Galileo and the Profit Motive
How to make the Europe’s future satellite navigation system most beneficial?

Laurence Nardon
Mars 2007
In 2007, the Space Policy Programme at Ifri launched a research project on the future applications of the Galileo satellite navigation system. The present paper is an initial assessment of Galileo’s possible applications identified today. It will be updated as necessary. A conference exploring this issue will be held in Brussels in the Autumn of 2007.

Past Ifri research on Galileo focused on the relationship between the European program and its U.S. counterpart, GPS. Information on conferences held at Ifri in 2002, 2003 and 2004, as well as all reports on the issue can be found on our website, www.ifri.org.

Laurence Nardon : nardon@ifri.org

© Tous droits réservés, Ifri, 2007
Crédit photographique : © ESA, J. Huart.

IFRI
27 RUE DE LA PROCESSION
75740 PARIS CEDEX 15 - FRANCE
Tél. : 33 (0)1 40 61 60 00
Email: ifri@ifri.org

SITE INTERNET : www.ifri.org

EUR-IFRI
22-28 AVENUE D’AUDERGHEM
1040 - BRUXELLES, BELGIQUE
Tél. : 00 + (32) 2 238 51 10
Email: info.eurifr@ifri.org
Europe’s future satellite navigation system Galileo is an extensive programme involving dual use technologies and conducive to the development of a tremendous service market down the line. The first programme to be managed jointly by the European Union and the European space agency, Galileo has challenged them repeatedly to come up with new concepts and ideas.

One reason for the laborious negotiation process that is currently underway between industrial partners as well as institutions and member states is the fact that the Galileo business case remains difficult to define. Although Galileo five signals are clearly defined, no one knows for sure how many types of end-users will exist ten years from now, and in what numbers.

This is why two different exercises have been launched at the European level to identify new and profitable applications for satellite navigation. Their goal is to optimise and clarify the Galileo business case. The principle of best value for money demands, for instance, that the government signal PRS be used by European military customers, as well as other government users.
# Table of contents

INTRODUCTION: THE PROFIT MOTIVE .......................................................... 3

A WELL-ORGANISED CONSTELLATION OF ATOMIC CLOCKS ............ 5

Galileo Galilei .......................................................................................... 7
The Galileo Calendar .................................................................................. 6

MANY APPLICATIONS TO DISCOVER ..................................................... 7

Imagining new applications for satellite navigation ......................... 7
Galileo’s five signals .................................................................................. 8
The Open Service ...................................................................................... 9
The Commercial Signal .......................................................................... 10
The Safety of Life signal (SoL) ................................................................. 10
The Public Regulated Signal (PRS) .......................................................... 11
Interfering with the signal ..................................................................... 12
Search and Rescue (SaR) ........................................................................ 12
The signals and their characteristics .................................................... 13

THE PRS ISSUE ..................................................................................... 14

The cost of security .................................................................................. 14
Creating safe export controls for Galileo ............................................. 15
The Chinese factor ................................................................................... 16
At the end of the day, a political choice about Europe ....................... 17

CONCLUSION: GALILEO AS A NEGOTIATING PROCESS ................. 19
Introduction: the profit motive

People became aware of the existence of satellite navigation when hand-held GPS receivers began to save stranded navigators and mountaineers. In fact, GPS (for Global Positioning System), a U.S. system operational since 1978, has now become a household name, due mostly to its growing use in cars. The term GPS now appears in the Oxford English Dictionary. But this fame may not last. By the beginning of the next decade, a European system called Galileo will start to operate. It may become a widely used common noun, and we might start using colloquial expressions such as « does your car have Galileo? ». This will depend on the commercial success of the system.

Indeed, one major issue regarding this up-coming European system is predicting the scope of the navigation business down the line. It is particularly difficult because navigation services are not yet all developed. Many have yet to be invented and implemented. Since space application systems have a very long life cycle, it was necessary to launch the system before all its possible applications could be known. The initial studies on the European satellite navigation programme took place in the early 1990’s. In other words, Europeans betted on the system’s success more than ten years ago. Current estimates indicate that Galileo will be fully operational in 2012. Launching the program was an intentional business risk!

A few consulting firms have tried to assess the Galileo business plan. The British consulting firm Price Waterhouse Coopers produced an estimate in 2001, meant to facilitate the political decision-making process at the European level\(^1\). The California-based consulting firm Frost & Sullivan produced its own analysis in 2004\(^2\). European companies bidding for the consortium conducted similar works. Most of these business plans forecasted a global economic impact of 7 to 9 billion euros per year between 2012 and 2027. The cumulated market for products and services could reach €400 billion by 2025.

\(^1\) Inception Study to Support the Development of a Business Plan for the Galileo Programme, PricewaterhouseCoopers November 2001.
The EU concurs with these promising forecasts. According to EU reports, the market for navigation products and services is growing at an annual rate of 25%. Some 3 billion satellite navigation receivers should be in service by 2020. It seems safe to say that the civil and commercial market will very probably take off and that there are serious reasons to expect unprecedented use of satellite navigation and a booming market in the coming decades.

However, the details of the business plan of these studies differ. Which services will be foremost? What original uses will be devised and how much revenue will they generate? The balance between commercial and government revenues will also be particularly important. The bigger the revenue from commercial services, the lower the cost for government use. If commercial revenues are more limited, governments will have to support more operational costs for the programme, probably pushing up the price of the services they buy.

These uncertainties make it difficult for the private partners to commit to the programme. This partly explains why European companies have such a hard time agreeing on the management aspects of the Galileo Concession. Companies and administrations, as well as the end-user community, need to know what to expect. The purpose of this policy paper in the Notes de l’Ifri Collection is to identify the different applications that one can foresee for the upcoming Galileo navigation system.
A well-organised constellation of atomic clocks

The European Union first expressed a wish to develop a Global Navigation Satellite System (GNSS) in the years 1993-94. The official decision to proceed with programmes GNSS 1 and GNSS 2 was made in 1998. The first programme would be a limited system relying on GPS, the second was to be a much more ambitious autonomous programme. British politician Neil Kinnock, the E.U. Transport Commissioner from 1995 to 1999, was deeply committed to the development of a self-standing European system and convinced other European countries of the need to launch GNSS 2. Both programmes are jointly managed by the EU and the European Space Agency (ESA).

GNSS 1, later called Egnos (for European Geostationary Navigation Overlay Service), relies on a network of ground stations and transponders on three GEO satellites deployed over Europe, to complement and improve the American GPS services. Besides ESA and the EU, the European authority for the safety of air traffic, Eurocontrol, is also part of Egnos management. Egnos has been partially operational since 2005.

Galileo Galilei

On 7 January 1610, Galileo Galilei (1564-1642) turned his telescope towards the sky and discovered four moons orbiting around the planet Jupiter. They were named Io, Europa, Ganymede and Callisto.

Galileo realised that the formation of these four moons, whose eclipses are frequent and visible, provided a clock whose face could be seen from every point on the Earth. Tables describing the motion of these four Jovian moons were used to determine longitude at sea and on land.

Galileo's method of determining longitude by observing the eclipses of Jovian moons heralded a revolution in navigation, geodesy and cartography in the 17th and 18th centuries. It is therefore appropriate that a European satellite navigation program is named after him.

GNSS 2, later called Galileo, will consist of 30 satellites orbiting in a well-organised configuration in mid-Earth orbit. Each satellite contains four atomic clocks providing extremely accurate timing. Each point on Earth will be in view of at least four satellites at all times. Combined data from these satellites will provide accurate positioning, navigation and timing services to a wide array of end users on Earth.
The Galileo Calendar

The Development phase of the Galileo programme started at the end of 2004 and will end at the end of 2009. It will oversee the launch and validation of two demonstrators (Giove A and B) and the four first satellites of the system.

The first of these, Giove A (for “Galileo In-Orbit Validation Element”) was successfully launched in December of 2005. The launch of Giove B has been delayed and should occur in late 2007 or 2008.

The next stage is the Deployment and Exploitation phase. A contractor will take over from ESA to build and launch the 26 remaining satellites of the Galileo constellation. To choose a contractor, the EU conducted a call for tender and selected a consortium of almost all European aerospace industries\(^3\). The eight companies that are now members of the consortium have run into many disputes and delays while negotiating the Concession agreement. The CEO of the consortium is currently being selected and, if everything goes well, the contract should be notified at the end of the year or the beginning of 2008. The 26 satellites will be launched over 2010 and 2011. The full Exploitation phase is expected to start in 2012.

The progression of the programme is reflected on the institutional side. As of January 1\(^{st}\), 2007, the institutional structure in charge of the programme has changed. The Galileo Surveillance Authority (GSA) took over from the Galileo Joint Undertaking (GJU), whose mission to select the contractor is now over. The GSA will own the constellation and be responsible for dealing with the contractor.

---

\(^3\) EADS (European), Inmarsat (U.K.), Deutsche Telekom (Germany), Alcatel and Thales (France), Finmeccanica (Italy), Hispasat and Aena (Spain).
Many applications to discover

A wide-ranging effort is currently underway in Europe to identify innovative business opportunities for Galileo. They rely on the five signals of Galileo.

*Imagining new applications for satellite navigation*

A “Green book on Satellite Navigation Applications” was presented to the EU Council of the ministers of Transport in December 2006. The text launches a consultation process that addresses the industry, public authorities, consumer groups and individuals in order to identify Galileo's possible commercial and civil applications. The answers will be analysed by the European Commission and used for making recommendations to the Council and Parliament.

A parallel effort has been launched by the GSA, acting with EU funds (attributed by the 6th Research Framework Program). Starting in 2007, an EADS-led consortium will explore the governmental signal PRS's possible applications. This 18 months consulting project is called Pacific, for “PRS Application Concept Involving Future Interested Customers”.

All the applications of satellite navigation that are currently in existence are covered by GPS and GPS-related data. When operational, Galileo will seek to cover these applications. It will also aim to expand them, in order to develop new offers and new markets. The Green Book and Pacific initiatives will hopefully induce creativity and innovation in identifying the system's possible future uses, which will eventually help the industry devise better offers to the market.

A large number of areas are likely to benefit from satellite navigation. According to the Green Book, these appear not only in the fields of transport and communications, but also in those of land survey, agriculture, scientific research, tourism and others. Cars, portable phones as well as energy distribution networks or banking systems will benefit from satellite navigation services. Each area must be explored.
Expanding Galileo's applications will also benefit from better technology on the receiver side:

“Receivers are now found in all kinds of electronic devices for everyday use such as mobile phones, personal digital assistants, cameras, portable PCs or wristwatches. Mobile telephony is a promising market with over 2 billion mobile phone subscribers. Half a billion units are sold every year, with a prospect of 1 billion a year by 2020, allowing for fast market penetration of satellite positioning-based services. Vehicles will increasingly be fitted with navigation equipment. Conservative projections suggest 50 million units sales by 2020⁴. “

**Galileo’s five signals**

The Council of Transport Ministers of December 2004, was a very important one. It adopted the final programme architecture, that provides for five different signals constituting the bedrock of the programme's business offer. The signals have different design features, meant to appeal to different sets of customers. Their main characteristics are the following:

1. **Precision**: This defines the actual precision of the position given by the signal. Galileo's high-level precision will provide a position within tens of cm, while standard precision will be within ten meters. The current GPS system offers a standard localisation of 15 meters.

2. **Integrity**: This feature is meant to inform the user if the Galileo system encounters a failure, therefore indicating if the signal received is pertinent or not. For uses such as air traffic management, where lives are at risk, this information will be provided within 6 seconds.

3. **Protection**: Some signals will be protected against unauthorised uses: commercial-level encoding for the commercial signal, military-level encryption for the government-use signal, PRS. Besides, the government-use signal will benefit from special types of protection against jamming and spoofing (see below).

---

4. **Service guarantee**: This feature covers authentication and legal protection in case of system failure.

5. **The price of the signal** ensues from the level of service provided in all the above features. It will either be collected via the application of fees or be reflected in the cost of the receiver/beacon. Transportation authorities in the civil aviation sector, for instance, may also pay for the global service and subsequently apply a tax to their members. The open signal will remain free of charge.

Galileo will propose five signals. The first three signals will have commercial applications. The last two are for non-commercial use (government and rescue).

### The Open Service

The Open Service is open and free. It is the equivalent of what GPS currently offers, only with better precision. Since it is free, it will mostly appeal to individual users, who will use it to install a navigator in their cars or to add a localisation feature to their cell phones. Navigation systems in cars currently help drivers find their way around. In the future, they will help them escape traffic jams or even find parking places. Localisation services in cell phones are already compulsory in the U.S., where cell phone operators must be able to locate emergency calls (i.e. 911 calls) within 67 meters (50 feet). This is where a mass market for Galileo could emerge and could become the essential part of the Galileo business plan.

An upgraded version of the Open Service could also be proposed. This service could provide an “authenticated” Galileo signal. This means that the signal would come with the guarantee that it was indeed provided by the Galileo system. This is meant to insure that nobody could provide a fake or tampered Galileo signal as evidence.

The applications of the authenticated Open Service are promising. For instance, when a no-fishing zone has been defined, fishing boats must prove that they keep out of it by providing their position to the EU authority in charge. A non-authenticated position could very well be spoofed, showing the boat to be outside the zone, when it is really inside the zone. An authenticated signal could provide indisputable proof. The same applies to Electronic Fee Collection systems (EFC). With an authenticated signal, trucks using the motorway will not be able to escape due tolling. Pay-per-use insurance could be another promising use of the authenticated Open Service.
Current estimates show that the authenticated Open Service could come to represent up to 50-60% of Galileo business. Creation of this signal was not suggested until December 2004, when the EU Council of Transport adopted the five-signal structure. Since then, the commercial possibilities associated with it have grown and the creation of the system is now apparently just a technical issue. If adopted, the authentication service could constitute a legal guarantee. It could therefore be applied for a fee.

**The Commercial Signal**

The commercial service aims to provide outstanding performance to professional users. The precision will be higher, with a full-fledged service guarantee. It could therefore be charged for a higher fee. To ensure that all users have paid the fee, an access code, i.e. a commercial-level encryption, will be set up.

The commercial signal will appeal to big company clients: oil platforms, geodesy institutes, electricity distribution networks, fleet management, time-based network security for money services, time stamping for financial services, and so forth. The Green book exercise should present numerous ideas and details.

**The Safety of Life signal (SoL)**

The Safety-of-Life service (SoL) has been mostly developed for transportation systems, where continuous navigation information is essential.

The SoL signal will improve traffic management for civil aviation in particular, allowing air traffic to grow over the next decades. European air traffic management (ATM) authorities have certified use of the satellite navigation system GPS since 1996, for en-route navigation – not for take-off and landing. It is expected that Galileo will at least be used for en-route navigation and landing when it becomes operational. SoL will also be used for rail traffic management, maritime fleet, and other transportation systems.

The integrity information associated with SoL will make it particularly helpful. Planes, for instance, rely on navigation data to follow their route or land. The lives of their passengers and crew rely on the exactitude of the provided data. It is extremely important that the signal be received continuously, and that any signal dysfunction be made known as fast as possible. If the information flow stops or becomes inaccurate, a plane could possibly crash. With the Galileo-based SoL signal, the pilot would be informed within 6 seconds from the moment that the Galileo signal is erroneous.
The SoL service will be paid for by fees or royalties charged by civil aviation authorities and other transportation organisations. Special receivers will also be necessary.

The Public Regulated Signal (PRS)

The raison d'être of the Public Restricted Signal (PRS) is to provide governments with a highly protected signal that they can access at all times. PRS benefits from two types of protection:

1. Protection one is a heavily encrypted access system, i.e. a military-level encryption system, that prevents unauthorised use of the PRS.

2. Protection two is an anti-jamming and anti-spoofing capacity that will allow PRS to continue at all times, in order to cover the needs of the European governments.

### Interfering with the signal

- **Jamming** a signal means to interrupt it. The end user does not receive the information anymore.

- **Spoofing** a signal means to replace the information it conveys with other data. The end users will believe they are getting the correct information.

- **Meaconing** is a more precise term used by the U.S. military. It means to receive a signal and rebroadcast it many times on the same frequency, in order to confuse navigation.

**Two possible jammers:** Interfering with the navigation signal can be the act of hostile forces; Jamming could also be enforced by the authority in charge of the signal, if they want to deny access to it by hostile forces.

Military forces in European countries may use the PRS signal if they want to. Navigation services are extremely useful to military forces, covering a wide span of uses, from the monitoring of troop movements to high-tech uses such as guided munitions. During the Iraq invasion campaign of 2003, 80% of munitions used by the Coalition forces were precision-guided. Precision guidance relies on several techniques, such as radio, lasers and satellites, the latter being by far the most efficient. PRS will provide an autonomous military-level signal to European forces.

PRS users will also include civilian government services such as the police (including military police forces such as the gendarmerie in France or the carabinieri in Italy) for internal security and law enforcement. Other uses will be for custom services, the monitoring of dangerous material transportation, the monitoring of critical energy transportation networks, synchronisation of critical means of communications, economic activities of strategic importance and, more
generally, all emergency needs. In all these areas, continued access to an accurate navigation signal will be ensured even when, for security reasons, the other four signals must be interrupted.

Use of the PRS signal is expected by the future Concessionaire to make up 20 to 25% of the Galileo business. The EU has commissioned an industry-led study, similar to the Green Book effort, to help identify possible non-military uses of the PRS. The study, named Pacific for “PRS Application Concept Involving Future Interested Customers” should last 18 months.

The PRS precision level will be standard and the service may also provide integrity information similar to the SoL signal. Since the system is heavily protected, an official entity with security cleared personnel and protected facilities will distribute access keys. These aspects have been under negotiation since the end of 2004. All government users will pay for the service.

**Search and Rescue (SaR)**

The Search and Rescue service (SaR) will be used to localise distress events and initiate rescue operations. It is an improvement in the existing Cospas-Sarsat system, that currently localises distress beacons within a 400 to 500 meters range. Cospas-Sarsat relies on a system of ten to twelve polar and GEO satellites and a network of ground stations. Since its launch in 1982, the system has saved more than 20,000 persons. Approximately one million beacons are currently on the market.

Galileo will greatly improve the Cospas-Sarsat system. Relying on 30 satellites, it will provide worldwide localisation with a ten-meter precision. Also, the satellite that picked up a distress signal will send a recognition signal back to the beacon —and alert the rescue centre. Letting the person in distress know that his or her situation is being dealt with constitutes a second major improvement in the rescue system.

The SaR signal will not be encrypted. The price of the service will be reflected in the cost of the beacon and/or a system of subscription.
The signals and their characteristics
(Some features remain to be defined, “TBD”)

<table>
<thead>
<tr>
<th></th>
<th>Precision</th>
<th>Protection</th>
<th>Integrity</th>
<th>Guarantee of service</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Open service</td>
<td>Standard</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Free</td>
</tr>
<tr>
<td>“Authenticated Open Service” TBD</td>
<td>Standard</td>
<td>Access conditions TBD</td>
<td>No</td>
<td>First level (authentication) TBD</td>
<td>Pay service</td>
</tr>
<tr>
<td>2. Commercial</td>
<td>High-level</td>
<td>Commercial level encryption</td>
<td>No</td>
<td>Second-level</td>
<td>Pay service</td>
</tr>
<tr>
<td>3. SoL</td>
<td>Standard</td>
<td>No</td>
<td>Yes</td>
<td>Third-level</td>
<td>Pay service</td>
</tr>
<tr>
<td>4. PRS</td>
<td>Standard</td>
<td>High level encryption</td>
<td>Yes</td>
<td>Continuity of service</td>
<td>Pay service</td>
</tr>
<tr>
<td>5. SaR</td>
<td>Standard</td>
<td>No</td>
<td>No</td>
<td>Yes TBD</td>
<td>Pay service</td>
</tr>
</tbody>
</table>
The PRS issue

Currently superseded by the difficult negotiation process between industry members of the Galileo consortium, a political dispute has been going on at least since 2004. It has to do with the government signal PRS and, more precisely, whether its use by military and defense forces in Europe should be allowed. A number of arguments have been discussed.

The cost of Security

A first argument is that PRS military applications are too expensive. This is not exactly true.

The first pricing exercise for the Galileo system took place around 2001. It estimated that the system development (i.e. the IOV phase) would cost approximately 1.1 billion euros. Because it would have been too complex at that point, this estimate did not take the cost of security specifications into consideration.

By 2004, the cost estimate for the Galileo development phase jumped from 1.1 to 1.5 billion euros. One third of the 400 million difference corresponded to the taking into account of general security specifications. The security specifications are meant to control the use of Galileo-derived information and refuse access to it by hostile forces. These features are necessary for the whole system. 130 millions euros doesn’t sound like too much to guarantee EU security.

The specific added cost of the PRS signal, including the setting up of high-level encryption and the anti-jamming features represents a very small part of the 130 million euros. These will insure continued government access to one navigation signal when the other four signals must be interrupted for security reasons. These features have been devised for PRS signal security. Whether the governmental end-user is civilian or military does not affect the cost of the PRS system. Military use of PRS does not add any cost to the PRS architecture. On the contrary, allowing more users to buy this particular signal will greatly improve the Galileo business plan. Several European countries have put forward the principle of “best value for
money”. Since PRS was definitely adopted in December of 2004 and the corresponding budget was set aside, Europeans must now make sure its customer base is the widest possible.

As reported earlier, there are several estimates for a 7-9 billion euro market per year, of which PRS would represent 25%. Current business forecasts regarding military use of the PRS can rely on a poll that was conducted by the Commission in July of 2006\(^5\). EU members were asked what type of PRS service they planned to use, if any. France, Lithuania, Luxembourg, Portugal and Spain confirmed their intention to use PRS for defence needs (they rate its use as “most likely”). The Czech Republic, Denmark, Greece, Italy, the Netherlands, and Sweden may use PRS for defence, based on certain conditions -mostly financial considerations- being met. Out of the then 25 EU members, only the United Kingdom does not foresee defence-related use of PRS. The British already have a wide-reaching agreement on navigation systems with the United States and are reluctant to pay for another similar service. They will therefore opt out of military use of PRS. The UK may however be interested in other government applications, such as customs monitoring, critical transport and emergency services. Prisoners’ tracking, introduced in the UK in 1990’s with GPS tags, could also be done with the PRS signal in the future.

Amongst the European countries who choose to use PRS for defence-related needs, those who already receive the military-level GPS signal, thanks to bilateral deals with the U.S., may be able to combine the two military signals for a better service\(^6\). They would have to use dual mode receivers. Does this mean that European military receivers combining PRS and future M Code signals will have a better service than U.S. military receivers relying on the GPS M Code only? In that case, the U.S. may be tempted to use the Galileo PRS as well. This would be possible on the condition of a positive vote by all EU members.

**Creating safe export controls for Galileo**

Another concern linked to the PRS signal is the risk of technology transfer to non-European countries. Such non-intentional exports could happen if an unauthorised user high-jacks the PRS signal used by a legitimate user, or if the PRS service is bought by a non-

\(^5\) The poll was made public at the GNSS conference in Münich in March, 2007.

\(^6\) This possibility was also mentioned at the Münich conference.
European country who either uses it for hostile ends or somehow re-exports PRS technologies to another country.

There are two solutions to this:

1. The first step is the creation of a safe and tight encryption system for PRS, so that non-authorised users cannot have access to it. This entails strict procedures to distribute PRS keys amongst EU member States. This is a straightforward technical question.

2. The second solution is the quasi-impossibility of authorised PRS use by non-EU countries. Indeed, such use would only be allowed by a unanimous vote of the now 27 EU members. Furthermore, the respect of EU export controls (toward third parties) would be demanded of said countries. It is easy to assume that very few countries will obtain such a unanimous vote.

The access conditions to the PRS signal imposed on non-European countries are very strict. That does not preclude cooperation with these countries on the global architecture of the European system.

The Chinese factor

The EU has sought early on to associate non-European partners to its programme. Several benefits were expected to accrue from these partnerships. One idea was to ensure future use of Galileo in these countries and, more immediately, to receive either some financial or in kind contribution from them. It was a way to give credibility to the endeavour as well as creating international support for Galileo in the context of U.S. opposition to the European project in the early years.

Agreements have been signed with China, Israel, India (although the agreement is not yet signed), South Korea, Morocco and the Ukraine. Technical agreements have only been signed with China and Israel.

As expected, these deals are two-way opportunities. Israel, for instance, has contributed 19 million euros to the GJU and ESA, 5 of which were incorporated in the capital of the GJU. There is an understanding that Israeli companies can now bid for orders up to 14 million euros in Galileo-related call for tenders.

The agreement with China has been more problematic. Galileo industry has ordered parts of the SaR signal payload and antennas to the NRSCC. The deals are strictly confined to the on-going In-Orbit Validation phase and represent 65 million euros.
In the meantime, in spite of its cooperation on Galileo, China has begun developing its own navigation satellite system called Compass. China plans to launch 4 GEO satellites over China (one was launched recently). Chinese technological needs for the Compass project were obvious and made the EU very wary of possible technology transfers. There has been no discussion of business deals concerning the Deployment phase of Galileo between the GJU or the GSA and Chinese space entities.

**At the end of the day, a political choice about Europe**

The question of Galileo future applications and how to make the system most profitable should be seen as a straightforward business issue. After all, ensuring high profits is key to the smooth operation of the consortium. The PRS dispute is real however. It is emblematic of an old and deep political divide in what European defence should look like.

Governments of countries with Atlantist leanings, such as the UK, generally think that Europe must remain the closest ally of the United States. According to these countries, this closeness should be such that no major independent defence means should be developed in Europe. This does not mean that Europe would be defenceless: political proximity with the U.S. would ensure that the U.S. would defend our continent in case of necessity. Furthermore, the closest allies amongst European countries would be rewarded by sharing in U.S. military systems. This is why, for instance, British military forces enjoy preferred access to the GPS military signal.

However, the strong anti-jamming features of PRS could make it difficult for the U.S. to jam it anywhere, which would be contrary to the U.S. “NavWar” doctrine. This is why some voices in the UK seem not only to prefer opting out of the option of military use for PRS, but also to want to prevent any such use by other programme partners. They are particularly worried about the possibility that the European guided munitions systems could become too autonomous. In December of 2004, the then British Secretary of State for Transports Alistair Darling made a statement at the House of Commons that PRS would not allow “guided weapons”.

This attitude contrasts of course with that of most continental countries, which are determined to set up independent defence

---

7 NavWar is the doctrine on « Navigation Warfare ». 
means for Europe. Some go as far as recommending that the EU
take significant responsibility on defense matters. Such developments
would allow Europe to take a different stand from the U.S. in the
future.

The dispute over the nature of European defence is long-
standing. It is a political choice and as such, cannot be solved by
rational argumentation. The issue of the PRS military use has come
to fit in that irrational debate. This is why, at the end of the day, the
best solution is probably to let each EU member make their own
policy choice: whether they wish to use PRS, or opt out.
Conclusion: Galileo as a negotiating process

Galileo is a huge programme involving dual use technologies. It is conducive to the development of a tremendous service market down the line, as well as top-level military applications. European countries have expressed many different motivations and commitment levels when setting it up. Its arduous management process was also a first for the EU. For all these reasons, the progression of the programme has been a long series of difficult negotiations.

Early disputes have opposed most famously the EU and the U.S., who had misgivings about losing the GPS monopoly and had legitimate concerns about whether Europe could really manage such a project, especially from a security standpoint. Since 2004, however, most disputes have opposed European countries.

The European dynamics involved in the Galileo programme are indeed interesting. For one thing, it is remarkable that France, who has so often led European space projects in the past chose not to lead the Galileo project. This is reportedly the result of a trade-off between France and Germany: France would continue to lead Europe in the launcher’s area, while Germany would be the primary country for Galileo. Since then, Italy has claimed a co-leadership with Germany. As a result, the four main Galileo partners within ESA (France, Germany, Italy and the U.K.) have all taken an equal share of the Project: 17%.

The repartition of the future industrials sites of the consortium, as well as the division of other management and contractual aspects have been under negotiation since 2005. At some point, it was agreed that the eight companies that constitute the consortium would develop two control centres in Germany and Italy, the industry headquarters in Toulouse, one centre for civil aviation in Spain and the headquarters for an operational contractor in the U.K. Lately, Spain has demanded that a third control centre be established near Madrid, stalling effectively the discussion process. The EU Transportation Council of March, 2007, demanded that the consortium companies find a compromise in order to begin operating in earnest.

Meanwhile, negotiation for the location of the headquarters of the new institutional authority for the programme, namely the Galileo
Surveillance Authority (GSA) is also underway. Member states have to choose between eleven cities: Athens (Greece), Barcelona (Spain), Brussels (Belgium), Cardiff (U.K.), La Valette (Malta), Ljubljana (Slovenia), Munich (Germany), Noordwijk (the Netherlands), Prague (Czech Republic), Rome (Italy) and Strasbourg (France).

As we see, Galileo can be seen as a succession of difficult negotiation processes. The dispute about the military use of the government signal PRS is only one of them. Such arguments are a given of the European Union building process and, indeed, of international relations. It is probably better at this point to concentrate on the process undertaken with the Green Book and the Pacific exercise, that aims to identify new and promising applications for satellite navigation. Looking at ways to optimise Galileo’s benefits will serve the European citizen both as end-user and tax-payer.