Location Based M-Commerce Platform in the GALILEO Value Chain

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Abstract

The European Commission has embarked on financing the development and deployment of Europe's independent and entirely civilian Global Navigation Space System (GNSS), GALILEO. The EUR3.4 Billion infrastructure is to be managed and operated through a Public Private Partnership (PPP), which aims at minimizing life cycle cost by generating revenues from future value-added services. However, the value-added services envisioned are solely based on the system's physical layer. GALILEO's value proposition is based on a high-accuracy, guaranteed signal with integrity information that will be made available to paying users. Taking into account the upgrade of the free of charge Global Positioning System (GPS) and GLONASS it is questionable whether GALILEO will indeed be able to generate revenues from the enhanced signal. To better its position in the value chain, it is proposed that GALILEO JU develops a global, publicly accessible, Location Based Services (LBS) platform to enrich its value proposition by spurring growth in GNSS applications and thus gaining a significant competitive advantage over the up-coming GPS III. This paper describes the model for such a platform and puts emphasis on the key-role that GALILEO can play in the creation of the location-aware Geo Web.

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1) Introduction

The European GALILEO navigation system has been promoted as a user-oriented civilian infrastructure, as opposed to the military conceived American GPS and Russian GLONASS. The focus on civilian use is reflected in the guarantee of service provision, which sets it apart from the latter systems, whose operators reserve the right to degrade or shut down civilian access in emergency situations. The system's requirements have been set in accordance with the demands of known GNSS applications, which today comprise a market of EUR 7 Billion[i] At the same time, global Location Based Services (LBS) represent a market of EUR 12 Billion[ii] today and is widely expected to be the most important revenue source in the near future. According to Research and Markets, in Europe alone LBS is meant to account for EUR 2 Billion of revenue over the next five years[iii].

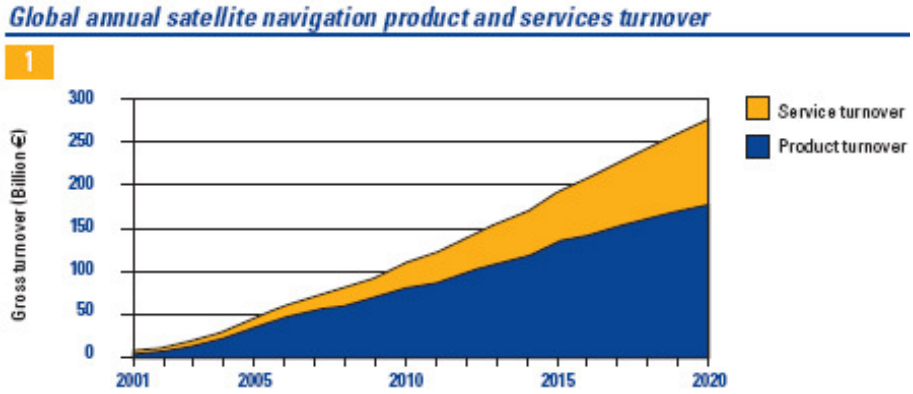


Fig.1) Source: GALILEO Business Brochure 2005

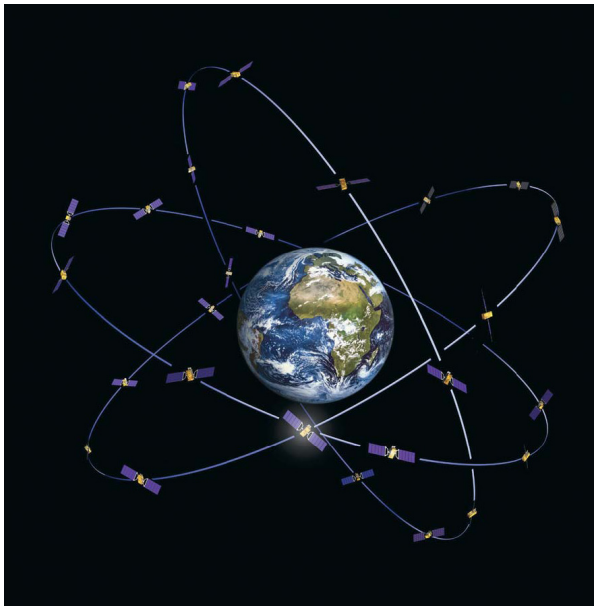
At the same time, the number of mobile handsets worldwide has passed 800 million in year 2005[iv]. With the advent of 3G mobile networks, Mobile Network Operators (MNO's) are looking to mobile data services to boost Average Revenues Per User (ARPU). In the telecom sector as well, LBS is regarded as one of the most promising data traffic generators. Operators around the world have been deploying LBS applications based on both terrestrial (i.e. cell-id, ETA) and space-based (A-GPS) positioning technologies. It is expected that by year 2006, over 60% of mobile phones will be equipped with GNSS receivers. However, none of the applications have been able to deliver on the full promise of LBS. This has been due to several factors such as the lack of compelling applications, lack of global search-engine type services, high-cost for service providers, unavailability of GPS-equipped handsets or low positioning accuracy. MNO's see GNSS as the possible remedy to the above mentioned shortcomings.

Moreover, the convergence of information and telecommunication technologies in ever-smaller devices is leading to the creation of the Geo Web. While internet services are tailored to static user needs, Geo Web services must accommodate for anywhere, anytime, needs in dynamic user contexts.

Thanks to its commercially oriented PPP structure, GALILEO stands in the unique position to take an active role in the creation of the LBS market and eventually, the Geo

Web[v]. The JU should not stop short of identifying the tremendous potential of LBS, but secure its place in the LBS-specific part of its value chain. The proposed approach recommends that the GALILEO Concessionaire enhance its offering with an LBS service-creation infrastructure through a publicly accessible global platform.

2) Global Navigation Satellite Systems (GNSS)



2.1) Exisiting GNSS Systems

Today there are two globally available space navigation systems: the American Global Positioning System (GPS) and the Russian GLONASS. Both systems have military origins. GPS has been developed in the early 1970's by the U.S. Department of Defense (DoD). The system allows for passive global positioning and is weather independent. GPS is based on a system of 24 satellites in six circular orbits at an altitude of 20,200 km. At least for satellites must be in view of the receiver to enable position determination[vi]. Originally, it was intended for military use, but has been later made available to civilian users. It is now a dual-use system serving both military and civil users[vii]. However, The DoD reserves the right to degrade or block the signal in case of emergency. Despite this

shortcoming, GPS is now established as the primary system for determining time and position information.

Its Russian counterpart, GLONASS is today also a dual-use. The system was originally conceived to enable global tracking of Russian submarines[viii]. Despite its open signal, its accuracy has been severely degraded from 2001, as only seven out of the original constellation of twenty one satellites is currently operational.[ix]

The two systems are interoperable in principle. In practice, useful interoperability is compromised by the fact that both systems use different terrestrial coordinate frames. GPS uses WGS 84 and GLONASS the PZ-90 system. The two coordinate systems result in measurement discrepancies between the two systems of up to 20 meters on the ground.

2.2) GALILEO

GALILEO is the European, civilian GNSS that is planned to be fully operational by the end of 2010[x] It will be based on a constellation of 27 operational satellites in three circular orbital planes at an altitude of 23,616 km. The European system will be superior to the two existing systems both in positioning accuracy and signal availability as well as providing service guarantees for selected service levels. This will allow for its application to safety-of-life applications such as aircraft landing approaches or rail management.

2.3) Market Trends

Like the internet, GNSS has been designed and developed with military users in mind. Today, two global systems both deployed in the cold war era co-exist. The GPS system's gradual opening to commercial use has led unexpected civilian applications for positioning information. Similarly to the PC revolution, the once hardware dominated market-place has been crating increasingly more opportunities for providers of innovative services and applications. The key drivers behind this process originate in falling costs, miniaturization, increasing processing speeds, and power efficiency in electronics. The combination of these processes has allowed for mass-market personal GPS devices such as TomTom GO to be available for under $100. Personal mobility represents the most significant segment of the civilian GNSS use.

Worldwide net turnover by application in 2005 and in 2010

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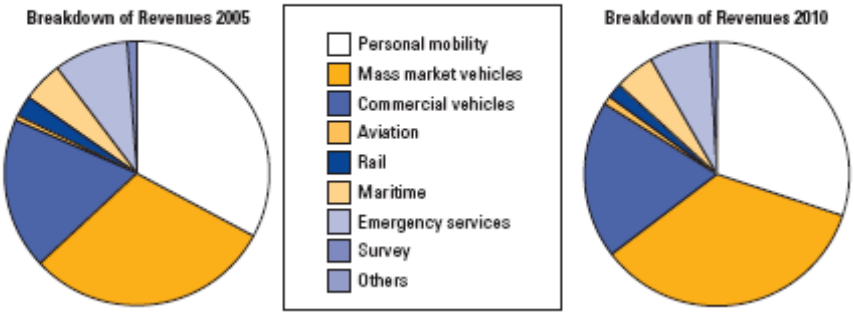

Fig.2) Source: GALILEO Business Brochure 2005

2.4) Applications

Over the relatively short time of civilian usage, a large number of applications have emerged. Generic GNSS applications include:

- Location Based Services
- Road Applications
- Aviation
- Maritime
- Rail
- Oil and Gas
- Agriculture
- Fisheries
- Survey and marine engineering
- Science
- Electricity Networks

Due to the recent spur of growth in the applications sector, numerous research projects are being conducted to enhance the capabilities of GNSS. Areas of investigation include in-door positioning, personal navigation, aviation safety of life services and other novel uses of positioning[xi]. One successful way of extending current applications is through the convergence of GNSS with additional sensors and systems. Software suite's such as Polaris[xii] have been specifically developed to support GNSS-based application design.

3) GALILEO Value Chain

3.1) The rationale behind GALILEO

Galileo is promoted by the European Commission and the European Space Agency. Its rationale is:
- **Strategic:** to protect European economies from dependency on other states' systems which could deny access to civil users at any time, and to enhance safety and reliability.

- **Commercial:** although Galileo will not be able to charge for the use of its basic service, because it is accepted that users need to have free open access, it could become a commercially viable business by providing value added services which will establish a position in the market alongside GPS.

- **Economic:** to secure an increased share for Europe in the equipment market and related technologies, deliver efficiency savings for industry, create social benefits through cheaper transport, reduced congestion and less pollution and stimulate employment.[xiii]

The system has been designed to provide five different service levels where only the Open Service will be made available free of charge:

- Open Service
- Safety of Life
- Commercial Service
- Public Regulated Service
- Support to Search and Rescue Service

In the GALILEO business Case Study conducted by PriceWaterHouseCoopers[xiv] (PwC) a minimum Return on Investment (ROI) of 4 times has been calculated. PWC's calculation of expected ROI is questionable to many, however. The system's backers have been openly criticized for attempting to falsely justify an infrastructure with high priority on the political agenda with unrealistic and promises of future benefits. The aviation industry for instance, which is claimed by GALILEO as one of the industries that will benefit from GALILEO's Safety of Life Service has described the supposed benefits as non-existent[xv].

- PPP
- cost not so high (<high-way) EUR3.4 – 3.6 Billion
- expected ROI – 4 times
- uncertain business model
-

3.2) Traditional Value Chain Definition

The concept of value chains has been around since the mid-80's. According to Professor Michael Porter of Harvard Business School the value chain categorizes the generic value-adding activities of an organization[xvi]. The "primary activities" include: inbound logistics, production, outbound logistics, sales and marketing, and maintenance. The "support activities" include: administrative infrastructure management, human resources management, R&D, and procurement. The costs and value drivers are identified for each value activity. The value chain framework quickly made its way to the forefront of management thought as a powerful analysis tool for strategic planning. Its ultimate goal is to maximize value creation while minimizing costs. The above definition however is company-centric and particularly ill-suited to network infrastructures, products and services such as GALILEO.

3.3) Co-creation in the Value Chain

As the information age advances possibilities of 2-way communication between companies and consumers as well as consumers and other consumers, the consumer begins to play an active role in the creation of value. As a result, the companies themselves loose control of the value-creation process in favor of the consumer and his or her environment[xvii]. In particular, products and services based on networks have no value at all with out a critical mass of users who in themselves add value to the offering.

Typical examples are telecommunication networks where the more users a network has, the more valuable it is to the end-user as communication possibilities expand. Location Based Services inherently depend on its users co-creating their value. The more data points are in the service, the more useful it is for the end-user. In the case of GALILEO its relative value to the customer is not determined by the system itself, but by the interactions of the user with all other players in the chain. Thus, omitting the end-user or customer of the system results in a distorted image of the origins of its value.

In the GALILEO value chain the user interacts with:

- Content Providers i.e. LBS application providers
- Communication Providers i.e. cellular networks
- Services Providers
- Receiver Manufacturers i.e. cell phone makers
- System Providers
- Physical Platform Providers i.e. car manufacturer where the GPS receiver is installed
- User Communities i.e. other users of the system

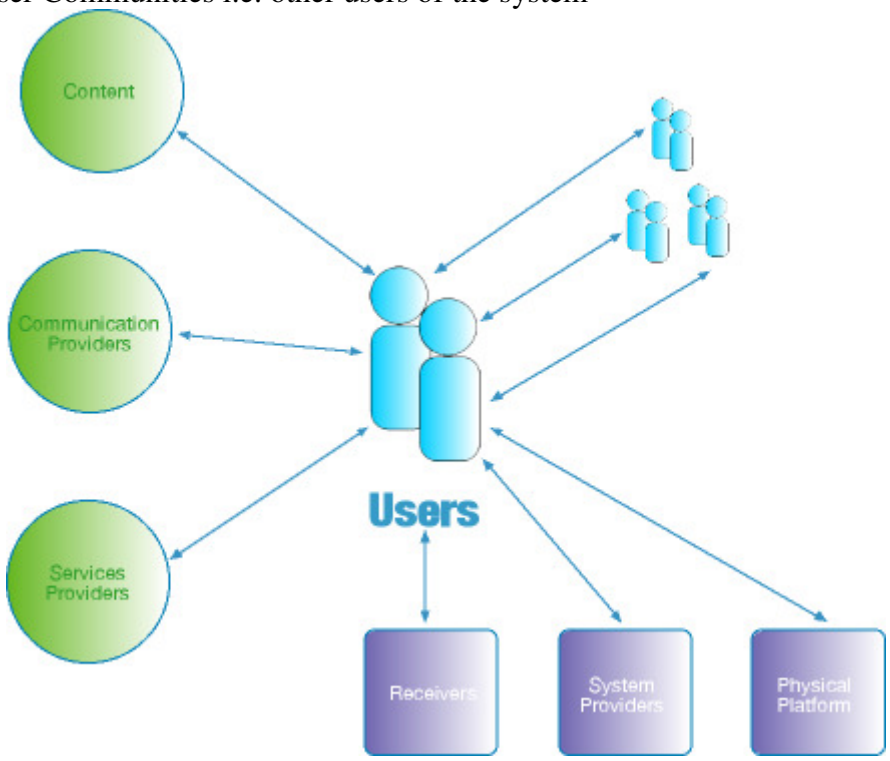

Fig. 3 The co-creation of value in the GALILEO value chain

4) Location Based Services (LBS) For Mobile Handsets

4.1) LBS-enabled m-commerce

The promise of m-commerce has been around since year 2000 when the first handsets with Wireless Application Protocol (WAP)[xviii] were introduced on the market. The general approach to mobile commerce has been largely based on direct translation of existing internet business concepts onto the small mobile screen. Usability proved to be a major shortcoming as the user experience was below the user–acceptance threshold. In addition, the usefulness of being able to purchase a pair of jeans through a cell phone was rather questionable. The failure of early m-commerce ventures is well illustrated on the Technology Acceptance Model (TAM). TAM is a general level model which is capable of explaining user behavior across a broad range of end-user computing technologies and user populations. According to the model the likelihood of technology use is determined by the perceived usefulness, apprehensiveness, enjoyment and ease of use of the product or service[xix].

Mobile location services have not taken off as rapidly as many observers expected a few years ago. Revenues from location-based service (LBS) in the European market were approximately EUR 108 million in 2004. Over the coming five years, we believe this figure will grow to EUR 2,183 million and account for 4.5 percent of total non-voice revenues[xx].

4.2) The Mobility Factor

What the early m-commerce entrepreneurs failed to realize was the inherent value in the fact that the user of the mobile phone is mobile[xxi] While the mobile phone can not compete with the user experience of a PC, its uniqueness lies in its portability. In a traditional e-commerce transaction, the context of the customer experience stays the same at all times as the interaction is always static. The user enters navigates to the desired e-commerce service and expects to provide it with the same level of service each time.

Fig.4) E-commerce user-application interaction

In an m-commerce transaction however, the expected service and anticipated experience depends on the user's location and activity at a given time.

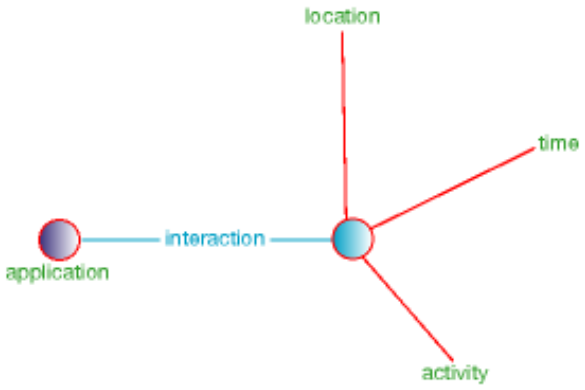

Fig.6 M-commerce client-application interaction

In order to better illustrate the significance of the context of the experience, an illustrative example is given. In case 1 the user of an online social networking service is browsing through pictures of interesting people in his area. In this situation, he or she is simply browsing through profiles and the value of the service to him at the time is based on the ability to provide profiles of interesting people that he can get in touch with. In case 2 the same user is out in town after work. He is with a friend and they want to decide where to spend the night. The user logs into the mobile version of the service hoping to locate people who interest him and head down to the same place in order to actually meet them. Suddenly, the value of the application is not only displaying interesting profiles, but finding them nearby to help in deciding where to go that night.

4.3) The Market

The global market for Location Based Services has been estimated at EUR 12 Billion In the years to come it is widely expected to experience rapid growth due to two several driving factors. Miniaturization, increased processing speeds, advances in displays, power efficiency, etc. The EU directive on 112 and the U.S. equivalent 911 has pushed MNO's to build-up caller localization capabilities[1]. Finally, legal obstacles are being overcome thanks to legislation allowing for caller tracking by third-party service providers.

LBS is divided into 4 generic segments[xxii]:

- Wireless advertising
    - Location based advertising allowing companies to push location specific advertising. i.e. someone walking by a store.

[1] Commission of the European Communities. Sixth Report on the Implementation of the Telecommunications Regulatory Package, Brussels 07/12/00

- Mobile information
    - Location specific information i.e. mobile maps, local event guides, city guides, etc.
- Mobile transactions
    - Location based payment services i.e. road tolling, Wi-Fi hot spot access, etc.

4.4) LBS Success Factors

The success factors critical to successful LBS deployment are:

- Open market for location-based applications
- Accurate, available position information.
- Technology integration

4.5) Emerging LBS sectors

- **Geo-spatial Data mining**
    - As information becomes increasingly available "on the go" new data mining techniques will allow for establishing spatio-temporal data patterns. Today's data mining techniques operate in 2D space i.e. Amazon.com informing you that the user who bought this book has also bought another book. LBS data-mining techniques will have to add the spatio-temporal context i.e. the user who came into this yesterday restaurant, later went to this bar and today he is at a concert in this jazz club.

- **Collaboration Software**
    - As work forces become increasingly mobile collaboration software will have to be enhanced with contextual information. Areas to be investigated include the impact of the employees relative position to one another, the changing user requirements based on the environment surrounding the user and his interaction with it, as well as adapting information to the specific context.
    -
- **Geo Web**
    - As advances in mobile information technology converge with wireless capabilities and miniaturization a new vision of a Geo Web emerges. The Geo Web is to superimpose the internet data layer onto the physical world. Millions of location aware micro-

computing devices embedded in all kinds of objects are envisioned to seamlessly communicate with each other (the internet of objects) and users enabling the adoption of the pervasive computing model.

Fig.7) Migration towards the Geo Web

Innovative Examples

5) Ground-based vs. Space-based LBS

5.1) Common positioning technologies overview for LBS

Cell-ID

Cell-ID is the cheapest but also the least accurate implementation of LBS. Here every cell is given one coordinate. The accuracy varies with the size of the cells. In urban areas, where cells are relatively small, accuracies of 100 meters are typical. In rural area, where cells are relatively large, the accuracy can be as low as 3000 meters. Despite the lack of accuracy, cell-ID is still useful for range based queries, where the exact location is not a priority. A query such as "Where can I get Vietnamese food?" could be answered with a list of restaurants in the nearby neighborhood. Cell ID can be implemented on any GSM network without additional hardware on the handhelds or on the provider side.

Triangulation

The triangulation method is more accurate than Cell-ID but it is also more expensive to implement for providers. It works by measuring the time at which a signal from at least three base stations arrives at the handset. The accuracy varies from 50 to 200 meters. There is no additional hardware required on the handheld.

GPS and A-GPS

An assisted GPS system offers the highest level of accuracy, i.e. 5 – 30 meters, provided the receiver has a line of sight to at least three satellites. Studies show that about 60% of all mobile phone calls are made from within buildings, where GPS localization fails. GPS also requires additional hardware on the handset. There is no additional hardware required on the provider side.

Assisted GPS is combination of an autonomous GPS system and Cell ID. Because it also works in buildings, it sometimes referred to as indoor GPS. So far A-GPS handsets are rare. One of the first providers to introduce A-GPS to its customers is the service provider Three, a subsidiary of the Hong Kong based company Hutchison Whampoa. The service is available in Austria, Denmark, UK and Sweden.

Country	**Method**	**Providers**
Germany	Triangulation	All providers
Netherlands	Triangulation and A-GPS	Only Vodafone
Italy	Triangulation and A-GPS	A-GPS only available with "3"
Spain	Triangulation	All Providers
UK	Triangulation and AGPS	5 out of 6 operators: Vodafone, Orange, O2, T-Mobile, Three
France	Triangulation	All Providers
Portugal	Triangulation	All providers
Ireland	Triangulation+ A-GPS	Only with "3"

Table 1: Technologies used for localization in selected European countries

5.2) Global Service Availability

The roll-out of mobile LBS services based on terrestrial positioning systems has been slowed down by bureaucratic barriers resulting from the lack of a trans-boarder LBS infrastructure. Today, in order to introduce an EU-wide service the application service provider (ASP) has to sign an individual contract with each mobile operator in 25 countries in order to connect to the individual positioning systems. The integration of GNSS receivers into mobile phones will enable ASP's to get access to one global positioning system.

5.3) Passive Positioning

Current network based positioning infrastructures in practice do not allow for "passive positioning" meaning the continuous tracking of the user position like in an automotive navigation system. This is due both to technical reasons, but also the charging model for positioning information that is used by the operators.

5.4) Cost

The large investment costs related to the implementation of network based positioning infrastructures have been translated into exuberant usage costs for ASP's. Not only does each operator charge a flat-rate access fee, but each ping to determine user position incurs an incremental cost as high as EUR0.15. This situation has practically rendered any European-wide 3rd party LBS service economically unfeasible.

5.5) Hybrid Systems

GNSS, despite its clear advantages over terrestrial systems has one know problem – its unavailability indoors. This is why most operators are envisioning hybrid systems where terrestrial positioning is used in conjunction with A-GPS to provide service continuity.

6) GALILEO-based M-Commerce Platform

6.1) Platform Overview

Considering the realm of todays increasingly service based economy GALILEO and its future private operator (The Galileo Concessionaire) stand in a unique position to benefit not only from the physical infrastructure layer, but also building a services infrastructure based on the physical layer. Thus, it is not only the physical part that should be available as a global utility[xxiii], but also the services platform which can permit anyone to benefit from navigation.

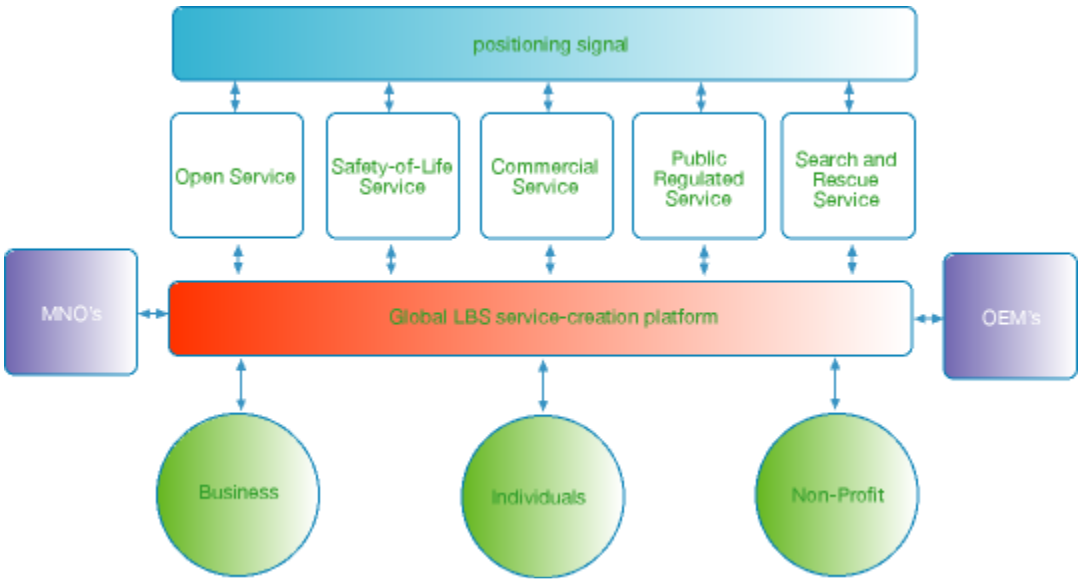

Fig.8) The GALILEO LBS creation platform

6.2) Unique Position

On one hand, GALILEO JU sees the enormous potential in the services market for GNSS. The idea behind the PPP is that it is profit oriented (bringing better value on capital investment). However, the PPP is mainly physical infrastructure focused, missing out on the enormous opportunity to cut-into the services revenues that it has already identified. GALILEO can also leverage its political aspect to push for an international initiative for the creation of a global location-aware search engine.

In the era of privately owned internet search services such as Yahoo or Google, the PPP approach to the development of such a system may sound obsolete. However, the platform would stop short of providing the actual end-user services. Rather, it will act as a global location aware directory that can be commercially offered to prospective service providers.

6.3) Platform Objectives

The main objective would be the creation of a mass-market location aware search engine which would be provided as a public utility. A PPP is a perfect means of achieving this goal. Just like phone books were once produced by the state, the modern version of phone books is the search engine. GALILEO JU is very right to see the European-built GNSS infrastructure as a utility, but it seems to overlook the fact that a modern service-oriented economy must also provide a service framework to enable growth of services.

In order to be successful the platform will have to be easily accessible from any place on earth both to information suppliers as well as users. Any business and private person in the world should be able to add his or her information to this global, location-aware, search engine.

Moreover, the GALILEO Concessionaire must push the platform to all device manufacturers in order to create a critical mass of Original Equipment Manufacturers (OEM's) that would incorporate the platform into their devices.

The platform will also have to be inter-operable with all other space and terrestrial positioning systems.

6.4) Key Stake Holders

- GALILEO Consortium
- The consortium could be expanded
- Value-Added service providers

- End-Users

6.5) Value Added

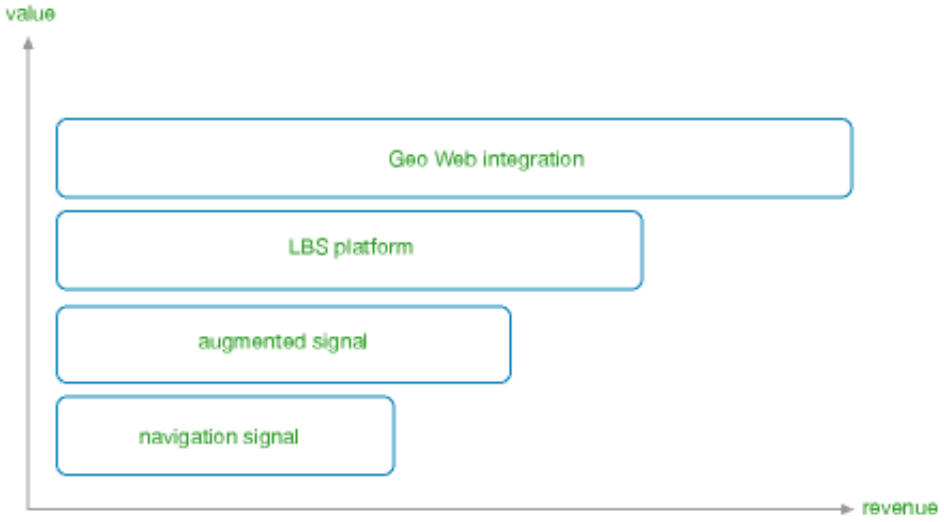

Fig.9) Platform Added-Value for GALILEO

By securing its place in the services market, GALILEO would significantly add value to its offering by providing a vertically integrated service. The value proposition would not only offer the positioning signal, but also a ready-made services infrastructure, which will act as a catalyser for the usage of the signal. This in turn would provide a true competitive advantage over the future GPS III which will solely offer a positioning signal. Device manufacturers will be more prone to incorporating a system that offers its own value-added services platform, as compelling services are a key determinant of demand for hardware.

6.6) Real Benefits for Society

The successful implementation of such a platform can bring significant benefits to European society. By laying the ground work for the creation of the location aware mobile internet or Geo Web, the system can facilitate the next step in the transformation to an information society. The Geo Web will not only allow for the exchange of information, but implement a global standard for location aware information. The inherent value of such a system may be illustrated to creating a global “Google” that is available from anywhere at any time. This newly created information tool adds important new dimensions to information, being their position in time in relation to the users location at the given time.

7) Conclusion

It has been demonstrated that the increasing role of Location Based Services in mobile operator strategies, the continuing growth of mobile phone users as well as the integration of GNSS receivers into handsets creates an enormous market opportunity for GALILEO. In order to realize this potential, the GALILEO consortium must take a pro-active approach in positioning itself as the enabler of LBS. The inclusion of the LBS service creation platform will not only secure additional revenues, but more importantly advance global information society to a new form of internet – the Geo Web. While the technical superiority of its physical infrastructure will surely be challenged by GPS III, innovative value-added services can provide a real competitive advantage. GALILEO's financial success will depend on its ability to understand end-user needs by placing the end-user at the center of its value chain.

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[i] GALILEO Business Brochure 2005
[ii] Cambridge Positioning Systems Press Release
[iii] Research and Markets, The Structure of the European LBS Market 2005 July 2005
[iv] IDC Press Release 26/11/06
[v] Spatio-temporal Data Mining for Location-based Services (Industrial Ph.D. study proposal at Aalborg University)

[vi] Ahmed El-Rabbany. Introduction to The Global Positioning System, ARTECH House, Inc. 2002 pp1-14
[vii] Ramjee Prasad, Marina Ruggieri. Applied Satellite Navigation. Using GPS, GALILEO, and Augmentation Systems. ARTECH House London, 2005 pp1-10
[viii] Lecture given at the International Space University by Prof. Nikolai Tolyarenko. "Global Navigation Systems" Fall 2005
[ix] http://ilrs.gsfc.nasa.gov/satellite_missions/list_of_satellites/glonass/
[x] ESA Press Release 17/02/06
[xi] Gerard Lachapelle. 2005 Research Report, Alberta Informatics Research Excellence
[xii] Angel J. Gavin, Stefano Scarda, Kevin Sheridan, J. Ignacio Herrero. Polaris: A Software Tool to Support GNSS-based Application Design
[xiii] Etude initiale en vue du développement d'un plan d'exploitation pour le programme GALILEO TREN/B5/23-2001
[xiv] The GALILEO Business Case. PriceWaterhouseCoopers Phase II study for GALILEO Joint Undertaking 2001
[xv] GALILEO SATNAV: Airspace users position paper. IATA, 01/07/03
[xvi] Michael E. Porter. Competitive Strategy: Techniques for Analyzing Industries and Competitors Harvard University Press 1998, p.20
[xvii] C.K. Prahalad, Venkat Raswamy. The Future of Competition Harvard University Press, 2004 pp12-17
[xviii] Beth Schultz "The M-Commerce Fallacy" Network World, 02/26/01 http://www.networkworld.com/ecomm2001/mcom/mcom.html
[xix] TECHNOLOGY ACCEPTANCE MODEL FOR COMPLEX TECHNOLOGIES IN A PERIOD OF RAPID CATCHING-UP S.A. Rau Department of Scientific and Industrial Research, Technology Bhawan, New Delhi.

[xx] http://www.researchandmarkets.com/reports/c21170
[xxi] Dr. Jakob Nielsen. Killing Time is the Killer App, Dec 04, 2000. TheFeature.com

[xxii] KAMIL A. GRAJSKI and ELLEN KIRK. Towards a Mobile Multimedia Age – Location-Based Services
A Case Study, *Wireless Personal Communications* 26: 105–116, 2003.

[xxiii] GALILEO Business Brochure 2005 p. 7