October Transport Council also disagreed on the funding modalities but most countries preferred the funding of the programme through the EU budget because they thought that the European Commission would be more efficient in managing the programme. Yet Germany wanted the attribution of future funds according to the rule of "fair geographical return" and therefore favoured the funding of Galileo through the European Space Agency (ESA).[4] During the Transport Council of December 2007, Germany finally agreed on a fully EU-funded budget. Other Member

States had managed to reassure Germany that future calls for tender would give a fair place to German companies and that Germany would continue to exert an implicit leadership in the Galileo programme. The main consequence of this funding plan was that the EU received full authority over the programme since it provided the funds. The Commission now acts as the contracting authority for Galileo, with ESA as a procurement agent.
In April 2008, the European Commission and the European Parliament agreed on details for the funding of the Galileo programme. An additional amount of 3.4 billion euros will be shifted to Galileo from unused budget lines of the Common Agricultural Policy. Moreover, a new management structure was set up for the programme, with Galileo being placed under the authority of four EU bodies: the Transport Council, the European Commission, the European Parliament and a new body, the GIP (Galileo Inter-institutional Panel). A call for tender was issued on 1 July 2008 concerning the development and deployment phase of the programme – the achievement of Full Operational Capability (FOC).

1.1.2. The calls for tender

The Galileo programme comprises six work packages (Table 1):

Tab. 1: *The work packages of the Galileo programme.*

1. System support	120 million euros
2. Ground mission segment	270 million euros
3. Ground control segment	45 million euros
4. 26 satellites	840 million euros
5. Launch services for the satellites	700 million euros
6. Co-ordination of the operation	170 million euros
Total amount	2.145 million euros

Requests to participate were expected by 7 August 2008. Pre-selected entities will then be invited to a "competitive dialogue" with ESA, which will conduct the negotiations in the fall of 2008 and spring 2009. The Commission hopes to sign the contracts in May – June 2009. The satellites package will receive at least two offers: one by EADS Astrium Satellites as the prime contractor with Thales Alenia Space as the major subcontractor, and another by OHB-System teaming with Surrey Satellite Technology Ltd. (SSTL). Being relatively smaller companies, OHB and SSTL insist on a "dual sourcing" for the system. This means that two bidders would be selected for each phase of the project in order to have a back-up, which would give companies the size of OHB and SSTL a bigger chance of being selected for building satellites alongside big companies such as EADS.[5] Astrium and Alenia both insist that the selection process set up by the European Commission and ESA is too long and that this may delay the programme yet again.[6] ESA has responded that some work packages may be contracted earlier if this proves possible, which is however not predictable since the number of the bidding companies is still unknown.
Among the other known bidders at this time is the Anglo-Dutch firm LogicaCMG, which will submit a bid for the software-providing System Support package.[7] Non-European companies may also bid, but under restricted conditions.[8] For reasons of security, the EU decided to select only European candidates for the prime level. For the sub-prime level, restrictions to EU-only companies will apply if they work on critical technologies. For sub-prime contracts involving non-crucial technologies, competition will be open to non-EU companies and the EU will respect the rules of the World Trade Organization (WTO). However, since launch services are not under WTO rules (this provision was adopted at the request of the USA), a European preference may apply in the choice of the launch service for Galileo.

1.2. The impact on future European policies

The difficulties with and the recovery of Galileo as well as the interruption of the entry into force of the Treaty of Lisbon have impacted on the recent discussions about the future governance of the European space programmes. Article 189 of the "Revised Treaty" would have made space a "shared competence" between the EU and its Member States, making space activities easier to manage at the European level. But the Irish vote of June 2008 suspended this evolution. Meanwhile, Galileo progressed in spite of the PPP fiasco. Most remarkably, it did so by investing the European Commission with more authority, at a time when the process of the EU's political integration experienced difficulties. Two lessons seem to have come out of this: First, the contrasting evolution of the Galileo programme seems to be in line with the story of EU integration since the 1950s. Top-down political pushes such as Treaties and bottom-up management breakthroughs such as the December 2007 decision do not necessarily follow the same pace. They rather complement each other and seem to result in a continued progression of the EU. Second, reinforcing the Commission's authority over Galileo was a pragmatic and forceful solution that may influence the management of future major European programmes. We can think here of GMES (now called "Copernicus") but also of programmes outside the realm of space such as TransEuropean networks or ITER (the International Thermonuclear Experimental Reactor).[9]

The way in which future space programmes will be managed in Europe remains to be clarified, however. Discussions between the EU and ESA are underway and decisions could be made public during the ESA Ministerial Council of November 2008. It is very likely that the EU will continue to turn to ESA for help in managing space programmes. But the suggestion – dating back to the Wise Men Report of 2000[10] – that ESA should become an agency of the EU has been put on the back burner for now. Some Member States such as Germany do not want to give up the policy of "fair geographical return". There is also a fear that the EU may not have enough political will to promote space projects and finance space infrastructures when there are so many other programmes to be taken care of at the European level. In the present situation, ESA thus remains autonomous, with its funding coming directly from the Research Ministries of the Member States. That way, there is less risk that space will be neglected. Last but not least, the failure of the "Revised Treaty" leaves the EU in a state of continuing confusion and the time may therefore not be ideal for merging ESA with the EU. In the more distant future, the EU may have a consolidated space budget line and even a Space General Directorate, making it safer to turn over all responsibility for space policy to Brussels. But there is no indication that this may happen any time soon. Still, a single model of cooperation between the EU and ESA must be elaborated (paying particular attention to the difficult issue of "geographical return") so that the two entities do not have to negotiate from scratch for every new programme and thereby waste time, as they did with Galileo and GMES.

1.3. Meanwhile at the ranch: the in-orbit validation process

Galileo has also undergone positive developments on the technical side. A few years ago, delays in the programme were still causing concerns that the frequencies allotted to Galileo by the International Telecommunication Union (ITU) might be lost. The first test satellite, GIOVE-A, was launched in December 2005 and started to send navigation signals by May 2007. GIOVE-B was launched on 27 April 2008 and will test Galileo's most innovative technologies.[11] Its payload comprises two rubidium atomic clocks (allowing for a stability of ten nanoseconds per day) and one of the new clocks created for Galileo, the Passive Hydrogen Maser (PHM).[12] This state-of-the-art technology developed by Astrium measures time with a lapse of less than one nanosecond per day. This means that the system will be able to provide a precision of about one metre to its users. The final payload of the Galileo satellites will comprise two PHM clocks and two atomic clocks as a back-up. Other technologies aboard GIOVE-B include instruments for radiation studies and high precision telemetry as well as a signal generator in three different frequencies. ESA announced that

the test phase was a complete success during an in-orbit test review on 3 July 2008. Currently, Astrium is building the next four satellites of the Galileo in-orbit validation phase which will be completed by 2010-2011. Many European actors are involved: The German Aerospace Center (DLR) manages the operation segment activities of the IOV phase for ESA and recently awarded a contract to Inmarsat, which will develop an in-orbit payload testing facility.[13]

2. A bigger issue: when should taxpayers pay for space?

In the past years, one of the most disputed issues regarding Galileo has been whether it should be funded using public money and if yes, to what degree. This is indeed a major issue for all space programmes.

2.1. Space needs public money

A basic principle of economics is that private companies need a large expected return on investment if they are to invest in a programme. Yet many space programmes are not significantly profitable or even financially self-sustaining. They rely to different degrees on public funding. Extreme cases in point are exploration and manned spaceflight programmes. It is fairly obvious that no profit can be expected from such activities and that they therefore rely entirely on public funding. There is, however, a wide-spread belief that many space applications and launching activities will eventually become profitable. The primary investments, as for the development of a prototype or the deployment of a space and ground architecture, are so immense that only a public institution will be able to fund them. But afterwards, the private sector can take over and run the business. This is the model followed by ESA, which funds technology developments and then turns them over to the private sector once they are operational.
Most space programmes, in contrast, do not generate enough profit to pay for the development of second-generation satellites. Indeed, it is often considered a success if they can even cover their running costs. Launching activities in Europe and the U.S. are still heavily subsidised. In the 1990s, the space community came to realise that observation systems were not profitable. U.S. commercial companies such as DigitalGlobe or GeoEye rely on “national” contracts designed to keep them afloat. SpotImage was unable to pay for the development and launching of the successive Spot satellites. Some service operators, most famously in the telecommunications sector, do make a huge profit from space. But since they are one step away from the actual production of space systems, they cannot be expected to invest in space programmes.

2.1.1. The case of satellite navigation

The profit motive has been put forward many times regarding Galileo but still remains questionable. The Galileo system will include five different signals, four of which will come at a fee in exchange for a guarantee of service (Table 2). This fee will add to the profit obtained through down-stream services. Several consulting firms have tried to assess the future profitability of the programme. The British consulting firm PriceWaterhouseCoopers produced an estimate in 2001;[14] the California-based consulting firm Frost & Sullivan produced its own analysis in 2004.[15] European companies conducted similar works for their own purposes. Most of these reports forecast an annual income of 7 to 9 billion euros between 2012 and 2027, and a products and services market that could reach a cumulated turnover of 400 billion euros by 2025. However, these studies were deemed too optimistic and not credible enough, given that precise information on the future revenues of the different Galileo signals did not exist at the time (and still does not exist). Private companies refused to risk their own money in the venture of the PPP, and this was surely a sign that profit remained a distant

prospect. Profit will surely come in time, but it cannot be put forward as a reason for embarking on the Galileo programme.
Satellite navigation thus confirms the rule observed for most space application programmes: The bill for the Galileo infrastructure will have to be footed by public authorities. Private companies will take over once the system is up and running and hopefully make a profit from the operation.[16]
At the end of the day, the question about space and profit is not about whether private companies can be convinced of financing primary investments for a space programme – they will not. The issue is rather whether they will make a profit from operating the space system later on, and even whether they will make enough profit for being able to finance second-generation systems.

Tab. 2: *The five Galileo signals and their characteristics (source: Nardon 2007).*

	Precision	**Protection**	**Integrity**	**Guarantee of service**	**Price**
1. Open service	Standard	No	No	No	Free
"Authenticated Open Service" TBD	Standard	Access conditions TBD	No	First level (authentication) TBD	Pay service
2. Commercial	High-level	Commercial level encryption	No	Second-level	Pay service
3. SoL	Standard	No	Yes	Third-level	Pay service
4. PRS	Standard	High level encryption	TBD	Not applicable	Pay service
5. SaR	Standard	No	No	Yes TBD	Pay service

2.2. Why should governments pay for space? – Defining the national interest

After space prototypes and architectures have been developed using public money, governments often continue to fund running costs and further investments. Why do they agree to such outrageous expenses? Because, contrary to private money, public money can be spent without any prospects of a return on investment if it is in the "general" or "national interest". The definition of this general interest varies greatly according to cultural factors, political creeds and economic theories. More precisely, the dispute takes place between the advocates of a strong state and the advocates of "laissez-faire". The latter, also called "free market" or "liberal" economists, see a problem in using taxpayers' money for funding large programmes[17]. They contend that if a venture is profitable, it will naturally be undertaken by the private sector, i.e. "the market". Governments should not meddle in such activities. Rather, they should strictly limit their actions to ensuring a secure environment and property rights. Therefore, only space programmes with a security aspect should be funded by governments.

2.2.1. Exhibit A: The UK

The United Kingdom provides a perfect illustration of a "liberal" point of view. The British national space programme and the UK's contribution to the ESA budget are both extremely limited. The British National Space Council is only a small coordinating body. By contrast, there has been one major contribution of the UK to space – the Skynet telecommunications system –in the field of defence. Skynet, now reaching its 5th generation, is a military system intended for the Royal Navy. It was developed because it was deemed in the "national interest" that the Navy's ships could communicate both amongst themselves and with the Admiralty in London. The funding for developing the system was therefore granted.

2.2.2. Exhibit B: The U.S.

The case of the United States is more complex. In the context of the Cold War, winning the race to the Moon was of the utmost national concern. In the 1960s, space as a whole came to be considered a "national interest" and all areas of space development were public-funded. To this day, space remains an area covered by public funding. This is a matter of course for exploration and manned spaceflight as well as military programmes. Moreover, civilian space applications and launchers are also subsidised – although indirectly – by the sheer volume of government activity in civilian space. The United States boasts of the biggest national space budget in the World, with a total of almost 40 billion dollars in 2008.[18] However, there are also voices which dispute the public monopoly in the U.S. space sector, and there is indeed a recent trend of private ventures undertaking launch activities and even space exploration.[19] The X-Prize Foundation has revived the tradition of prizes that helped along the advent of aeronautics. The Ansari X-Prize for Suborbital Spaceflight was awarded to Burt Rutan and his SpaceShipOne in 2004. He had been funded by Microsoft co-founder Paul Allen and won 10 million dollars. There is also an on-going Google Lunar X-Prize that will award 20 million dollars to a privately developed lunar rover, as well as a "Northrop Grumann Lunar Lander Challenge". NASA acknowledged this trend when it launched the "Commercial Orbital Transportation Services" (COTS) in 2006. With this programme, NASA will select and help private companies in the development of a cargo demonstrator to the ISS. A budget of 500 million dollars has been set aside for this purpose. Yet these efforts still represent only a fraction of the U.S. space budget and remain peripheral to the system. Moreover, they do not really differ from the financing model observed for Galileo in which an entity chooses to "lose" money by subsidising the initial costs without any hope of a return on investment. Even if the space company receives the money for that from a private patron rather than a public authority, the investment is still not spurred by the market itself.

2.3. Galileo and the national interest

It was always evident that Galileo would at least in part be funded with public money. The PPP was set up to infuse some private money into the programme and make it look good for policy-makers. When the PPP failed, however, some commentators with a "free market" approach questioned the rationale of a completely public funding scheme. The British weekly "The Economist" claimed that Galileo should be abandoned because it made no sense economically.[20] By the time it would be operational, GPS would have been upgraded and GLONASS would be back on the market. In such an environment, Galileo would never be profitable. Yet in choosing to ignore any possible motivations for Galileo other than profit, the author of the article presumably made the assumption that Galileo could not promote any "national interests" because it is a European programme and Europe is not a nation. However, this political opinion about Europe is highly debatable, since one might argue quite to the contrary that the EU could and should come to represent something close to "a nation" and endorse responsibilities similar to that of a "nation state". As we saw, the "national interest" includes at the very least security and defence capacities. However, it is often defined more broadly. For instance, most governments consider it their duty to support their economy via technology and innovation programmes. Acquiring a prestigious image is also a key attribute of a "nation state". Galileo may meet all of these "national interests" for the benefit of the EU.

2.3.1. Galileo for security

The potential use of Galileo by military personnel has given rise to a difficult debate. France, on the one hand, has a strong wish to use Galileo for military purposes since the motive of strategic independence has been paramount in France's decision to participate in a satellite navigation system. Possible uses comprise direct services such as navigation for troops and

applications such as precision-guided munitions. The UK, on the other hand, seeks to be loyal to U.S. interests and in this case the doctrine of Navigation Warfare as defined by the U.S. Air Force.[21] The "NavWar Doctrine" dictates that the U.S. must be able to interrupt or incapacitate all satellite navigation systems anywhere and anytime. However, Galileo's government-used Public-Restricted Signal (PRS) will be equipped with very strong anti-jamming devices which make this impossible. The UK government has therefore held the position that Galileo should not be used by military forces. Ironically, this ran counter to the tenet of free-market economists that security should be the only justification for the public funding of space programmes.

This difference of positions was consecrated by the Transport Council of December 2004, when the definition of Galileo as a "civilian system under civilian control" was coined. The definition was understood by the British as meaning that no military uses of Galileo would be allowed, whereas to the French, it meant that the customers could be civilian or military. That dispute was partly settled later when difficulties concerning the PPP had arisen. At that time, worries about the profitability of the system made it clear that forbidding 27 possible customers (i.e. the military forces of the 27 Members States) access to the system would seriously undermine the profits from the system. Again, this ran counter to the objective of "best value for money" on which British civil servants had largely relied to "sell" the Galileo project to their own authorities.

According to an 18-months study published by the Galileo Surveillance Authority in June 2008,[22] half of the users of the PRS signal will be non-military government services such as police, customs, emergency response units etc. The other half will be military users. The Survey estimates that PRS will be used by 4 million individuals across the 27 Member States. The latest development is the vote of the European Parliament of 10 July 2008 agreeing to the use of Galileo for operations related to the European Security and Defence Policy (ESDP).[23] The parliamentarians were asked to vote on a report on "Space and Security" presented by Karl von Wogau, Chairman of the European Parliament's Subcommittee on Security and Defence. The report was adopted by 483 votes in favour and 99 against, with 20 abstentions. Given the reinforced authority of EU institutions over Galileo and since ESDP operations are conducted by the military forces of the Member States, this may signal the end of the disagreement.

2.3.2. Galileo for innovation

Proponents of the Galileo programme in Brussels have repeatedly said that Galileo could spur innovation in Europe. This is true for the system architecture itself (as shown by the maser clock, for instance), but also for the down-stream services for which many new applications can be developed. This will contribute to the maintenance of a strong industrial base as well as highly qualified jobs in Europe, which is also in line with the "Lisbon Strategy" adopted in 2000. A number of exercises have therefore been conducted in that area, many of them particularly productive in recent months. A "Green Book on Satellite Navigation Applications" was presented to the EU Council of the Ministers of Transport in December 2006. The text launched a consultation process that addressed the industry, public authorities, consumer groups and individuals in order to identify possible commercial and civilian uses of Galileo. The exercise was continued by a conference on the civil applications of Galileo held on 24 June 2008. It was funded by several European Union bodies, private companies and media enterprises. A parallel effort for finding new uses for government and military-used signals was launched by the Galileo Surveillance Authority (GSA), also equipped with EU funds (under the 6th Research Framework Program). Starting in September 2006, an EADS-led consortium explored potential uses of the governmental signal PRS. The 18-months consultation was called PACIFIC (PRS Application Concept Involving Future Interested Customers). The final workshop was conducted in Sofia Antipolis in April 2008. In addition, private companies such as Altran in France lead efforts to search for new applications for Galileo.[24] Brain-storming sessions conducted in the spring of 2008 were particularly creative. For instance, Galileo may offer services for finding lost objects

inside buildings because the signal can go through concrete walls, for high-precision traffic information by showing vehicles coming from opposite directions, for sending information about nearby restaurants to movie-goers, or for receiving local weather information when travelling on the road. Many unexpected services should appear in the coming years, which shall be very exciting.

2.3.3. Galileo for prestige

Finally, prestige may be construed as a justification for spending public money. Again, an important factor here is whether people think that the EU has a political status similar to that of a nation. Do Europeans feel patriotic towards the EU's institutions? Do they want prestige for Europe? Certainly not all of them. But for those who do, Europe should surely not be absent from satellite navigation when the U.S., Russia and China have their own systems.

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[1] Plattard, Serge. "What's the Problem With Europe's Flagships Galileo and GMES?" Yearbook on Space Policy 2006/2007: New Impetus for Europe. Eds. Kai-Uwe Schrogl, Charlotte Mathieu, and Nicolas Peter. Vienna: Springer, 2008. 153-166.

[2] As of summer 2008, the new Transports Commissioner is Antonio Tajani.

[3] Nardon, Laurence. Galileo and the Profit Motive: How to Make the Europe's Future Satellite Navigation System Most Beneficial? Note de l'Ifri, March 2007. Ifri 3 Oct. 2008 <http://www.ifri.org/files/Espace/NardonGalileo.pdf>.

[4] When attributing workshares, ESA follows the rule of "fair geographical return". This means that for a given programme, contracts in an amount roughly equivalent to the country's contribution to that programme will be awarded to national companies. Some technology transfers may be necessary to enable the country's enterprises to fulfil the contracts; this sometimes decreases competitiveness but also guarantees the participation of more ESA members and especially smaller states. By contrast, the European Union awards contracts on the basis of calls for tender.

[5] "Galileo, Les premiers contrats seront signés au plus tard début 2009." Europolitique Transport 22 July 2008.

[6] de Selding, Peter. "Industry Officials Predict Current Procurement Plan Will Delay Galileo." Space News 4 August 2008: 6.

[7] "Logica to Participate in Tender to Provide Software for Galileo." Dutch News Digest 16 July 2008.

[8] Paul Verhoef, qtd. in "The French Presidency of the EU and the Dynamics of European Space." Conference Report, 2 July 2008. 11. Ifri 3 Oct. 2008 <http://www.ifri.org/files/Espace/CRNardon.pdf>.

[9] ITER is an international project. Members include the EU, Russia, the USA and Japan.

[10] Bildt, Carl, Jean Peyrelevade, and Lothar Späth. "Towards a Space Agency for the European Union." Report to the Director General of the European Space Agency, November 2000. ESA 3 Oct. 2008 <http://esamultimedia.esa.int/docs/annex2_wisemen.pdf>.

[11] "Mise en orbite de GIOVE-B, nouvelle étape vers le déploiement de Galileo." Bulletin Electronique France 210, 26 May 2008. BE France 3 Oct. 2008 <http://www.bulletins-electroniques.com/actualites/054/54760.htm>.

[12] Microwave Amplification by Stimulated Emission of Radiation (maser) provides a high-precision frequency reference that is used for measuring time. It is the predecessor of the laser (Light Amplification by Stimulated Emission of Radiation).

[13] "Inmarsat to Manage Payload Tests for Galileo IOV Programme." M2 Presswire 28 July 2008.

[14] PriceWaterhouseCoopers. Inception Study to Support the Development of a Business Plan for the Galileo Programme. 20 Nov. 2001. European Commission 3 Oct. 2008 <http://ec.europa.eu/dgs/energy_transport/galileo/doc/gal_exec_summ_final_report_v1_7.pdf >.
[15] Frost & Sullivan. Global Positioning System and Galileo: Lift-off Time for Applications Markets. 16 February 2004. Frost & Sullivan 3 Oct. 2008 <http://www.frost.com/prod/servlet/report-homepage.pag?repid=B310-01-00-00-00>.
[16] For the U.S. navigation satellite system GPS, profitability was never an issue since it is entirely paid for by the U.S. Air Force (i.e. using American taxpayers' money).
[17] The tradition of liberal economics is well-established, having started with Jean-Baptiste Say and Adam Smith in the 18 and 19th century. Around 1900, the "Austrian School" of Carl Menger and Friedrich von Hayek was founded. Today, Pascal Salin is a prominent free-market economist in France. Research societies such as the CATO Institute of the Objectivist Center in the Unites States focus more on political philosophy than on economics.
[18] *Aeronautics and Space Report of the President*, edition 2006, see pp. 113-115 (online at history.nasa.gov/presrep2006.pdf).
[19] Leahy, Bart. "Space Access: The Private Investment vs. Public Funding Debate." National Space Society website 12 May 2006. Space.com 3 Oct. 2008 <http://www.space.com/adastra/adastra_debate_060512.html>.
[20] "Lost in Space." The Economist Online 10 May 2007; "Struggling Galileo." The Economist Online 22 May 2007.
[21] An official source for this can be found in the Report of the House of Commons Transport Committee "Galileo: Eighteenth Report of Session 2003-2004." HC1210, 25 Nov. 2004. 19-21 and oral questions 203-219. UK Parliament 3 Oct. 2008 <http://www.publications.parliament.uk/pa/cm200304/cmselect/cmtran/1210/1210.pdf>.
[22] de Selding, Peter. "Half of Galileo Users Expected to be Military." Defense News 14 July 2008.
[23] von Wogau, Karl. Report on Space and Security. European Parliament A6-0250/2008, 10 June 2008. European Parliament 3 Oct. 2008 <http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//NONSGML+REPORT+A6-2008-0250+0+DOC+PDF+V0//EN>.
[24] See the Altran presentation in "The French Presidency of the EU and the Dynamics of European Space." Conference Report, 2 July 2008. 15. Ifri 3 Oct. 2008 <http://www.ifri.org/files/Espace/CRNardon.pdf>.