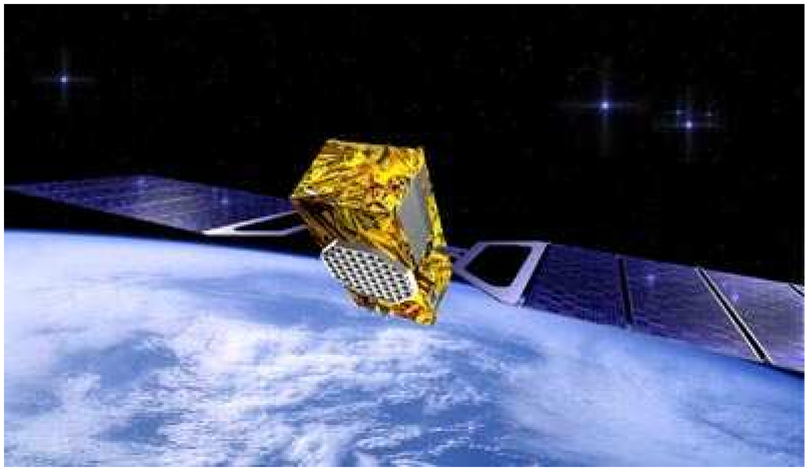

Galileo: A Closer Look at the Security and Defence Implications of the European Global Navigation Satellite System

European Studies

Master's Thesis

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Abstract

At the end of the 1990s, Europe realized the need to develop an independent satellite navigation system named after the renowned thinker Galileo Galilei. The civilian nature of Galileo and its prospective economic and social benefits have been strongly emphasized by the European authorities right from the outset vis-à-vis the military controlled/operated US GPS and Russian GLONASS. However, as a potential dual use system, Galieo also has a security and defence dimension since Europe, upon its completion, will possess a capability comparable to GPS that has revolutionized modern warfare. Amidst the disagreements surrounding the system's characteristics and the failure of its financing structure, the EU managed to secure a deal and decided to go ahead with Galileo in November 2007. While the significant delay from the original schedule in the face of the GPS modernization programme raises questions over the project's commercial viability, the EU, for the first time, officially acknowledged the potential military use of Galileo in May 2007. Galileo will have implications for the CFSP, ESDP, and the EU-US-NATO relations. International involvement in the project adds further complexity to the debate with regard to the EU's position in world affairs. This study explores the depths of the European GNSS project from a security and defence perspective and analyzes to what extent Galileo could influence the global standing of the EU within this context.

Overview

In May 2007, the EU has adopted a new space policy officially acknowledging the potential military use of Galileo satellite navigation system; a step calling for greater attention to the security and defence aspects of the project. In 2001, the then United States (U.S.) Deputy Secretary of Defence Paul Wolfowitz's letter (see appendix I) to the defence ministers of the European Union (EU) member states demanded the abandonment of the project. This aroused worldwide interest in the security and defence implications of the Galileo system which has been developed as a civil system under civil control as opposed to the U.S. Global Positioning System (GPS) and the Russian Global'naya Navigatsionnaya Sputnikovaya Sistema (Global Orbiting Navigation Satellite System - GLONASS) both of which are sponsored and managed by military authorities. Alongside its anticipated commercial and social benefits to the EU and its citizens, Galileo has also a strategic value for Europe. The EU affirms that this alternative satellite navigation system is being developed not only for the sake of competitiveness, growth, job creation, better transportation across Europe and new services that would improve the daily life of its citizens, but also for attaining such a critical infrastructure of this scale and capability that will strengthen Europe's independence, competitiveness and influence in world affairs. (EC, 2002a, EC, 2002b, GPS World, 2007, EC, 2007a)

Despite these assertions, Galileo also prompted scepticisms and divergence within the EU which caused significant delay from the original schedule of the project. Consequently, doubts have been raised over the system's commercial viability and competitiveness within the framework of the US GPS modernization programme. In the wake of the failure of its unique financing structure, the project even came to the brink of termination. Until recently, this trend has not changed and the project remained troubled. However, the EU members agreed, following the settlement of internal disputes, in late November 2007 to go ahead and take full control of the project from the private sector and finance it entirely through the EU budget. (Lembke 2002a, EurActiv 2007)

The recent act might be seen to have consolidated the argument that the economic motives behind Galileo are not the overwhelming factor to keep the project up and running; instead strategic interests also play a crucial part as the EU's aspirations to possess an independent satellite navigation system prevail. This notion of independence arguably involves a security and defence dimension besides economic, political and technological spheres that could be linked to the EU's motive, in general, towards improving its status in world affairs.

This research has been conducted to explore the security and defence implications of the Galileo Satellite System within the aforementioned context and the research question has been formulated with particular emphasis on this facet of the topic. Though the civilian nature of the project is frequently underscored, inherent dual-use[2] character of space assets, as in the case of Galileo, is too important to neglect. This also implies the possibility of Galileo's future exploitation for various security and defence applications besides its proposed civilian use and whether the EU will fully harness this potential is a major question.

Prior Research

The significance of Galileo Satellite System and the implications of the project

[2] It entails the capability of space technology (satellite navigation in particular) to potentially serve for both civil and military purposes. (Dickow, 2007)

have already been addressed in a number of academic studies. Most of the literature particularly concentrates on the economic benefits of Galileo along with an emphasis on its security and defence implications (Lembke, 2003, Lindstrom & Gasparini, 2003, Lembke, 2001a, Lembke, 2001b, Lembke 2002b, Lewis, 2005). Besides, some of the literature deals with the general aspects of the European High Technology and Space Policy and its internal challenges with or without emphasis on Galileo, (Lembke 2002a, Siebert, 1997, Silvestri, 2003, Logsdon, 2002) some others attempt to shed light on Galileo against the background of transatlantic affairs and international involvement in the project which could be linked with the overall discussion (Lungu, 2004, Kogan, 2005, Anthony, 2005, Sigurdson, 2003).There are also a number EU, European Space Agency (ESA), Western European Union (WEU) official documents and publications of affiliate organizations such as the European Space Policy Institute (ESPI), European Union Institute for Security Studies (EUISS) addressing the EU Space Policy in general or Galileo and its implications in particular. Meanwhile, various articles in notable periodicals explore different aspects of the EU Space Policy and future European constellation including those covered by this research (Divis, 2002, Naja, 2001, Smith 1994, Burzykowska, 2006, Larsen, 2001, Brachet & Deloffre, 2006, Peter, 2007a, Kolovos, 2002, Vielhaber & Sattler, 2002, Brown, 2002, Braunschvig & Garwin & Marwell, 2003). Lastly, papers presented in conferences and symposiums provide insight into the core elements of the case (Flament, 2004, Pinker & Smith, 2000, Khan, 2001, Broughton, 2005, Forsberg, 2007). As far as the prior research is concerned; the necessity to devote more attention on the security and defence implications of Galileo Satellite System is noticeable given the fact that these aspects become increasingly noteworthy with regard to the evolving nature of global affairs.

<u>Research Question</u>

This study will address the following main research question:

To what extent might the advent of the Galileo Satellite Navigation System affect the global position of the EU particularly with regard to the security and defence implications of the project?

In order to be able to judge whether the Galileo system might influence the EU's global standing, exploring the link between advanced space capabilities and today's strategic environment might be useful aside from the economic advantages Galileo would bring. Could the dual-use character of Galileo as an advanced space capability help the EU to exert more influence in global affairs and play a role in the making of security identity for Europe as a prestigious global actor? To examine these questions, aforementioned potential use of the European Global Navigation Satellite System (GNSS) should also be highlighted besides its anticipated civilian commercial and social benefits as this research primarily concerns.

Subquestions:

Research question has been broken into 3 subquestions so as to highlight the different elements of the issue and produce a well-grounded evaluation. Each subquestion mentioned below is associated with its respective chapter following the introduction.

1) What are the specifications and potential benefits of Galileo; Why the EU develops an alternative GNSS while similar services are offered by the US GPS?

2) What are the security and defence implications of Galileo and how could they be linked to the Common Foreign and Security Policy (CFSP), European Security and Defence Policy (ESDP), and North Atlantic Treaty Organization (NATO)?

3) How could Galileo serve the EU to strengthen its position and enhance its influence in world affairs particularly with regard to its security and defence implications?

The Structure of the Thesis

The thesis consists of five chapters. Following the introduction including the theoretical framework and background information on EU Space Policy, chapter two addresses the first subquestion and contains brief history of Galileo, its specifications, application areas and potential benefits and its comparison with other satellite navigation systems. This chapter also explores the motives behind Galileo's development as well as the EU's internal rifts involved in the project. Third chapter covers the security and defence implications of European GNSS when dealing with the second subquestion. In this chapter, military-security applications of GPS and its involvement in the U.S. military campaigns are explored with an emphasis on how satellite navigation revolutionized the nature of the strategic and tactical warfare as many experts argue. Within this context, potential military benefits of Galileo and the necessity of satellite navigation capability for attaining a global power status are discussed. The last section of this chapter is devoted to analyzing the relevant implications of Galileo for CFSP, ESDP and NATO. Chapter four, in light of the third subquestion, evaluates the transatlantic relations and the international involvement in Galileo against the background of the discussion in the previous chapter. The final chapter includes the conclusions drawn from the study and prospects for future research.

CHAPTER 1: INTRODUCTION

The European Union's latest generation GNSS project "Galileo", named after the renowned Renaissance astronomer, represents a major step in the development of European High Technology and Space Policy. Along with the other high technology undertakings, Galileo could potentially serve the European cause "to become the most competitive and dynamic knowledge-based economy in the world" a target set by the Lisbon Strategy. The project is jointly managed by a tripartite body consisting of the European Commission (EC)[3], the European Space Agency (ESA) and the European Organization for the Safety of Air Navigation (Eurocontrol). The European Commission deals with the political and strategic issues involving the project while ESA is in charge of the technical aspects such as the development phase and in-orbit validation of the system. Once being fully operational, Galileo will provide precise positioning, navigation and timing services in a wide spectrum of applications areas ranging from transport and energy to environment and leisure which would considerably boost European economies and create a substantial amount of new jobs according to some estimates. (EC, 2003a, EC, 2007b, EC, 2006, Sharpe, 2001, Flament, 2004)

Nevertheless, the differences of opinion between the EU member states play a significant role in the realization of Galileo project as in every aspect of EU policy making. These differences involve an array of issues from economic and budgetary concerns to political interests of individual member states, e.g. hard line stance of France towards a common European security and defence identity and the employment of space

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[3] Directorate General for Transport and Energy (DG TREN) of the European Commission is the responsible body for the Galileo Programme. (Lembke, 2002a)

assets for this cause vs. the United Kingdom's (U.K.) sceptical approach to such an endeavour against the background of its close transatlantic ties, Germany's aspirations to assume a leading role in the project to secure its future industrial gains vs. the similar concerns of Italy and Spain or overall funding issues, that resulted in a significant departure from the original programme[4]. However, despite the aforementioned setbacks and delays in the development stage, proponents of the system advocated that the most viable option on the part of the EU is to keep this crucial project up and running without any detailed cost analyses as Galileo, being a strategic asset, would increase its influence and prestige in global context and break European dependence on third parties. Eventually, the November 2007 Council decision endorsed this approach. (Lembke, 2002a, Vielhaber & Sattler, 2002)

Currently, two GNSS constellations are available[5]; the US-run GPS and Russian GLONASS. However, GPS is in leading position to offer positioning and timing services since GLONASS is not fully operational. Though GPS is widely used for civilian applications, it is controlled by the US Armed Forces[6] which, as European authorities claim, raises serious concerns over its availability in times of conflict. In case of any discontinuity of GPS service, damage to Europe's economy is estimated at millions of Euros per day. Besides, it is feared that the US, in the future, may decide to charge

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[4] Galileo was initially planned to be operational in 2008 but currently the earliest estimate for the system to reach its full operational capability (FOC) is 2012. (EC, 2007b,)

[5] People's Republic of China (PRC) is moving ahead to build its own GNSS named Compass. In this context, PRC successfully launched 5 navigation satellites so far. The system is expected to provide services in China and neighbouring countries by 2008 before being expanded into a global network of navigation and positioning. Compass known as Beidou in Chinese would feature 35 satellites once operational. (Peter, 2007b)

[6] GPS is managed by the United States Air Force (USAF). (Lembke, 2002a)

governmental levies for GPS use. However, under the current circumstances, it is hard to expect that the US would somehow hinder the use of GPS signals for civilian applications which are freely available. In fact, the developments since the Clinton administration came into office indicate the opposite trend when the US removed Selective Availability (SA)[7] feature of GPS (see appendix II). Even though, for the time being, GPS is not capable of efficiently addressing the civilian needs particularly in safety-critical applications, the US has future plans to extend and improve the capacity of the system for civilian purposes by gradually replacing the current constellation with new generation satellites, aiming to boost the system's dual use character, as the GNSS applications become more and more indispensable part of daily life both in the US as well as around the world. This trend primarily involves a commercial argument behind the EU's aspirations to develop its own system as the US attempts to maintain its present advantage, secure its economic/industrial gains and minimize competition within the booming GNSS applications market by having the GPS recognized as the world standard system. Apart from the purely commercial argument, there exists a strategic case as well behind an independent European GNSS. The fact that the EU lacks such a critical infrastructure is interpreted as the loss of sovereignty that requires immediate attention particularly with regard to technological incapability for taking independent European action. Consequently, the debates, surrounding Europe's dependence on external actors concerning such vital issues, are triggered. (Legat & Hoffmann-Wellenhof, 2000, EC, 2002a, Lembke, 2002a, Vielhaber & Sattler, 2002, Pappas, 2002)

Within the context of the above mentioned high technology competition

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[7] SA enabled the US to intentionally degrade the accuracy of GPS for nonmilitary users. "This was the largest source of error in GPS positioning". (Legat & Hoffmann-Wellenhof, 2000, Khan, 2001)

environment, the concerns associated with relevant arguments led to the idea of deploying civilian controlled, independent European GNSS as an alternative to GPS and GLONASS both funded and operated by military authorities of the states concerned. While in theory, Galileo will be interoperable with and complementary to GPS, it inevitably brings new issues to the agenda with regard to the changing dynamics of transatlantic relations in post-Cold War era. (Lembke, 2002a, Beidleman, 2006)

Galileo, in a way, symbolises greater sovereignty of Europe and its independence from the US and its GNSS. Besides its potential economic and social benefits to Europe, Galileo, as the flagship project of European space program, will have security and defence implications due to its dual use character which deserve greater attention within the context of the development of CFSP, ESDP and the EU-NATO relations. Since its inception, civilian nature of Galileo has strongly been emphasized partly due to the primarily civilian objectives of the project, aforementioned management structure and decision making process, or due to the initial efforts of individual member states such as the UK and the Netherlands to keep the project strictly civilian oriented even though France insisted that defence aspects should also be taken into consideration. However, the EU itself officially acknowledged the potential military use of Galileo through a document entitled "European Space Policy" jointly drafted by the European Commission and the ESA and the subsequent resolution adopted in May 2007 setting out the guidelines for Europe's future activities in space and aiming to improve synergies between military and civilian actors in the domain of security and defence with an emphasis on the fact that space assets required for civilian and military applications significantly overlap. Presumably, this implies, on European level, greater understanding of the crucial role of space systems for defence and security related undertakings. (Lembke, 2002a, GPS World, 2007, EC, 2007a)

This study devotes particular attention to the security and defence aspects of Galileo while acknowledging the fact that it is a civilian project under civilian control. It attempts to evaluate the extent of the contribution of Galileo to the further development and strengthening of European security and defence identity as the flagship project of European Space Policy. Within this context, relevant evidence is presented that the system, upon successful completion, might considerably influence the EU's position in world affairs and pave the way for further integration in the space dimension of the security and defence domain by triggering a possible spill over effect to eventually acquire an advanced space capability which is, in the current outlook of strategic affairs, an indispensable attribute of a global power and will likely remain so in foreseeable future.

1.1. Theoretical Framework

The theoretical arguments contained in this study involve two corresponding approaches; one towards the EU High Technology Policy from the perspective of Strategic Trade Theory, the other concerning the theory of the balancing behaviour of Europe against the U.S. following the Cold War era.

Within the framework of the first approach, Lembke (2002a, p.17) defines 'high technology policy' as "active and purposive market adjustment intervention by public institutions to shape large-scale technology-intensive infrastructure projects in order to maximize economic, political and other gains." and use Galileo as empirical evidence where public intervention, therefore, high technology policy is strong due to expected benefits (including strategic gains) from the system such as obtaining a share in booming GNSS market which is currently dominated by American firms. Apart from its welfare-enhancing implications, Lembke (2002a) advocates that the EU has strategic motives as well to build Galileo e.g. possessing an independent radio navigation infrastructure, subsequently playing a role in high technology policy formulation. Lembke (2001a) also adopts a realist state-oriented or realist strategic trade perspective arguing that the European efforts to develop the Galileo system are primarily based on the importance of certain key civilian technologies and dual-use technologies in the context of tight military budgets, expected "spin-on" implications, and national security considerations.

Other approach concerns the belief that Europe, in the post-Cold War era, developed a balancing attitude against the U.S. which could be associated with the realist paradigm of international relations. This approach is thought to have gained more ground particularly after the Iraq crisis in the transatlantic relations (Forsberg, 2007).

Waltz (2000) argues that the EU could be regarded as a candidate to restore balance in the unipolar system of post-Cold War era and it has demonstrated significant achievements in terms of economic integration adding that it "lacks the organizational ability" to use its full potential especially in the domain of "foreign and military policy". Waltz (2000) contends that "Europe, […] will not be able to claim a louder voice in alliance affairs unless it builds a platform for giving it an expression. If Europeans ever mean to write a tune to go with their libretto, they will have to develop the unity in foreign and military affairs that they are achieving in economic matters."

Posen (2006) similarly argues that "if Europeans wish to influence the management of global security affairs, they need to be able to show up globally with capabilities, including military capabilities, that matter to local outcomes."

The debate concerning the emergence of the ESDP also highlights this balancing approach. One of the explanations aiming to address the foundation of the ESDP "stems from the belief that the ESDP represents an attempt to balance US power in world politics" (Forsberg, 2007).

Posen (2004) believes that "ESDP is a form of balance-of-power behaviour, albeit a weak form" posed particularly by the hegemonic position of the U.S. The EU, in response, wants to have its autonomous capabilities to fulfil its own security needs. "[…] the maturation of the ESDP will produce Europeans who are increasingly convinced that they could provide for their own security if they had to do so. This is not a prediction of an EU ready to compete with the U.S. It is a prediction of an EU ready to look after itself. This will not happen soon, but given the planned pace of European capabilities improvements, a more militarily autonomous Europe will appear viable in a bit less than a decade"[8]. This growing consciousness will help Europe raise its voice and enhance its influence in world affairs vis-à-vis the U.S.

"The relevant point here is not about the ability of the EU to match the US with any degree of military parity but to be able to achieve more autonomy and independence vis-à-vis the United States" (Forsberg, 2007). The direct military threat perception from the United States and the possibility of a transatlantic military conflict is not the case to explain the evolution of ESDP against the hegemonic position of the U.S. Rather it is the EU's lack of ability to move autonomously in military domain that reveals its

[8] Posen (2004) refers Galileo as one of these crucial autonomous capabilities the EU will possess in the near future.

dependency. “Thus, it is a question about a “balance of power” or “balance of influence” […] rather than a security threat” (Forsberg, 2007). Forsberg (2007) refers to Maria Stromvik arguing that “the political will to cooperate has periodically increased when EU members have disagreed with American strategies on international security management.”

The rise of anti-American, particularly, anti-Bush sentiment among Europeans can also be put forward to underpin the balancing theory. “In 2002, majority of Europeans criticized the Bush government for its handling of several foreign policy issues […]. According to the same poll, 65% of Europeans, in particular the French but also a majority of the British, said the EU should become a superpower like the United States, while only 14% endorsed the view that the United States should remain the only superpower.” (Forsberg, 2007) Balancing theory may also shed light on the Luxemburg meeting attended by France, Germany, Luxemburg and Belgium in April 2003 where they proposed the formation of European military headquarters particularly as it coincided with the period of crisis over Iraq policy (Forsberg, 2007). Jones (2006) puts a special emphasis on defence industrial collaboration among European countries in the post-Cold War era to reduce reliance on U.S. technology and resources and compete with the United States in defence sector. It can serve as another case to support balancing theory. In this context, besides other crucial European undertakings[9], Galileo project can be regarded as an attempt to rival the American GPS (Forsberg, 2007).

As evidenced by the analysis, both of the aforementioned approaches indicate

[9] The Eurofighter combat aircraft, the A400M tactical and strategic airlift, the European medium-altitude long-endurance unmanned aerial vehicle, the Storm Shadow long-range cruise missile, the Brimstone anti-tank missile, the Taurus air-to-surface guided missile, and the Scalp cruise missile. (Jones, 2006)

Europe's drive to improve its global position and involve an element of rivalry between the EU and the U.S. that is underpinned by the case of Galileo as well. Before exploring the depths of Galileo and its implications, background information on EU Space Policy of which Galileo is the flagship project is considered helpful in general context.

1.2. Background Information on EU Space Policy

European space policy has been developed and carried out in the framework of ESA over 30 years (Peter & Plattard, 2007a, Peter, 2007a, Peter, 2007b, EC, 2007). In 1975, the European Space Research Organization (ESRO) and the European Launcher Development Organization (ELDO) have been merged to create the European Space Agency so as to integrate diverging national space policies. ESA has served as an intergovernmental institution in charge of organizing collective European space activities along with a number of other organizations responsible for specific actions such as the European Organization for the Exploitation of Meteorological Satellites (Eumetsat). "The European space landscape is, therefore, split into three distinct levels: the overall European level with the EU; intergovernmental organizations, e.g. ESA and Eumetsat and the national space agencies"[10] (Peter, 2007a).

National programmes as well as European collective activities in almost every field of space domain have lifted Europe to the position of second largest civilian space power with regard to its consolidated budget. ESA and national agencies have been the primary drivers of European space effort for a long time. However, this trend is changing since the European space landscape is facing an institutional evolution process with the

[10] Norway and Switzerland are among the 17 member states of ESA but not of the EU 27 while 12 states that entered the EU since 2004 are not members of ESA (Peter, 2007a)

rise of the EU as the future leader of the European space domain. This process is characterized by the growing awareness of the EC towards the strategic nature of space activities and their potential to serve the interests[11] of the European Union as an instrument. The EC also realized that it has to develop its own programmes in this context. "Europe is, therefore, in the process of making space a community matter and has been introducing a space dimension into its political ambitions of global actor" (Peter, 2007a).

The EU's involvement in space issues dates back to 1970s. However the EC's active engagement and leading role in space affairs started in late 1980s symbolized by its 1988 communication entitled 'The European Community and Space: A Coherent Approach' where closer cooperation with ESA has already been urged in line with its new ambition in space. In 1992 and 1996 respectively, the EC released two more communications in space and the growing tendency to work closely with ESA was strengthened with the establishment of the Joint Space Strategy Advisory Group (JSSAG) which consisted of EU and ESA members. In September 2000 the European Strategy for Space (ESS) was initiated by this advisory group emphasizing the strategic nature of space as an instrument for sovereignty and economic progress. Further on, the communication released in 2000 'Europe and Space: Turning to a New Chapter' led to the emergence of the Joint Task Force (JTF) in February 2001 responsible for the management of the ESS. In January 2003, the EC introduced a Green Paper on European Space Policy in cooperation with the ESA paving the way for a White Paper which eventually appeared in November 2003 and was entitled 'A New European Frontier for

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[11] Those involve humanitarian, environmental and peace-keeping activities (Peter, 2007a).

an Expanding Union – An Action Plan for Implementing the European Space Policy' (Peter, 2007a, Naja, 2001).

The EC – ESA Framework Agreement which entered into force in May 2004 replaced the JSSAG and the JTF with a Space Council. The first European Space Council took place in Brussels on 25 November 2004 involving all EU and ESA member states. Its main objective was to set out a road map for the European Space Policy. The second Space Council gathered in June 2005, specified the roles of the different actors and named Galileo and Global Monitoring for Environment and Security (GMES)[12] as flagship programmes of the European Space Policy. GMES programme was at the centre of the third Space Council held in November 2005 (Peter, 2007a).

The fourth Space Council held in Brussels on May 22, 2007 was a milestone in European space effort as it witnessed the adoption of the first European Space Policy jointly drafted with ESA[13] (Peter, 2007b, Peter & Plattard, 2007a, Peter & Plattard, 2007b) "This collective European Space Policy has historic and symbolic value as it provides for the first time a European Union dimension to space policy" (Peter & Plattard, 2007a, Peter & Plattard, 2007b).

The European Space Policy has been first presented to the European Council and Parliament as a communication from the Commission on 26 April 2007 accompanied by

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[12] GMES is a European initiative for the implementation of information services dealing with environment and security. GMES will be based on observation data received from Earth Observation satellites and ground based information. It is envisaged to serve the European cause "not to be dependent on other nations for information relating to key policy issues such as environment treaties, conflict prevention and humanitarian actions. (GMES Official Website, Logsdon, 2002)

[13] The policy was drafted through a constant consultation process within the High-level Space Policy Group (HSPG) including representatives from the EU/ESA members, the European Defence Agency (EDA), the EU Satellite Centre and Eumetsat (Peter & Plattard, 2007a).

an EC Staff Working Paper on the 'Preliminary Elements for a European Space Programme (Peter & Plattard, 2007a, Peter & Plattard, 2007b). The document highlights the strategic value of space systems:

> Space systems are strategic assets demonstrating independence and the readiness to assume global responsibilities. Initially developed as defence or scientific projects, they now also provide commercial infrastructures on which important sectors of the economy depend and which are relevant in the daily life of citizens. However the space sector is confronted with high technological and financial risks and requires strategic investment decisions. Europe needs an effective space policy to enable it to exert global leadership in selected policy areas in accordance with European interests and values. To fulfil such roles the EU increasingly relies on autonomous decision-making, based on space-based information and communication systems. Independent access to space capabilities is therefore a strategic asset for Europe (EC, 2007a).

In this context, the steps to be taken for achieving the strategic mission of the European Space Policy were laid out in the document as follows:

- establishing a European Space Programme and the coordination of national and European level space activities , with a user-led focus;
- increasing synergy between defence and civil space programmes and technologies, having regard to institutional competencies; and
- developing a joint international relations strategy in space (EC, 2007a).

The fourth Space Council on May 22, 2007 endorsed this document and its associated Space Programme and a resolution on the European Space Policy was unanimously adopted by EU/ESA ministers representing a key factor in the process. As in the European Space Policy communication "the resolution highlights the strategic nature of the space sector contributing to the independence, security and economic development of Europe and recognizes the actual and potential contributions from space activities to support EU policies such as the Lisbon Strategy, Europe's Sustainable Development Strategy, as well as the Common Foreign and Security Policy (CFSP) […]" (Peter & Plattard, 2007a).

The resolution consists of there sections. The first section covers overall aspects of European space endeavour. The second section concerns the several areas laid out in the communication and addresses the efforts towards the implementation of flagship projects Galileo and GMES. "The Resolution deals also prominently with security and defence issues, and while recognizing the intrinsic dual nature of space activities it affirms the need to set up a "structured dialogue" with the competent bodies of the member states and within the EU Second and Third Pillars including the European Defence Agency for optimizing synergies between defence and civil space technologies and programmes. Along the same lines the Resolution does not preclude the use of GMES and Galileo by military users and therefore recognizes the implicit dual-use nature of the future services proposed by those programmes." The final section is devoted to the fundamental issues to be considered with respect to the implementation of the European Space Policy (Peter & Plattard, 2007a).

CHAPTER 2: GALILEO

In order to address the first subquestion, this chapter is divided into six sections. Each section covers different elements of the future European Satellite Navigation System to underpin the analysis taking place in the following chapters. In this context, after a brief history of the European GNSS programme the chapter provides insight into the overall features of the system and explores the motives behind its development along with the divergence observed among the EU member states concerning the system's purpose and competition over hosting the ground segment and governing body of Galileo.

2.1. Brief History of the European GNSS Programme

Europe's actual interest in satellite navigation technology can be traced back to mid-1990s[14] when the European Geostationary Navigation Overlay Service (EGNOS) programme was initiated under the authority of the European Tri-partite Group (ETG) consisting of the EC, ESA and Eurocontrol as part of the GNSS1 activities. The ETG's GNSS1 effort involved the development of augmentations to the existing satellite navigation systems, GPS and GLONASS, to improve integrity and accuracy and it aimed to generate experience and competence for developing an independent civil successor to those systems (GNSS2). (Steciw & Storey & Tytgat, 1995[15], Chen & Ochieng, 2002,

[14] In 1994 the European Commission released a proposal, in the form of a communication entitled 'Satellite Navigation Services: A European Approach', for Europe to engage in satellite navigation representing the first political initiative in this domain. (Lembke, 2001a)

[15] Luc Tytgat (DGTREN), Andrew Steciw (ESA) and John Storey (Eurocontrol) may be referred to as the 'founding fathers of satellite navigation in Europe' (Lembke, 2002a)

Flament, 2004, Pasco, 2002)

EGNOS is one of these augmentation systems and it is considered to be the precursor to Galileo. EGNOS is composed of a network of ground stations monitoring the performance of GPS and GLONASS constellations, processing centres and three geostationary satellites[16]. It transmits correction signals to improve the precision and integrity of the data and enables users in Europe to determine their position to within 2 meters in comparison with about 20 meters for GPS and GLONASS alone and it entered its pre-operational phase in 2006. (Steciw & Storey & Tytgat, 1995, Legat & Hoffmann-Wellenhof, 2000, Chen & Ochieng, 2002, ESA EGNOS Website, Sharpe, 2001)

The second step in the development of European satellite navigation strategy was GNSS2 which would eventually provide Europe with autonomous global satellite navigation capability. The EU institutions continuously stressed the strategic importance of having an independent satellite navigation system in line with the evolution of the European space endeavour. As a result, a high level GNSS2 forum was set up in July 1998 and several research projects have been undertaken to address the issues regarding the European contribution to the second generation satellite navigation. Subsequently, in January 1998 the EC presented the available options for GNSS2 and an amended proposal followed in February 1999 which gave the proposed European system its name – Galileo. In June 1999, the EU Council decided that the Galileo definition phase should

[16] Satellites orbiting at 22,370 miles above the Earth's surface with the same rotational velocity as the Earth; therefore, the satellite remains over the same location on the Earth 24 hours a day. This feature makes them suitable for telecommunications and earth observation. (The U.S. National Weather Service Southern Region Headquarters' Website, Berlin, 1998, EC,1999)

begin in 2000. In November 2000, a report was released by the EC concerning the results of the Galileo definition phase. However, the EU Transport Council postponed a political decision on the development of Galileo in December 2000 due to disputes over issues such as funding, security aspects and legal structure. It was a major blow for the EC and ESA. In spring 2001 an agreement could not also be settled at the Stockholm EU Summit while Heads of State and Government reiterated the importance of Galileo. Amidst the external and internal problems, the EU Council of transport ministers could not again reach a consensus over the public financing of the project in early December 2001 and the weak conclusions of the subsequent Laeken summit in mid-December 2001 met with severe criticism by prominent figures including Transport and Energy Commissioner Loyola de Palacio and the former Swedish Prime Minister Carl Bildt underscoring the EU's inability to take major political decisions. Finally, in the wake of the Barcelona Summit in mid-March 2002 the EU Transport Council gave the official go-ahead to the project and relevant funds were equally released by the EC and ESA for the Galileo development phase while the Galileo Joint Undertaking (GJU) was set up, under Article 171 of the Treaty, to manage the process and to prepare the deployment phase allowing a public and private funding structure[17]. (Lembke, 2002a, Lembke, 2001a, Chen & Ochieng, 2002, Pasco, 2002, Flament, 2004, Onidi, 2002, EC, 1999, Lechner & Baumann, 2000, Hein, 2000, GJU Official Website)

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[17] After the development phased funded by ESA, the deployment and operating phases of the programme was planned to be financed within the framework of a public-private partnership (PPP) which was the first in Europe. GJU was in charge of organizing the selection procedure of the future concessionaire. The concessionaire, as the winning private consortium, was supposed to construct and manage the system for duration of about 20 years. The Supervisory Authority, another actor of PPP, was envisaged to be the licensing authority vis-à-vis the concessionaire. (EC, 2004a)

GIOVE-A[18] was the first experimental satellite launched in December 2005 and its successful operation allowed the EU to meet the mid-2006 deadline for securing the frequency spectrum reserved for Galileo at the 2000 World Radiocommunication Conference (WRC) organized by the International Telecommunication Union (ITU) in Istanbul[19]. Then, the project fell into a deep crisis due to the failure of the public private partnership as the companies of the winning consortium[20] could not commit the necessary funding by claiming that they would need to take a high financial risk without any firm guarantees in return. Subsequently, in light of the alternatives set out by the EC on financing the programme and its call for reaching an urgent decision, EU-27 finance ministers and the European Parliament agreed in late November 2007 that Galileo will be fully funded through EU budget and the EU transport ministers later on gave the green light to the long troubled European GNSS by approving the new industrial tendering plan tabled by the EC (Peter, 2007b, EC, 2007b, Last, 2004, Euractiv Website, Pasco, 2002, CERE, 2006).

[18] In April 27, 2008, the second Galileo In-Orbit Validation Element (GIOVE-B) satellite was launched from the Baikonur cosmodrome in Kazakhstan representing a further step towards the deployment of Galileo. GIOVE-B carries the most accurate atomic clock ever flown into space. (ESA Galileo Website)

[19] The Istanbul Conference specified a time limit (5 years as from 13 February 2001) for the European countries to launch the first satellite of the Galileo programme, emitting signals in the frequency bands applied for, based on the applicable international regulations in this domain. (EC, 2002b)

[20] Eurely/INavsat consortium consisted of AENA, Alcatel, EADS, Finmeccanica, Hispasat, Inmarsat, TeleOp and Thales (Euractiv Website).

Artist's impression of GIOVE-A
Credit: ESA
Source: http://www.bnsc.gov.uk/content.aspx?nid=5649

2.2. What is Galileo?

Since the beginning of time people have looked to the sky to find their way. The modern satellite navigation fulfils this basic human need through cutting-edge technology providing an accuracy which is incomparable with that of the traditional techniques. Today's satellite navigation, a technology which has originally been created for military purposes over the last three decades, enables anyone with a suitable receiver capable of acquiring signals from a constellation of satellites to pinpoint their position in time and space with tremendous accuracy. "The operating principle is simple: the satellites in the constellation are fitted with an atomic clock measuring time very accurately. The satellites emit personalized signals indicating the precise time the signal leaves the satellite. The ground receiver, incorporated for example into a mobile phone, has in its memory the precise details of the orbits of all the satellites in the constellation. By reading the incoming signal, it can thus recognize the particular satellite, determine the time taken by the signal to arrive and calculate the distance from the satellite. Once the ground receiver receives the signals from at least four satellites simultaneously, it can calculate the exact position.” (EC, 2003c, Galileo Official Website)

Artist's impression of GIOVE-B in orbit
Credit: ESA
Source: http://www.esa.int/esaNA/SEMZWWTQMFF_index_0.html

The proposed Galileo system will be the European contribution to the second generation satellite navigation technology representing even greater accuracy and integrity. It will have three major components: the space segment consisting of the constellation of satellites, the ground segment encompassing the command and control structure and the user segment involving the final user. “The core of the Galileo system is the global constellation of 30 satellites in medium Earth orbit, three planes inclined at 56° to the equator at 23 616 km altitude. Ten satellites will be spread evenly around each plane, with each taking about 14 hours to orbit the Earth. Each plane has one active spare, able to be cover for any failed satellite in that plane. Two Galileo Control Centres[21] in Europe will control the constellation, as well as the synchronization of the satellite atomic clocks, integrity signal processing and data handling of all internal and external elements." (Beidleman, 2006, Pappas, 2002, EC, 2004a, ESA, 2005)

Galileo programme is a public enterprise and symbolizes the most ambitious large scale project (aside from the Euro-zone initiative) ever undertaken by the EU institutions. The estimated cost of the system is between EURO 3.2 and 3.4 billion which, according to the November 2007 agreement, will be financed through the EU budget. Once operational, Galileo will provide highly accurate[22] global positioning, navigation and timing service and it will most probably be the first GNSS to feature real-time signal-integrity monitoring[23] entailing the system's ability to report any operational failure or interruption to the end user within seconds. To summarize, Galileo represents the next generation of satellite navigation technology which becomes more and more integrated into daily lives. (Lembke, 2002a, Pasco, 2002, Beidleman, 2006, Pappas, 2002, EC, 2004a, Sharpe, 2001, ESA, 2005)

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[21] The two main control centres will be located in Italy and Germany as per the agreement reached by the EU transport ministers in November 2007. Spain will host a safety of life centre which could evolve into a Galileo ground control centre if the right conditions are met. (Euractiv, 2007)

[22] "By offering dual frequencies as standard […] Galileo will deliver real-time positioning accuracy down to the metre range, which is unprecedented for a publicly available system." (ESA Galileo Website)

[23] This is based on the assumption that Galileo will be operational before the US GPS modernization programme, GPS III, is completed since the modernized GPS will have a similar capability.

2.3. Application Areas and Potential Benefits

The proposed Galileo system will encompass a wide range of application areas[24] where a number of benefits would be reaped. Galileo will play a major role in every aspect of transport applications. It is designed to satisfy the specific requirements of each transport domain – air, sea, land and even pedestrian. As far as the civil aviation is concerned, Galileo will be used in various stages of flight: "en route navigation, airport approach, landing and ground guidance." In maritime domain, "Galileo will be used for onboard navigation for all forms of transport, including ocean and coastal navigation, port approach and port manoeuvres." Galileo services will also be exercised in road transport extensively and applications in this area include "in-car navigation, fleet management of taxis, lorries and buses and driver assistance." "Rail community will benefit from train control, train supervision, fleet management, track survey and passenger information services." Galileo's accuracy, integrity, and service guarantee will be the key to fulfil the needs derived from the aforementioned applications. (ESA, 2005, Forrester, 2003, Berthelot & Ashkenazi, 1999, Tytgat, 1999, Sharpe, 2001, Flament, 2004)

Concerning the energy domain, Galileo might offer benefits such as the efficient transfer of electricity, the accurate positioning and the safe drilling in oil and gas-related activities. The system's reliable time reference and tracking service could also be utilized in finance, banking and insurance applications. In agriculture, navigation could contribute

[24] Galileo's target applications include transport, road, rail/train safety, aviation, in-car telematics, public travel, maritime, inland waterways, safety, energy, telecom location, finance-insurance, civil engineering, fisheries, environment, disabled people, civil protection, time reference, science and leisure. (Forrester, 2003)

to yield monitoring while Galileo could potentially help to monitor resources in fisheries. In telecommunications sector, various benefits would be expected from Galileo combined with other technologies such as Global System for Mobile communications (GSM) and Universal Mobile Telecommunications System (UMTS). Additionally, personal navigation, search and rescue activities, crises and environment management, defence and civil protection activities, surveying and recreation are other notable fields in which Galileo will have a primary role and many more are likely to arise once the system becomes operational. (ESA, 2005, EC, 2004a)

Galileo will offer five different services in order to answer all of the above mentioned needs:

Open Service (OS): This service will be dedicated to consumer applications and general public use for basic navigation purposes. It will be provided free of charge but without integrity monitoring. OS will offer horizontal accuracy of 4 meters with 99 percent service availability. Its potential markets include in-car navigation, mobile telephony and other mass-market navigation applications. (Prasad & Ruggieri, 2005, Flament, 2004, Pappas, 2002, Beidleman, 2006, ESA, 2005, CERE, 2006, Transport Committee, 2004)

Commercial Service (CS): CS will be a controlled-access service for commercial and professional applications. It consists of two added signals to the open access signals that are protected through commercial encryption. CS will provide guaranteed service to users on subscription basis within the framework of a license agreement between the service provider and the private Galileo operator while access will be controlled at the receiver level, using access-protection keys. It would potentially serve in the fields of geodesy and in activities concerning customs and excise operations, network synchronization, sea fleet management, vehicle fleet management, road tolls etc. (Prasad & Ruggieri, 2005, Flament, 2004, Pappas, 2002, Beidleman, 2006, ESA, 2005, CERE, 2006, Transport Committee, 2004)

Safety of Life Service (SoL): SoL is specifically designed for safety critical applications where human lives are at stake as in civil aviation, maritime and rail. Its integrity monitoring feature will enable users to be aware of any system failure within 6 seconds which is highly crucial for critical applications such as landing an aircraft in bad weather conditions especially where services provided by traditional ground infrastructure are not available. SoL will also offer highly secure service with 99.9 percent availability and its enhanced signals could be acquired via specialized receivers. (Prasad & Ruggieri, 2005, Flament, 2004, Pappas, 2002, Beidleman, 2006, ESA, 2005, CERE, 2006, Transport Committee, 2004)

Search and Rescue Service (SAR): This service will potentially enhance search and rescue efforts as far as the people in distress are concerned. Once the distress message is received, it will help pinpoint stranded people very accurately and instantaneously while sending a message back to the user acknowledging the reception of the distress call. Availability of SAR will be greater than 99 percent. (Prasad & Ruggieri, 2005, Flament, 2004, Pappas, 2002, Beidleman, 2006, ESA, 2005, CERE, 2006, Transport Committee, 2004)

Public Regulated Service (PRS): PRS will be a further restricted service intended for government-authorized applications. As the name suggests, it will be accessible only to government agencies and public service providers. This service will use separate[25] and protected frequencies, it will be encrypted, resistant to interference and jamming and its availability will be over 99 percent. (Prasad & Ruggieri, 2005, Flament, 2004, Pappas, 2002, Beidleman, 2006, ESA, 2005, CERE, 2006, Transport Committee, 2004)

2.4. Galileo vs. other GNSSs

Galileo will be an alternative and a potential rival to the global satellite navigation systems that are presently in operation; the US GPS and Russian GLONASS both emerged as a result of the Cold War technology and arms race between the United States and the former Soviet Union in the 1960s. (Prasad & Ruggieri, 2005)

GLONASS: The first Soviet satellite navigation system was the Cicada system. The development of Glonass started in the 1970s, based on the Cicada system as part of an effort to use satellite positioning in precision guidance of new generation ballistic missiles. Though the first Glonass satellite was launched in 1982, the system was officially declared to reach its initial operational capability (IOC) in 1993. However, the Russian satellite system has never become fully operational due to economic difficulties. Whilst the original plan was to deploy 24 satellites in three medium Earth orbit planes, only 14 satellites are operational at the moment[26]. Russian authorities have undertaken a programme to modernize Glonass, controlled by the Russian Federation Ministry of Defence, and restore the system to full operating status, but the system's future is still

[25] PRS will consist of two wide band signals separated from other Galileo services so these services can be denied without affecting PRS operations. (Beidleman, 2006, Transport Committee, 2004)

[26] Based on the data as of 12.02.2008, six of the operational satellites were launched in 2007 and became operational in late 2007 and early 2008. (Russian Space Agency Information – Analytical Centre Website)

characterized by uncertainty. (Lembke, 2002a, Prasad & Ruggieri, 2005, Russian Space Agency Information – Analytical Centre Website, CERE, 2006)

GPS: **"**There is little doubt that satellite navigation is, in the mind of most people, synonymous with GPS." The efforts that culminated in the development of GPS started almost five decades ago. The Transit system, the predecessor of GPS, was the first satellite navigation system in the world which was developed in the 1960s to provide accurate navigation and precise targeting for the types of submarines that would carry submarine launched ballistic missiles (SLBM) named Polaris. The Transit system remained in service until it was made obsolete by GPS in 1996. Meanwhile, other related projects, such as Timation and Air Force 621B, were undertaken that constituted the foundations for GPS. In 1973, the US authorities gave green light to GPS officially called Navigation Satellite Timing and Ranging, GPS (Navstar/GPS). The executive responsibility for GPS was given to the US Air Force and a Joint Programme Office (JPO) was established in 1973 to include all satellite positioning efforts in a single strategy. In 1978, the first GPS satellite was launched and the launches continued until the system reached initial operational capability in 1993. In 1995, full operational capability was declared. (Lembke, 2002a, Prasad & Ruggieri, 2005, McNeff, 2002)

The GPS space segment consists of 24 satellites distributed on six medium Earth orbits. The control segment is composed of a network of tracking stations around the world. The main control centre is located at Falcon Air Force Base in Colorado. The GPS receiver and the user community constitute the GPS user segment. The system provides two services: one for civil use named standard positioning service (SPS) and the other for military and authorized users called precise positioning service (PPS). Since the inception of GPS, a variety of everyday life applications[27] has emerged and continues to develop besides its military functions. According to the Presidential Decision Directive (PDD) released in 1996, the Interagency GPS Executive Board (IGEB) was established which is jointly chaired by the US Department of Defence (DoD) and Department of Transportation (DoT) to ensure the maximum civil use of GPS and balance the interests of the military and non-military users. Civil applications have expanded rapidly and predominated in this context.[28] (Lechner & Baumann, 2000, Prasad & Ruggieri, 2005, Lembke, 2002a, Forrester, 2003, McNeff, 2002, Pappas, 2002, Legat & Hoffmann-Wellenhof, 2000)

The proposed Galileo system will have a number of advantages over GPS. Galileo is planned to provide better performance especially for civil use in urban areas compared to GPS, its integrity monitoring and guarantee of service will potentially satisfy specific navigation and positioning requirements of civil community which current GPS constellation can not answer; furthermore, Galileo will offer better coverage at high latitudes due to the greater inclination of its satellites to the equatorial plane than GPS satellites. In this context, Northern Europe will particularly benefit from Galileo as it is not well covered by GPS. "Galileo will transmit 10 signals: six serve open and safety-of-life services (although part may also be used for the commercial), two are for commercial

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[27] GPS has become essential for myriad civil applications such as telecommunications, transportation (air, land, and sea), electrical power distribution, precision agriculture and mining, oil exploration, electronic commerce and finance, emergency services and recreation. (McNeff, 2002, Pappas, 2002)

[28] As of 2000, the car navigation and consumer market segments constituted the majority of GPS unit sales by 35 percent and 22 percent respectively, followed by survey/mapping (16 percent) and track/machine control (13 percent). The military segment made up only 2 percent of the market. (The US Department of Commerce, 2001)

services and two are for public regulated services" whereas GPS only transmits 2 separate signals for civil and military users. On the other hand, the military character of GPS always leaves question marks over its availability in crisis situations that Galileo would capitalize by providing continuous service. (Pappas, 2002, Lechner & Baumann, 2000, ESA, 2005, EC, 2004a)

2.5. Why Europe Needs Galileo?

The motives behind developing a separate satellite navigation system for Europe can be examined in three categories: better performance that Galileo is expected to provide, independence and sovereignty it will generate and economic benefits involved. (Beidleman, 2006)

As satellite navigation becomes an essential tool for business operations and an indispensable part of daily life, reliance on this technology increases consequently. In similar context, future needs in this domain are likely to grow as a result. Since GPS is not able to satisfy particularly the requirements of civil users in terms of accuracy, availability and vulnerability, developing an alternative system might be deemed necessary for the EU. In fact, the US demonstrated its commitment towards providing uninterrupted service to civil users free of charge and enhancing the dual-use nature of GPS[29]. The fist major step in that direction was the removal of Selective Availability. Since the Gulf War, the civil GPS signal was intentionally degraded by the US

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[29] PDD that established IGEB in 1996 to increase civilian involvement also envisaged the removal of SA within a decade. The statement issued by the US State Department in March 2002 and the new US space-based Positioning, Navigation and Timing Policy adopted in December 2004 reiterated the US's commitment to providing uninterrupted service to civil users. (Pappas, 2002, Legat & Hoffmann-Wellenhof, 2000, Ripple & Vidal, 2005)

government in order to secure the strategic advantage of its Armed Forces until it was terminated by the Clinton administration in May 2000. After the lifting of SA, accuracy of SPS improved from 100 meters to 10-20 meters. However, the US has acquired a new "capability to prevent hostile use of GPS and its augmentations while retaining a military advantage in a theatre of operations without disrupting or degrading civilian uses outside the theatre" named Selective Deniability (SD). In other words, DoD has gained the ability to deny GPS signals on a regional basis when US national security is threatened. The discontinuation of SA significantly boosted the civil and commercial use of GPS but the current performance level is insufficient for many safety-critical applications[30] and the lack of guarantees regarding the continuity of service raises additional concerns. GPS does have a number of shortcomings concerning civil applications that can be classified as follows: varying positional accuracy depending on time and location, unreliable coverage in regions at high latitudes, low signal penetration in dense areas and town centres. Furthermore, the military character of GPS always leaves question marks over its availability for civil use in the event of a crisis. Whether intentional or not, signal interruptions can have severe consequences particularly in transport domain as there is no warning mechanism to inform users about errors in system. For instance, a Canadian research body reported that an aircraft was affected by signal interruption lasting longer than 80 minutes. The Icelandic aviation authorities reported several transatlantic flights similarly disturbed. A number of cases were also highlighted in three mid-US states and airline captains flying over the Mediterranean have reported the same phenomenon. The

[30] Even without SA, positional accuracy of GPS does not meet requirements for safety-critical applications. The integrity and availability of the system are insufficient for many safety-critical applications such as aircraft precision approach and landing procedures. (Legat & Hoffmann- Wellenhof, 2000)

report of the Volpe National Transportation Centre (August 2001) commissioned by the US Government emphasized these shortcomings. Aside from accuracy and reliability concerns, vulnerability of GPS is another issue raising questions. As emphasized in the Volpe report, GPS is susceptible to intentional (jamming) and unintentional interference. Eventually, the document states that GPS cannot serve as a single source for critical applications and backup systems are vital for all GPS applications with major economic, environmental and SoL implications. In view of these shortcomings, the US has embarked on a GPS modernization programme. The first phase of the modernization programme involves upgrading current Block IIR satellites to add a second civilian signal and a military signal named M-Code. In the second phase, Block IIF satellites, which will add the third civilian signal to increase accuracy and availability, are planned to be deployed. The third phase aims to further improve accuracy and availability by deploying Block III satellites under GPS III[31] strategy. (Legat & Hoffmann- Wellenhof, 2000, Pappas, 2002, Beidleman, 2006, Khan, 2001, Prasad & Ruggieri, 2005, Last, 2004, Ripple & Vidal, 2005, ESA, 2005)

Even the modernized GPS, would not tackle all of the above mentioned shortcomings. Service guarantee and accountability are incompatible with the system's military nature that could have severe implications in the event of an aviation accident or

[31] GPS III envisages new generation satellites and ground control centres which would provide greater accuracy and reliability for both civil and military users. GPS III satellites are planned to provide up to 300 times the transmission power of the current GPS constellation and they will be highly resistant to jamming. GPS III will also provide integrity monitoring. The first launch of GPS III is planned for 2013 and FOC is expected to be reached in 2018-2019. (Malow, 2003, Beidleman, 2006, Ripple & Vidal, 2005, CERE, 2006)

an oil tanker wreck. Therefore, the EU, in a joint effort with ESA, decided to develop an independent system that satisfies the criteria for accuracy, reliability and security. (ESA, 2005)

According to Lindstrom & Gasparini (2003), performance concerns are less compelling arguments for an independent European GNSS as far as the future improvements planned for GPS and GLONASS are concerned. The envisaged upgrades for GPS are likely to bring better accuracy and reliability. On the other hand, shutting down the system would not be in the interest of the US as it would damage not only the European but also the American economy. An improved GLONASS and efficient use of augmentation systems in combination with GPS could provide greater coverage over northern latitudes and should technically meet EU civilian requirements. The political, economic aspects should be considered to fully understand the arguments behind Galileo.

One of the main pillars of the European Space Strategy is to reap the benefits of space for markets and society. Within this context, potential economic gains emerge as an important incentive to develop Galileo. The fast growing market for GNSS civil applications has become subject of a number of studies[32] producing notable figures pertaining to the growth potential of the industry. According to these studies, total macro-economic benefits of Galileo system would amount to EUR 80-90 billion through sales of equipment and services within first 15 years of operation. Pricewaterhouse Coopers study shows a cost/benefit ratio of 4:6 for a period of twenty years which is higher than for any other infrastructure project in Europe. The world market for satellite radio navigation products and services doubled from EUR 10 billion in 2002 to EUR 20 billion in 2003. It

[32] Such as GALA, Geminus, Pricewaterhouse Coopers and Galilei (EC, 2004a).

will amount to around EUR 300 billion by 2020, with some 3 billion receivers in operation. These receivers will combine all the services offered by the GALILEO, EGNOS and GPS systems. 150 000 high qualified jobs will be created in Europe alone. On the other hand, European economic damage, should the GPS system become dysfunctional or be turned off, is conservatively estimated at between EUR 130 and EUR 500 million per day. (EC, 2004a, Pinker & Smith, 2000, Sharpe, 2001, Vielhaber & Sattler, 2002, Lindstrom & Gasparini, 2003, Beidleman, 2006)

Europe plans to gain a foothold in the growing GNSS market with Galileo just like it was done with Ariane. Currently, Ariane claims almost 50 percent of the commercial-satellite-launch market. Galileo represents a similar window of opportunity based on the above mentioned figures. The question is whether Europe can take a fair share of this substantial global market and make use of this chance. Upgraded GPS is expected to offer many of Galileo's promised services and would thus close the window of opportunity for the European system to gain acceptance and become established. In other words, Galileo needs enough time to prove itself in the launch of new equipment and services before GPS upgrades are completed. (Beidleman, 2006, Braunschvig & Garwin & Marwell, 2003)

Within this context, the delay accumulated in the project so far and the collapse of its unique financing structure (PPP) due to high risk perception by private sector raise some question marks as to whether Galileo would be economically viable[33] and challenge

[33] The programme is already running four years late and doubts have been raised about its ability to ever become economically viable or compete with the American GPS. However, as a diplomat from an EU member state put it, "everybody knows that there is no business case for Galileo. We only need a European system of our own, because at a militarily very critical moment we can't trust the GPS to be available." (EurActiv, 2007)

the US monopoly just as Ariane and Airbus have done. Despite such concerns, the EU has chosen to go ahead and finance the system entirely through public funds. This might be a compelling case to acknowledge political arguments behind Galileo.

An increasingly integrated Europe has progressively sought to acquire power and project geopolitical ambition," especially since the end of the Cold War. One of the EU's chief goals is to create a superpower on the European continent that stands equal to the United States. Naturally, this ambition extends to space. As early as 1991, the EC hinted at the potential development of an independent navigation system to reduce European dependence on US space-defence systems. Unsurprisingly, the ESA claims that European independence is the chief reason for building Galileo. Indeed, Galileo strengthens Europe's bid for political, security, and technological independence from the United States. (Beidleman, 2006)

Initially, Europe planned to take part in the international development of a global system similar to GPS which would be under civilian control. However, the US did not perceive this idea in its best interest and refused to yield control of GPS or to participate in an international system. This decision laid the foundations of an independent European GNSS. As satellite navigation technology becomes more and more indispensable in every aspect of life, in the absence of Galileo, basic governmental decisions and policies would depend upon US policy for GPS, which is subject to change without reference to European requirements. Without Galileo, European critical infrastructure will rely on a system owned and operated by a foreign power's military. Ultimately, the European Parliament (EP) concluded that "the sovereignty and safety of Europe will be in serious danger if the European navigation systems are removed from European control. (Beidleman, 2006)

Aside from the sovereignty argument, prestige is another strong political motive behind Galileo. Europeans still regard space as an area for significant technological innovation that can elevate international standing. Similar to the impacts of Ariane and Airbus, Europeans believe Galileo will enhance the international influence of the EU. As a result of the US unilateralism in international affairs, e.g. Iraq War, and the subsequent anti-Americanism, Europe may symbolically view Galileo as a means to struggle against American hegemony. (Beidleman, 2006)

The end of the Cold War changed the geopolitical landscape and the European security perspective. In the absence of the USSR, European security is no more an American priority as demonstrated by the American reluctance to prosecute the war in Kosovo. On the other hand, in the post-9/11 environment American priorities has shifted towards homeland defence and war on terrorism. (Beidleman, 2006)

Europe has redoubled its efforts to build a common defence policy in the wake of the Kosovo campaign as Europeans clearly understand the value of a GNSS to security[34]. Indeed, by 2000 the EU established the position of High Representative for Common Foreign and Security Policy and committed itself to fielding a rapid-reaction force of 60,000 troops deployable for at least a year to conduct peace operations. After the Kosovo war, several European governments agreed that an autonomous satellite navigation capability must serve as the basis for Europe's security and defence policy[35].

[34] Military applications of satellite navigation are discussed in Chapter 4 in greater detail.

[35] Lembke (2001a) quotes a French official saying "Military location capabilities and air transport safety would be subject to American standards and entirely in the hands of the US. Given the weakness of

The European military started to realize the potential advantages of such systems when they had to proceed to military operations in Europe or in countries nearby Europe, relying on GPS. When they operated in Kosovo they depended on GPS support and recognized that an autonomous system naturally could be helpful[36]. In this respect, Europe is taking actions to end its security dependence and Galileo would play a significant part in the endeavour. However, whether the EU will fully harness the military potential of Galileo is yet to be seen as the civilian nature of the system has always been strongly emphasized. (Beidleman, 2006, Braunschvig & Garwin & Marwell, 2003, Lembke, 2002a)

The prerequisite for greater independence in security policy is technological capability. The United States worries that the advent of Galileo will weaken American strategic superiority in the field of information, while Europe sees the program as a chance to develop a European defence identity. In twenty years at the latest, all essential weapons and military logistics systems will operate with the increased precision provided by satellite guidance. Galileo is therefore a central pillar for developing European independence in security policy. Without a capacity to rely on data from its own satellite navigation system, Europe would neither be able to meet future alliance obligations in the post-cold war North Atlantic Treaty Organization nor to carry out independent military missions abroad without American participation. (Vielhaber & Sattler, 2002)

Europe's communication, navigation and observation systems already highlighted by the recent conflict in Kosovo, this would be unacceptable."

[36] Romano Prodi argued that the Kosovo war had revealed the total dependency of Europe on the US. (Lembke, 2002b)

Apart from strengthening European transport infrastructures and creating positive macroeconomic and user benefits, industrial competitiveness and jobs, Galileo would increase Europe's strategic control and ownership, and thereby also strengthen EU's position in world affairs and bolster EU's administrative and political goals. (Lembke, 2002a)

2.6. EU's Internal Rifts over Galileo

Right from the onset, different opinions and concerns existed among EU Member States that caused delays in the development of the system. They are primarily associated with funding and the exact source and size of the Galileo revenue streams, the definition of security aspects and services, and Galileo's legal and management structure. In addition, the nature of the market (public/commercial) and the nature of the integration of Egnos with Galileo remained to be settled. (Lembke, 2002a)

On the one hand, there were those who wanted to move ahead quickly with the Galileo project through a lasting commitment at the earliest date. On the other hand, there were those who wanted to generate more information for a decision on the whole project at a later date. EU Member States like France, Italy and Finland, together with the EC and the ESA (and smaller ESA countries such as Norway and Switzerland) belong roughly in the former political grouping. Germany, the UK and Sweden belong to those that demanded a clear role for and commitment by the private sector at an early stage. Even though the ESA and EU Member States agreed that Galileo should be developed as a civil system, some wanted to leave the door open for military communities to use the system in the future. (Lembke, 2002a)

France has repeatedly stressed that Europe should not hamper the Galileo project with conditions on detailed cost analyses and the promise of a public-private partnership. In their view, delays and strategic fine-tuning must not cause Europe to miss out on what was considered a unique window of opportunity. This argument has been shared by national ESA/EU delegations, such as Italy, Norway, Portugal, Switzerland, Belgium, Spain, and Austria which regarded a European navigation system as primarily of a political and strategic nature and as public service system. It was considered early on that strategic issues were driving Galileo and that those issues fell within the domain of the EU. Meanwhile, Denmark, Germany, the Netherlands, and the UK stressed the exclusive commercial interpretation to the project, and expressed opposition to the inclusion of military user requirements. Finally, Finland, Norway, and Sweden expressed a great interest in developing Galileo within a well-defined and comprehensive security framework. (Lembke, 2002a, Lungu, 2004)

Lembke (2002a) suggests two factors that would explain the variance between the EU Member states: (a) the special relationship of certain EU Member States to the US combined with their Atlanticist orientation and their relative alignment with the "British model of European integration" (foreign economic and security policy); and (b) the expectation of domestic political-economic returns that benefit the major domestic economic groups in each country combined with the level of already made or planned investments in GPS (military) infrastructure and the existence of preferential commercial contracts with the US GPS industry and government.

However, the November 2007 decision seems to have cemented the programme since a number of differences of opinion were reconciled and the crisis over funding was resolved. The decision to finance Galileo through Community funds might be considered a move consolidating the argument of the group that view Galileo as a crucial strategic undertaking. Despite the doubts on the commercial viability, perhaps it became clear that the defence and military applications are, as such, a strong reason to use European taxpayer money to save Galileo. (Matias, 2007)

CHAPTER 3: SECURITY and DEFENCE IMPLICATIONS of the GALILEO SYSTEM

This chapter evaluates the security and defence implications of Galileo while addressing the second sub research question. To achieve that, military security applications of GPS are analysed in order to demonstrate the capability the EU will acquire once its own satellite navigation system is completed. Furthermore, the military security potential of Galileo is discussed within the context of CFSP, ESDP and EU-NATO relations.

3.1 Military Security Applications of GPS

The current progress in the military satellite technology has paved the way for new tactics that offer the facility of locating the positions more precisely, quickly, and at a cheaper cost. GPS has proved to be an exceptional device in trail administration. (Lindstrom & Gasparini, 2003)

Hardware selection is the first step in the mapping of a GPS system. GPS systems may vary according to their physical attributes like size and weight, precision details, and cost. Generally, all the military security application GPS systems possess a selective receiver apart from the routine positioning and directional capabilities. These systems are well in use for improved logistics. With the assistance of a transmission element, tracking of enemy locations and equipment is also possible. GPS also possesses the ability to co-ordinate the various segment units on the battle field – from space, air, sea or land offering area acquaintance to the army[37]. The system when joined with the weapons guiding system, offers an accurate strike efficiency that reduces the quantity of collateral damage in the course of a military operation. The facility offered by the supplementary systems supported by GPS to strike the enemy from a distance diminishes the risks involved to the military personnel during the combat operations. The use of navigational technology also reduces the risk of accidents due to 'friendly fire'. Additionally the system also offers protection to patrolling security personnel near the unmarked borders where border contravention can have dismal inferences. (Lindstrom & Gasparini, 2003)

The Navstar GPS of the United States is currently the only equipped and operating GPS system. This project was initiated in the year 1973 and was accomplished with complete operating facility in 1995. Developed by the United States army, the total cost of setting up the GPS was $14 billion and currently it is being administered by Department of Defense and US Air Force Space Command (AFSPC) under a Joint program. A GPS executive board has been set up working under the Presidential command on 29 March, 1996, which administers the GPS. The system policies – new regimes, introduction of new receivers, selective availability, and up-gradation are under the direct supervision of the President. (Lindstrom & Gasparini, 2003)

There are a multitude of military operations that are carried on with the help of the GPS technology. Some of these military applications of GPS are explained below.

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[37] This option can be combined with the shut down of signals available to opposing forces. (Lindstrom & Gasparini, 2003)

- Navigational operations – for the army personnel that are straying into the enemy area, the biggest threat was navigation. The use of night skies helped them to find the direction for ages , but did not help to locate their position on the ground by the base station. The urgent requirement of knowing the exact position in the battle field was first addressed during the Gulf war, in 1990. At first, over 1000 GPS systems were issued and the number reached to 10,000 handheld devices by the time the Gulf war ended. Also, the conventional compass has been already replaced by the handheld GPS receivers. Enemy installations can be easily targeted with the help of a GPS system, gun positions by the soldiers can now be promptly acquired, in order to avoid being hit and to take on to a target in lesser time. Convoy movements can also be tracked and planned effectively using GPS devices. (Baijal & Arora, 2001)

Image showing use of GPS receivers by US soldiers during Gulf War
(Source: http://www.aero.org/publications/GPSPRIMER)

- Tracking – for the military, it is significant to keep track of targets before they are declared as aggressive and dangerous. The tracked data position of these targets is fed into the weapons systems such as target printed missiles etc. to destroy the target closely. The United States army has enhanced the GPS with many facilities – like display, recording and real time data. This system is known as Truth Data

Acquisition, Recording, and Display System (TDARDS). TDARDS has proved to highly valuable with in built modular facilities, off-the-shelf hardware, and can also be restructured to meet the urgent real time needs. (Baijal & Arora, 2001)

- Missile guidance – as discussed above, the real time tracking data is fed into the weapon to destroy the targets. These types of weapons – Cruise missiles are specially designed to be GPS conversant and they make use of multichannel GPS receivers to determine their track while operating. The Multiple Launched Rocket System (MLRS) vehicle makes use of the inertial guidance technology to aim at the target. This diminishes any chances of the weapon detection by the enemy and counter attack. (Baijal & Arora, 2001)
- Rescue - Rescue missions have also taken the help of GPS in determining the position of the casualty personnel, and as a result reduce the response time of the emergency teams. Combat Survivor Evader Locator (CSEL) system based upon the GPS has already been deployed by the US army which links a GPS receiver to a radio so as to locate the missing squads more quickly than before. (Baijal & Arora, 2001)
- Facility Management- the role of facility management acquires a central role in the battle field where the army needs to continuously monitor its resources and requirements over large areas. In order to supervise these amenities efficiently; it is necessary to arrange a correct foundation map. Here GPS can be of enormous aid, as obtainable maps are not reorganized frequently. GPS co-opted with Geographic Information System (GIS) can successfully deal with this task. (Baijal & Arora, 2001)

Satellite navigation has revolutionized military operations through high-accuracy all-weather weapons targeting, and enhanced command and control systems. Satellite guided weapons are capable of hitting their targets in all-weather conditions with unprecedented accuracy. In terms of "command and control" the term "fog of war" should be highlighted which accurately conveys the difficulty in commanding forces during the height of battle. Historically, once military assets were committed, senior commanders often had limited information on their dispositions and overall control was lost, with increasing reliance placed on tactical commanders, who themselves had an imperfect grasp of the whole situation. With satellite positioning equipment and transponders issued to individual vehicles, linked with communications satellites, it is now possible for senior commanders to have an unprecedented quantity of reliable, "real time" information on the disposition of friendly forces. They have control of the battlefield and the ability to identify and deploy military assets with extraordinary efficiency. (North, 2004)

Lessons Learned

The Gulf War was the foremost battle where GPS was used. The fighter jets were equipped with GPS systems which allowed a very high degree of precision of targets and thus avoided any civilian casualties by a greater degree. In addition, the Tomahawk missile was also employed during the Gulf War. This jet missile was guided towards a specific target and most of the attacks launched by the Tomahawk missiles were accurate which helped to save thousands of military lives each and everyday. (Prasad & Ruggieri, 2005)

Since 1991, GPS has become the most significant force enhancement tool of the U.S. military. During Operation Dessert Storm only 15 GPS satellites were operational but their contribution to allied victory was paramount. The most dramatic example of the value of GPS precision is the famous “Left Hook” of the 1990-91 Persian Gulf War. Until this time, deep desert operations were considered too difficult to perform. Unsurprisingly, many Coalition commanders cited GPS as one of the most important technologies of the war. General Sir Peter de la Billiere, commander of all British forces in the Gulf, called GPS a “war-winner” (Pappas, 2002)

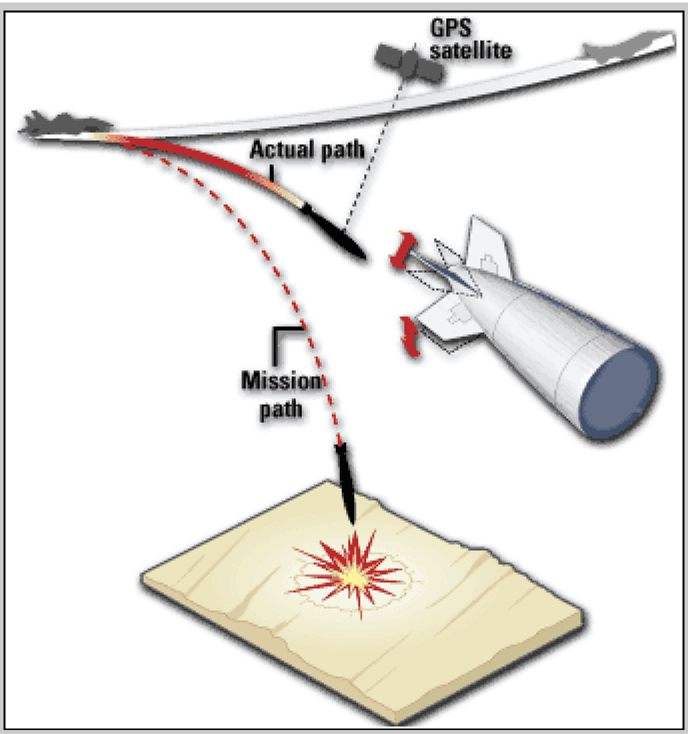
The technical and tactical supremacy enabled by GPS is clear reading the reports of that time:

NAVSTAR GPS played a key role and has many applications in all functional war-fighting areas. Land navigation was the biggest beneficiary, giving Coalition forces a major advantage over the Iraqis. (Prasad & Ruggieri, 2005)

GPS was a godsend for ground troops traversing the desert, especially in the frequent sandstorms....Tanks crews and drivers of all sorts of vehicles swore by the system. Meal trucks were equipped with GPS receivers to enable drivers to find and feed soldiers of frontline units widely dispersed among the dunes. (Prasad & Ruggieri, 2005)

GPS made it possible for the attackers to shift their attack plans back and forth virtually up to the moment of attack, since forces using it had no need for fixed markers on the ground. The marines reported that they kept adjusting their breaching point as they received fresh intelligence of Iraqi positions, and as the Iraqis moved their forces. (Prasad & Ruggieri, 2005)

The 1999 Kosovo war was the greatest test of U.S. airpower up to then, in part because President Clinton and Congress had forbidden the engagement of U.S. ground forces. However, this time the U.S. military had at its disposal new devices called Joint Direct Attack Munitions (JDAMs). These are “dumb bombs”-mostly 2,000-pounders-retrofitted with an electronic “brain” and fins for steering. A JDAM bomb is programmed with the coordinates of its target and then, as it falls from the sky, it calculates its position in space and directs itself to the target by reading GPS signals. Previously developed “smart bombs” were based on Inertial Navigation Set (INS)-based guidance systems. However, INS performance degrades with distance from launch. Since GPS performance does not, it is ideally suited for long range weapons guidance, thus providing an unprecedented all-weather precision strike capability. (Pappas, 2002)

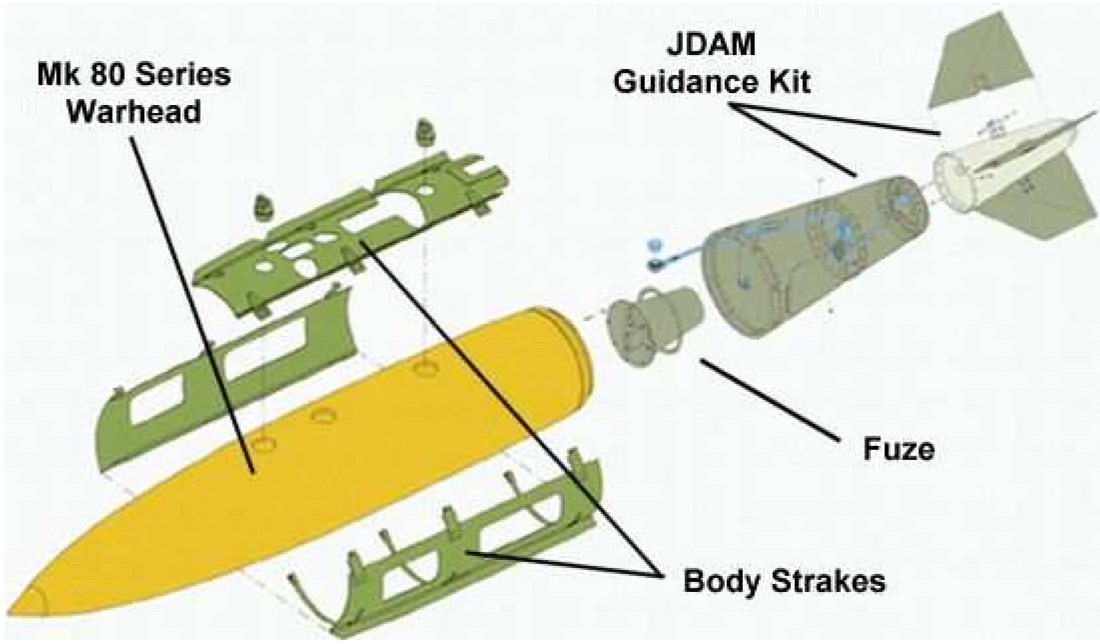


Joint Direct Attack Munition (JDAM)

During free fall, the bomb's GPS receives location data correcting INS errors.

The guidance computer uses the GPS/INS data to adjust the movable tail fins and correct the bomb's trajectory toward the designated target's coordinates.

Source: http://info.jpost.com/C003/Supplements/CTW/usm_04.html



GPS-guided JDAM bomb

Source: http://www.aerospaceweb.org/question/weapons/q0211.shtml

Without GPS, pilots facing 50 percent cloud cover more than 70 percent of the time would have to wait for clearer skies, creating sanctuaries and operational lulls. GPS-guided munitions proved so effective that US reliance on them increased from 3 percent of all bombs during Kosovo operation to roughly 60 percent in Iraq War. (Beidleman, 2006)

During the last decade, GPS has grown to support nearly every aspect of U.S. war fighting. Today, no significant military operation is conducted without it, and no system is built without GPS. GPS has enabled a combination of precision strike with standoff range, all-weather performance, and operational flexibility-all at a very low cost. (Pappas, 2002)

3.2 Military-Security Potential of Galileo and the Strategic Importance of Satellite Navigation Capability

During the 1990's, Europe had practically no attendance on the satellite navigation stage. The only global satellite navigation systems that operated around the globe were that from United States and Russia. Fundamentally, Europe was never under any sort of military demands and pressure before the nineties as there was in the United States. Policymakers and industrialists in Europe acquired an incentive to develop satellite navigation when GPS was made available to civilian users and when conflicts erupted close to the European borders in the 1990s. Then a race developed for market share and strategic independence. The belief that GPS, a militarily-controlled system, would not become accessible to the public had helped to keep European ambitions alive. (Lembke, 2001a)

The navigational system of the US – GPS is an open signal provider; however, it is not guaranteed since the system is operated by the US military. The US government maintains its rights to stop the services whenever any kind of risk is assessed to the nation's security. On the other hand, Galileo will offer a guaranteed service which is an important characteristic for safety based uses. (Legat & Hoffmann-Wellenhof, 2000)

Apart from being a very remarkable technical accomplishment and an enormously practical gizmo, Galileo will be a political declaration of European technical autonomy from the United States. A strong European motive for seeking technological independence is the strategy of the United States administration to make use of only American companies to engage in such projects. As an EU official puts it, "The United States may not want to lose its monopoly on satellite positioning signals, but in the long run, an arrangement in which the entire world depends on a single, monolithic technology can't be a wise on." (North, 2004, EC, 2002a)

Several countries within the European Commission are looking forward to harness the military potential of the Galileo satellite system. Countries like France, Italy and Spain sought after reinforcing their commercial and strategic autonomy and sight Galileo more as an unrestricted service than as a solely commercial enterprise. The armed forces have been predominantly influential in the larger EU Member States. No nation has a single position on Galileo; diverse groups have dissimilar interests. Some countries like Germany, Sweden and the UK, pressurize the statement that Galileo should be an entirely commercial navigation system. (Lembke, 2001a)

However, for the first time in May 2007, the EU has decided to formally approve to the "promising effectiveness" of Galileo—Europe's biggest combined satellite navigation mission—for armed forces through the European Space Policy. Jacques Barrot, the vice-president of the European Commission (EC), the executive arm of the EU, commented to the press in early May, 2007, "You cannot exclude a [navigations system] user because he is military. It will be civilian-controlled, but there will be military users." (GPS World, 2007, Woreck, 2007)

Initially Galileo was portrayed by its supporters only as a civilian venture, but the United States in the year 2001, has started cautioning of the danger created by the Galileo project to its own domination of the satellite navigation field. In a letter sent out to European defence ministers in early December 2001, the US Deputy Defence Secretary, Paul Wolfowitz, took the opportunity to express concerns about the Galileo programme and radio spectrum issues related military applications, and asked those ministers to convey his concerns to European transport ministers. Political pressure by the US government on Europe and Galileo programme is a natural result of its economic-industrial effort to maintain world leadership and of the effort to protect national military and security interests. At the same time, the EC argued that support for Galileo was of strategic importance to reduce vulnerability, to put an end to the US monopoly, and also to increase international competition in satellite navigation applications and services. (Lembke, 2002a, Divis, 2002, Space Daily, 2001)

With a navigational system, Europe will be competent enough to end its reliance on the US provided GPS system and considerably confront US superiority in space expertise. “We must prove our worth in this field of technology in competition with the United States, Russia and Asia,” stated German Transport Minister, Wolfgang Tie-fensee just like former French president Jacques Chirac warned that Europe’s failure to develop Galileo “would inevitably lead to [Europe] becoming vassals of the United States” He reportedly added that the Galileo programme would be of strategic importance for the ESDP and the EU rapid reaction force. (Woreck, 2007, Beidleman, 2006, Lembke, 2002a)

In "Galileo: An Imperative for Europe," a document released by its Directorate for Transport and Energy (DG-TREN) on December 31,2001, the EC argues that satellite navigation capabilities will become part of all aspects of defense over the next 20 years, and failure to have a separate satellite navigation capability will put European defense systems under the U.S. thumb. "If the Galileo program is abandoned” says the position paper, "we will, in the next 20 to 30 years, lose our autonomy in defense." (Divis, 2002)

Satellite and navigation expertise acts a progressively more noteworthy function in contemporary combat and is essential in promising effective communication, surveillance and strategic air superiority. The unexpected official declaration by the EU of the military suggestions regarding the Galileo project highlights the fact that the European countries are gradually looking to posses essential military expertise to counterpart their own foreign policy interests. (Woreck, 2007)

Space manufacturers likewise recognize the military link. Space-based navigation allows the military to design new aircraft, new missiles, and new weapons with this feature. The European military started to realize the potential advantages of such systems when they had to proceed to military operations in Europe or in countries nearby Europe, relying on GPS. In this respect, Galileo has been regarded as a key instrument not only in the process of modernization of the Common Foreign and Security Policy and ESDP, but also part of the ongoing integration of the European Union's defence industry. (Lembke, 2002b, Matias, 2007)

The potential market for military equipment incorporating satellite navigation is huge[38]. Navigation signals are working their way into intelligent weapons, aircraft, ships, individual hand-held units for soldiers, and unmanned surveillance systems. Eventually military equipment that does not include satellite navigation capability will become as hard to sell as rotary telephones. (Divis, 2002)

The advanced features of Galileo will provide numerous potential military benefits. Greater availability, accuracy and improved availability in urban areas would

[38] The US army for example has already developed a new sophisticated uniform incorporating GPS technology that allows US soldiers to pinpoint each other in the 'fog of war.' The French army, which has developed the same kind of uniforms, is tied to using GPS. "Imagine the potential market once Europe's armies are using Galileo for all their equipment" enthused the French source. (The Parliament.com, 2004)

significantly enhance the capabilities of armed forces and support crucial military applications while taking full advantage of such benefits that Galileo promises requires substantial investments in reconnaissance, surveillance, secure communications, and intelligence processing systems. (Rip & Hasik, 2003)

To further quote, "Galileo will underpin the common European defense policy that the Member States have decided to establish. There is no question here of coming into conflict with the United States which is and will remain our ally, but simply a question of putting an end to a situation of dependence. If the EU finds it necessary to undertake a security mission that the US does not consider to be in its interest, it will be impotent unless it has the satellite navigation technology that is now indispensable. Although designed primarily for civilian applications, Galileo will also give the EU a military capability." (EC, 2002c)

Therefore the assessed military benefits and the strategic importance from the development and deployment of the Galileo project are obvious that it will offer Europe an independent status with regards to its security concerns which were until now dependent upon the United States.

3.3 Galileo and Its Implications for CFSP, ESDP and NATO

As the Galileo system is set to be launched with the face of a civilian application module, the dual nature of the application has given rise to a number of security implications that could be materialized and have caught the attention of the EU members since the inception of the project. Galileo has been discussed in the context of the emerging Common European Security and Defence Policy (CESDP), at the same time as the EU institutions have aimed for a model of civil ownership and management. The security issues will tend to arise with a broad perception from across the nations like United States, and other organizations like NATO. Once after the project becomes fully operational, the activities will affect the EU CSFP/ESDP and may result in some unintentional (or intentional) consequences. The European Galileo programme will have implications for European security policy and relations with NATO. (Lindstrom & Gasparini, 2003)

Galileo and CFSP/ESDP

Politically, Galileo has been portrayed as a guarantee of independence and autonomy from the U.S.-established G.P.S. This perspective became more evident in the aftermath of the Kosovo War when European forces were fully dependent on the U.S. system, a limitation that has worried the actors involved in the development of a European Security and Defence Policy especially the member states that stand for the modernization of autonomous E.U. military capabilities. Since the beginning of the definition phase of Galileo, the European Community (EC) papers have noted the importance of Galileo for its Rapid Reaction Force, the E.U. peacekeeping missions and, separately, the realm of activities related to the "Petersberg Tasks," the latter of which are a set of security and military tasks in the field of peacekeeping and stability operations, agreed upon in 1992 among the E.U. members. (Matias, 2007)

After the Galileo starts its operation in full capacity, the policy makers can select the preference of exploiting its NPT (Navigation, Positioning, Timing) signals to enhance the capacity of both the Common Foreign and Security Policy (CFSP) and the European

Security and Defence Policy (ESDP). Also, for an effective development of Rapid reaction force (RRF), Galileo would be quite instrumental in improving its operational performance. (Lindstrom & Gasparini, 2003)

For instance, throughout the operations with mild intensity such as the Petersberg operations, the system could be utilized to control and keep track of group whereabouts (prearranged with sufficient tracking devices), smooth the progress of the transportation of materials, set up perimeters, etc. in the case of operations which need force, the Galileo system could be employed for the conventional GNSS tasks such as logistics scheduling, targeting and arms supervision. Therefore, we see that both the operations, whether low intensity or high intensity, the use of PRS signals could effectively yield better results, given the likelihood to use it asymmetrically. (Lindstrom & Gasparini, 2003)

In case, the policy makers decide not to exploit the military benefits of Galileo, the utilization of the RRF in any high tension mission, will need emergency tactics should conflicting forces make a decision to take advantage of signals against European armed forces or welfare. Safety measures could consist of closing down Galileo's open signals, launching an artificial error or blocking all positioning signals within the area of operations. (Lindstrom & Gasparini, 2003)

On the other hand, if CFSP/ESDP takes into the Galileo project, the EU would be able to make use of a number of potential possibilities to initiate operations. While self-regulating operations do not have high possibility to regularly take place, there exists a likelihood that the United States may decide not to be part of some operations. If the Galileo system is employed for ESDP reasons, the threat linked with signal failure from

GPS at serious phases of an action would be reduced, in particular if the United States was drawn in a simultaneous operation somewhere else necessitating GPS signal shutdown. Within the political sphere, an autonomous navigation system augments the influence of EU CFSP. Specially, sovereignty from GPS domination provides Europeans superior influence throughout negotiations with the United States – in particular if the systems are interoperable – in view of the fact that it influences the opportunity to use the signals asymmetrically. (Lindstrom & Gasparini, 2003)

When viewed from a different standpoint, possession of a GNSS carries with it additional responsibilities. While as for now, the EU reflects on Galileo a civilian system, other countries may not. These countries may mull over Galileo as a military tool that could provide an advanced role to the military objectives in some form or another. Since a large portion of Galileo's precise positioning signals will be openly available, any user – including terrorist cells and hostile countries – equipped with the proper receivers will have the option of using positioning data for military purposes such as targeting, ordnance guidance, etc. At the operational level, this means that European policymakers need to be prepared to deal with the eventual unauthorized use of the system by third parties. (Lindstrom & Gasparini, 2003)

Galileo and NATO

When seen from the perspective of NATO, Galileo delivers a number of possibilities for the future. One option that presents itself is the integration of services from GPS and Galileo signals to offer higher consistency and accuracy in military receivers. Therefore, a better access to a multitude of position signals will be an asset to all the likely ventures in the future – in particular for those activities that occur in urban areas. With the advent of Galileo, the European countries who are NATO members might assume a more influential role and have a greater say in the conduct of operations. The other concern that pervades the scene is the availability of the Galileo signals. Since NATO has no effective control over the PRS signals, it may not be able to warranty situational awareness advantages in areas of operations. With this situation, the NATO forces then might have to manoeuvre under the supposition that conflicting armed forces or terrorists may take advantage of PRS signals, which cannot be blocked. (Lindstrom & Gasparini, 2003)

Even though this situation might not arise in the very near future, its implications are quite clear and this may lead to heated debates between the EU and NATO members, regarding issues concerning selective jamming, degrading, or the closing down of signals to make sure of an asymmetric benefit. Unless these doubts are chased away, a block of apprehension possibly will become visible between non-EU NATO members and EU members regarding signal applications. (Lindstrom & Gasparini, 2003)

CHAPTER 4: GALILEO and the EU as a GLOBAL ACTOR

In this chapter, Galileo and its implications are discussed from an international perspective. Transatlantic relations, China dimension and the international involvement are analysed to investigate how Galileo would influence EU's position in global affairs within the context of the third sub research question.

4.1 Transatlantic Affairs

Even though the civilian facets of space technology and its uses have been paid particular attention, "space has a security dimension and security has a space dimension" as recognised by the EU's white paper on space policy. The European Union, while putting civilian objectives associated with space assets higher on the scene, has started initiatives to support its common security and defence policy. (EC, 2003b, Logsdon, 2002)

As opposed to the European Union, the United States has maintained its primary focus on the military issues that can be facilitated through the GPS system. The Bush administration and the other earlier governments have stayed on the same track of strengthening the country's military potential with the help of space aided technologies. The worldwide terror activities like the 9/11 in the United States and the Metro attacks in the UK and other terrorism incidents all over the world have provided enough motivation for the exploration of space technologies in the field of security and safety. The safety issues have also propped up for other nations who have been lately the target of terrorist activities. Space technology can offer a number of possibilities that can be explored. For instance, space-based assets have already transformed the conduct of war at the strategic, operational, and tactical levels; communication satellites, and space imagery can be exploited to monitor potential WMD proliferators and can also be used for identification purposes. (Ripple & Vidal, 2005)

The EU's mounting curiosity in space would generate the prospective for a number of transatlantic disputes that are yet to arrive on the scene. This situation has already come up in satellite navigation domain. As already discussed both GPS and Galileo possess dual possibilities in the field of civilian and military applications. United States had initially allotted some frequencies for military use and after the inception of the Galileo project, the use of these frequencies only by the United States seems doubtful. This has been a cause of dispute between the EU and the US; however, some agreements have made the two systems interoperable. (Lindstrom & Gasparini, 2003)

Apart from this transatlantic concern, which seems to have been resolved for the time being, there are other issues that are posing conflicts. Russia is involved as a cooperation partner for the Galileo project; however, Russia's presence on the scene is a serious concern across the Atlantic. At the same time, the structure of the European Union has made it difficult for the US to communicate or negotiate on specific issues. There are a number of groups inside the EU and a great deal of fragmentation among its members has occurred in the recent past. Although initiatives are underway to bring a greater sense of cohesion and common purpose to the organization, the EU still consists of 27 sovereign nations with individual interests that make it extremely difficult to reach a common ground. (Peter, 2007a)

The European Union's commencement of the first set of 30 satellites in its multibillion-dollar Galileo worldwide navigation programme was perceived across the European Continent as an enormous stride in challenging the U.S domination in the field of space technology. The EU has launched Galileo as a response to the United States Global Positioning system – GPS. This GPS system is employed by the United States army during the warfare for guiding and positioning aircrafts and other weapons. (Braunschvig & Garwin & Marwell, 2003)

At the same time, Galileo can be put to use for important military applications which has been the basic root cause of transatlantic concern. The system promises great potential (better than GPS) to enhance the ability of armed forces to match up and bring together the movement of the various units involved on the battle field, as a result increasing their effectiveness in countering attacks from the enemy. The EU satellite navigation system Galileo also promises to improve the precision of weapons guidance systems so that bombs and missiles hit their targets more accurately. (Rip & Hasik, 2003, Braunschvig & Garwin & Marwell, 2003)

Lungu (2004) underlines two elements justifying European actions to challenge US domination in high technology domain. "First, leadership's ambitions and dissatisfaction with the status quo are commonly accepted as factors that might motivate a nation (or a group of nations) to develop policies intended to challenge the existing configurations of power in the international system. Second, one may need fresh thinking when examining an old question—the relationship between technology, wealth, and power among the Western allies—in an international security environment fundamentally different from the Cold War years". Airbus Industry and Galileo projects show that the search for strategic independence accompanied by the fear of reduced influence in international affairs and deteriorating international economic competitiveness were strong motives behind European efforts to challenge the US supremacy in aerospace sector.

NATO's Kosovo air campaign in March-June 1999 accelerated the European quest for an independent satellite navigational system. This event made it very obvious to the European Union that they badly needed a higher level of independence for its security policy and this could be done only with the help of a new and improved space technological capability. It was also immediately recognized, especially in France, that navigation systems were an area of great concern, where immediate action was required. Subsequent to series of events that acted as an eye opener for the EU, the Galileo project was initiated, which has sparked considerable transatlantic dispute ever since. (Lungu, 2004)

It is far and wide well thought-out among Europeans that subsequent to the Airbus and the Arianespace project, Galileo is the third next global space project that intends to secure the EU against overdependence on US strategic air and space technology. Structured European efforts to reduce dependence on the American GPS system, however, have been clearly identifiable since the mid-1990s. They were primarily driven by the perception that since the end of the Cold War the United States was increasingly employing space systems as an instrument for strengthening its political, technological, and economic dominance. (Lungu, 2004)

During the 1990's, there existed three main European organizations that collectively controlled and pursued the aim of a European satellite navigations system. These three bodies were: the European Space Agency (ESA), Eurocontrol (the organization responsible for coordinating air traffic control), and the Directorate General for Transport and Energy of the European Commission (DG TREN). Conversely, due to the non-existence of an incorporated institutional agreement and arrangement for the space sector the European Commission took the opportunity to assert its power and authority and become the leading player. (Lungu, 2004)

According to an ESA official, “this was a natural evolution, because in principle, satellite navigation should be similar to the development of Airbus or Ariane where you needed a few good and strong promoters. However, given the political (strategic/military) dimension people felt quite strongly right from the beginning that it had to be integrated into the larger European context, that is, the EU. Moreover, the development of the program within an EU institutional framework was probably also envisaged to enhance the EU's strategic bargaining power in the context of future international negotiations (especially with the U.S.)”. A number of EU official papers in 1994-99 stressed the importance of an independent satellite navigation system while mentioning dissatisfaction regarding the strategic dependence on US capabilities in this domain. (Lungu, 2004)

First, in June 1994 the European Commission pointed out that: “If we (Europe) do not act promptly then the control of the entire system will be done from overseas by implementing a civil Transatlantic American complement to the military GPS system. Those who will own and operate the upgraded system will set user requirement standards and certification schemes for the equipment. The result would be a major dependence of Europe on the provision of a strategic asset for the future and a poor perspective for its industry to capture the huge associated market for user equipment”. (Lungu, 2004)

Within the same period, another organization - High Level Industry Working

Group (HLIWG) - was set up to evaluate the capability and competitiveness of the European space sector vis-à-vis the transatlantic challenges. This committee worked under the Chairmanship of Michel Delaye, then the Director of Aérospatiale's Space and Defence branch. The committee consisted of representatives of the European space industry. (Lungu, 2004)

The report that was submitted by the High Level Industry Working Group (HLIWG) committee in January 1996 indicated that Europe was lagging far behind its transatlantic counterpart and there was no major challenge that Europe posed to the US in the field of space technology. The High Level Industry Working Group (HLIWG) further proposed that if this would be the pattern, Europe would fast be eliminated from the race for space technology in the times to come. The space related technology that had already been developed by the United States, posed a major challenge to Europe which has not been able to cope up with the rising trends of space technology. The report also called for the formation of a European Agency for Navigation to reinforce the EU's autonomous political position and to defend its profitable interests. (Lungu, 2004)

After the report was issued, the committee gained a lot of political interest and acceptance from the ESA officials. It was generally believed that the time has come for Europe to undertake major steps in order to challenge the United States' goal to encourage recognition of GPS as international standard for civil applications" because this "will give Europe independence from foreign national/military satellite systems and control over its own element within a global civil navigation satellite system." (Lungu, 2004)

In June 1998, Euro space (The Association of European Space Industry) concluded a report pertaining to Europe's strategic dependence in space technology highlighting that: “In the short term, the existence of a world satellite navigation monopoly is liable to create a strategic dependence relationship in a substantial number of domains associated with national sovereignty. The evolution of the current American system, as also the existence of eventual alternatives, must be examined at political level. If not, the risk exists of a progressive loss of control of a technological resource which is essential in connection with the new international relations.” Within this context, in July 1999, the EU Transport Council decided that the EU could move ahead with plans to build its own global satellite navigation system. (Lungu, 2004)

Above mentioned developments clearly show that Galileo is a project with evident overlapping geo-economic and strategic implications that underscore the EU’s desire for a distinct and assertive voice in key international policy areas and the developments in Europe since the 1990s in satellite navigation have begun to increasingly provide the European elites with a kind of leverage *vis-à-vis* the U.S. that they did not previously have. (Lungu, 2004)

US Department of Defence’s vision statement for the 21st century states that “we must have information superiority; the capability to collect, process and disseminate an uninterrupted flow of information while exploiting or denying the enemy's ability to do the same”. Galileo, particularly the existence of PRS, confronts this policy and it was one of the major concerns of the American side during the negotiations for the allocation of frequencies between Galileo and GPS in 2004. As expressed in Wolfowitz’s letter the addition of any Galileo services in the same spectrum would significantly complicate the US’s ability to ensure availability of critical GPS services in time of crisis or conflict and at the same time assure that adversary forces are denied similar capabilities as in the case of the frequencies intended to be used by Galileo's PRS would be so close to those used by the US military M-code that it would be impossible to jam Galileo without affecting the US signal. Although parties referred to a “commitment to preserve national security capabilities” in the joint communiqué, there was no overt mention from either party of a specific ability to jam the PRS signal. Some details suggest that the EU will be able to insist on joint decision-making before denial of service can be secured. (North, 2004)

“On the other hand, it could be that the […] EU, with its aspirations of becoming a major player on the world scene, sees in Galileo the ability to apply irresistible leverage and influence US foreign policy decisions. […] The US, on past experience, will seek to avoid direct confrontation with the EU over foreign policy issues but, in the final analysis, in the past it has been able to ignore European sentiment when making its plans. With Galileo, however, the EU will have power physically to interfere with US military operations, by keeping the Galileo signal available in areas where the US would wish it to be discontinued. It can use that power to seek concessions or even prevent US action altogether. (North, 2004)

4.2 International Involvement in Galileo

China and Galileo

On September 18, 2003, the EC announced that China was to join the Galileo undertaking and finance it as a preferential external partner. According to the agreement, China would contribute at least 230 million euros. From Washington's point of view, this partnership posed several dangers to the transatlantic relationship and especially to the security and economic interests of the United States. Basically, by involving China in the development of Galileo, the European Union was indirectly helping the modernization of the People's Liberation Army (PLA), an act that is regarded as unacceptable by many analysts and politicians in Washington. Indeed, it would be almost impossible to prevent the transfer of sensitive dual-use technology to the Chinese. This has been a very sensitive issue at a time when the United States is increasingly preoccupied with the military capabilities of China. (Matias, 2007)

The European satellite navigational system - Galileo could be an important player to enhance the military program of China. Apparently, Beijing is intent on rapidly developing a more potent, modernised military. The country is looking forward to develop a complete range of land-attack and anti-ship cruise weaponry, long-range surface-to-air missiles, and anti-radiation missiles. In 2001, its Peoples' Liberation Army tested new aircraft carrier-killer guided missile destroyers. Additionally, China has developed its ballistic missiles to the point where it is now able to target parts of the United States with nuclear weapon-sized payloads. The use of satellite guidance in these and anti-shipping missiles could substantially enhance their accuracy. On this basis, access to Galileo would give China a significant boost. A major concern that can prop up between the United States and China is that over the military confrontation in Taiwan. In this case, the capabilities that are offered by the Galileo to be used by China as a member of the EU satellite navigational policy, could lead China to improve its precision-strike capabilities against U.S. and Taiwan forces. (Anthony, 2005, Matias, 2007, North, 2004, Johnson-Fresee, Erickson, 2006)

The agreement that took place between the EU and China states that China will take part in the exhaustive research and development program, equipment and application expertise, for Galileo. Until now, the investment from the country in the project has been 230 million euros through China Galileo Industries Ltd., which is a state-run company. At the same time, China has a record of using foreign aided technology to enhance its army and other security mechanisms. The Galileo agreement has further increased China's capability to copy weapon systems, incorporate highly developed technologies into China's manufacture lines, and lift up the technological knowledge of Chinese workers caught up in military-security invention. With inside knowledge of the system engineering and electronics, it should then be a relatively straightforward process for the Chinese to reverse-engineer the crucial components in order to produce its own high-precision receivers and, of course, PRS encryption codes could be obtained. (North, 2004, Matias, 2007, Anthony, 2005)

Strengthening EU defence and security capacities and the willingness of the EU to assert itself on the world stage through common foreign policy mechanisms are ingredients that have the potential of creating an increasing interest for consolidating China-EU relations. The interest of the Asian countries, especially China in the Galileo project controlled by the EU, has obviously showed a gradual increase in the context of improving economic and defence cooperation between Europe and China. This has further opened up new opportunities for the European governments and businesses to sell its technologies to China which is one of the biggest economies of the world and is poised to become a world power. The technology that can be easily imported to China is the British micro- and nano-satellite technology which is employed in the modern anti-satellite weapon systems[39], British airborne early warning radar that can be used in military aircraft, German engines that can be used in conventional submarines and French and Italian technology that can be used in attack helicopters. (Sigurdson, 2003, Kogan, 2005)

This level of cooperation can only be understood in light of a Sino-European "maturing and comprehensive partnership" based on intense economic and political linkages. Simultaneously, the European Union has been projecting itself as a global player with ambition to develop its autonomy and independence from the United States in terms of military capabilities. In China's eyes, cooperation in the Galileo project is seen as part of a strategy of strengthening China's position in the international arena, by cooperating in a sensitive technology that disrupts U.S. hegemony in GNSS. In addition, this cooperation appears to be a golden opportunity to benefit from the transfer of expertise and technology in such a sensitive asset[40]. This would be extremely useful in tandem with the Chinese Space Strategy. (Matias, 2007)

In terms of military-industry interests, the involvement of Russia and China on the Galileo project as cooperation partners is essential for Europe to project its power

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[39] According to the US House National Security Committee, China's People's Liberation Army has been building lasers capable of destroying satellites or disrupting their sensors and communications arrays. The study, entitled "Future Military Capabilities and Strategy for the People's Republic of China", warned that the PLA "plans to develop a capability to establish control of space or to deny access and use of military or commercial space systems in times of crises or war". On January 11, 2007 China tested an anti-satellite missile by destroying one of its ageing weather satellites which provoked wide range of international reaction. (North, 2004, Chan, 2007)

[40] The transfer of technology and knowledge could prove very useful, as China develops its own GNSS named Beidou.

status and capitalise on the significant commercial opportunities opening since these countries represent enormous markets and play major role in international affairs. (North, 2004)

Among other countries who have showed a lot of interest in the Galileo project, is Israel, which joined in March 2004, to become a partner in the Galileo project with the European Union. Israel plans to gain a share in undoubtly lucrative industrial contracts. However, Israel cannot be unaware of the military applications, and is perhaps hedging its bets against any change in US Mid-East policy, its reliance on GPS giving the US considerable leverage on the deployment of military assets. One can understand the Israelis wanting some sort of insurance against too great a reliance on US military technology, but one also wonders whether this is part of the overall plan by the EU to strengthen its influence in the Mid-East, and its determination to reduce American influence. Similarly, on June 3, 2005 Ukraine signed an agreement with the European Union to join and promote the Galileo project. On September 7, 2005, India signed a pact with the EU and promised to take part in the project in order to set up an Asian / regional augmentation system which will be set up on the European Geostationary Navigation Overlay Service (EGNOS). Korea, Morocco and Saudi Arabia are other countries that have joined the program by January 2006. (North, 2004, Matias, 2007)

CHAPTER 5: CONCLUSION

The Satellite navigation users in Europe have no other option other than to take NPT services from the United States controlled - GPS or Russian GLONASS satellite systems. However, the military character of both systems raises question marks as to whether those services would available at all times as the satellite navigation technology has become an indispensable tool for various critical applications. If the systems are switched off randomly, it would have severe consequences for the countries that are dependent on either of them in both economic and security terms. Transport sector would find it inconvenient and difficult to revert to traditional navigation methods. Moreover, since the usage of satellite navigation has increased by many folds, the implications of a signal failure will be even greater, putting at risk not only the efficient running of transport systems, but also human safety.

During the early 1990s, the European Union realized the need for Europe to posses its own global satellite navigation system. The decision to build Galileo was taken in comparable character to resolution in the 1970s to go on board on other well-known European activities, such as the Ariane launcher and the Airbus. The European Commission and European Space Agency coupled forces to construct Galileo, a sovereign system under civilian control which will be assured to remain activate at all times, barring the direst crisis situations.

Aside from the commercial and social benefits Galileo would bring as a superior system compared to its rivals, European sovereignty is a major motivational factor for taking this important step. This study attempts to demonstrate that this large-scale project would strengthen EU's independence and access to multiple sources for information, its role in world affairs, and European competitiveness.

Galileo programme has been promoted as a geo-economic and geo-strategic ambition to provide satellite navigation and positioning signals from an independent, global infrastructure under European civilian control and ownership. This effort has implications for both security policy cooperation in Europe and for the transatlantic relationship. Galileo programme encompasses a range of issues pertaining to the development of a European security framework and policy; the growing reliance on satellite navigation infrastructures and the need to reduce vulnerability; the relationship between a high-accuracy, high-capability infrastructure in Europe and the potential for the adverse use of such capability; the role of ESA, which becomes more incorporated into the EU institutional and political framework, in taking on security-related responsibilities as part of the joint ESA/EU implementation of the European space strategy; and the relationship between the EU/Galileo and NATO/US/GPS. It is also seen that a number of economic, political and security aspects overlap as far as the Galileo project is concerned. The development of Galileo provides and interesting illustration of the dynamic interaction of technology infrastructure policy, political-economic integration in Western Europe and the role of the EU as an actor in foreign economic policy making, on the one hand, and European security-oriented policy integration, transatlantic (and international) security relations and the possible strengthening of the EU as an actor in foreign security policy making, on the other. (Lembke, 2002b)

As a dual-use system, Galileo will undoubtly have security and defence implications. As demonstrated above, satellite navigation has revolutionized modern warfare and drastically enhanced US military applications. Given the fact that this capability provides significant advantages in military/security domain and the successful launch of Galileo will enable the EU to exploit those benefits even with greater effectiveness, the implications for CFSP and ESDP would be strong.

Since the late 1980s, elites in the EU widely shared a goal of rivalling the US in critical high-technology undertakings to gain economic benefits and strategic independence. EU will probably follow a similar strategy for Galileo as pursued for Airbus in the past. It will first focus on breaking the virtual U.S. technological and commercial monopoly provided by the GPS system, and then focuses to profiting from the interest of buyers in a major non-U.S. supplier of services and equipment. If these first two, essentially commercial, steps succeed, an increased EU role in world military and security affairs could be just another small step away. On other hand, it is widely recognized that, in any project, it is the strategically focused partner (usually France[41] in the case of European projects) who shapes the course of the program. (Lungu, 2004) In this context, a further research topic would be "how and under which institutional/decision making setting Europe could harness the military-security potential of Galileo to the fullest extent possible with a view that differences of opinion will continue to exist among the member states in this strategic issue.

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[41] According to a senior French official, […Europe] cannot let its armies remain dependent for much longer on American goodwill. "Imagine, all it would need is for the Americans to scramble their GPS, which they could do at any moment, and all air-strikes and military operations would grind to a halt". "Nothing will be done before 2010 or 2015," the official continued. "In an initial phase we will propose Galileo for use in planning humanitarian actions, police and civil protection operations, and to assist coastguards. No-one can object to this." But, he added, "in a second phase it will be very simple to adapt it to military ends". (The Parliament.com, 2004)

It is also worth noting that, Galileo would play a major role in the development of the European security identity and create a spill over effect as taking full advantage of Galileo services for security and defence applications requires substantial investments in a number of military domains. Speculatively, the system would turn into an indispensable force multiplier for a future common European army.

Combining all the economic/strategic aspects analysed in this study and the involvement of major global players in the programme, it can be concluded that the Galileo system has a significant potential to strengthen and enhance the influence of the EU in 21st century international affairs.

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List of Abbreviations

AFSPC	Air Force Space Command
CFSP	Common Foreign and Security Policy
CS	Commercial Service
CSEL	Combat Survivor Evader Locator
DG TREN	Directorate General for Transport and Energy
DoD	Department of Defence
DoT	Department of Transport
EC	European Commission
GPS	Global Positioning System
GLONASS	Globalnaya Navigatsionnaya Sputnikova Sistema (Global Orbiting Navigation Satellite System)
EDA	European Defence Agency
EGNOS	European Geostationary Navigation Overlay Service
ELDO	European Launcher Development Organization
EP	European Parliament
ESA	European Space Agency
ESDP	European Security and Defence Policy
ESPI	European Space Policy Institute
ESRO	European Space Research Organization
ESS	European Strategy for Space
ETG	European Tri-partite Group

EUISS	European Union Institute for Security Studies
Eumetsat	European Organization for the Exploitation of Meteorological Satellites
Eurocontrol	European Organization for the Safety of Air Navigation
FOC	Full Operational Capability
GJU	Galileo Joint Undertaking
GIS	Geographic Information System
GNSS	Global Navigation Satellite System
GMES	Global Monitoring for Environment and Security
GSM	Global System for Mobile Communications
HLIWG	High Level Industry Working Group
HSPG	High-level Space Policy Group
IGEB	Interagency GPS Executive Board
INS	Inertial Navigation Set
IOC	Initial Operational Capability
ITU	International Telecommunication Union
JDAM	Joint Direct Attack Munition
JPO	Joint Programme Office
JSSAG	Joint Space Strategy Advisory Group
JTF	Joint Task Force
MLRS	Multiple Launched Rocket System
NATO	North Atlantic Treaty Organization
Navstar/GPS	Navigation Satellite Timing and Ranging, GPS
NPT	Navigation Positioning Timing

OS	Open Service
PDD	Presidential Decision Directive
PLA	People's Liberation Army
PPP	Public Private Partnership
PPS	Precise Positioning Service
PRC	People's Republic of China
PRS	Public Regulated Service
RRF	Rapid Reaction Force
SA	Selective Availability
SAR	Search and Rescue
SD	Selective Deniability
SLBM	Submarine Launched Ballistic Missiles
SoL	Safety of Life
SPS	Standard Positioning System
TDARDS	Truth Data Acquisition, Recording, and Display System
UMTS	Universal Mobile Telecommunications System
USAF	United States Air Force
WEU	Western European Union
WMD	Weapons of Mass Destruction
WRC	World Radiocommunication Conference

Appendix 1

DEPUTY SECRETARY OF DEFENSE

1010 DEFENSE PENTAGON
WASHINGTON DC 20301-1010

DEC 1 2001

The Honorable [redacted]
Minister of Defense
[redacted]

Dear Mr. Minister:

I am writing you at this time to convey my concerns about security ramifications for future NATO operations if the European Union proceeds with Galileo satellite navigation services that would overlay spectrum of the Global Positioning System (GPS) military M-code signals.

Over the next several years, the U.S. plans a major modification to GPS to meet future military and civil requirements. One significant feature of the modernization is the spectral separation of the GPS military M-code signals from civil signals. Separating the signals will facilitate our ability to deny adversaries the benefits of these space-based navigation services in a local theater of operations without negating the military use of the system.

In a recent meeting in the U.S., a European Commission (EC) delegation indicated that a Galileo Public Regulated Service (PRS) was being considered for the same spectrum planned for the modernized GPS M-code signals. The addition of any Galileo services in the same spectrum as the GPS M-code will significantly complicate our ability to ensure availability of critical military GPS services in a time of crisis or conflict and at the same time assure that adversary forces are denied similar capabilities. Additionally, I am concerned that it is intended that the Galileo PRS will have the features of the military signals of GPS. If the future PRS is actually intended to serve such a purpose, I do not believe the current civil forum being used by the EC provides the proper venue to fully assess the security implications.

I believe that acceptable solutions can be found and that we can avert potentially serious impacts to future alliance operations that rely on GPS. To find such solutions, however, I believe we need to identify and establish the proper forum to discuss the security ramifications of this future services. In this regard, I urge you to consider two actions. First, convey these security concerns to your Minister of Transport in advance of the 6 December EC meeting to review the Galileo mandate. In expressing these concerns, I believe it is in the interest of NATO to preclude future Galileo signal development in spectrum to be used by the GPS M-code. Second, inquire whether the EC intends to develop a Galileo PRS that will have military features and, if so, we must examine in an appropriate forum the security implications of the proposed system.

Sincerely,

Paul Wolfowitz

Letter from Paul Wolfowitz to EU ministers, calling for abandonment of the Galileo

Source: www.zdnet.fr/actualites/internet/0,39020774,2106129,00.htm

Appendix 2

THE WHITE HOUSE
Office of the Press Secretary
For Immediate Release May 1, 2000

STATEMENT BY THE PRESIDENT REGARDING THE UNITED STATES' DECISION TO STOP DEGRADING GLOBAL POSITIONING SYSTEM ACCURACY

Today, I am pleased to announce that the United States will stop the intentional degradation of the Global Positioning System (GPS) signals available to the public beginning at midnight tonight. We call this degradation feature Selective Availability (SA). This will mean that civilian users of GPS will be able to pinpoint locations up to ten times more accurately than they do now. GPS is a dual-use, satellite-based system that provides accurate location and timing data to users worldwide. My March 1996 Presidential Decision Directive included in the goals for GPS to: "encourage acceptance and integration of GPS into peaceful civil, commercial and scientific applications worldwide; and to encourage private sector investment in and use of U.S. GPS technologies and services." To meet these goals, I committed the U.S. to discontinuing the use of SA by 2006 with an annual assessment of its continued use beginning this year.

The decision to discontinue SA is the latest measure in an on-going effort to make GPS more responsive to civil and commercial users worldwide. Last year, Vice President Gore announced our plans to modernize GPS by adding two new civilian signals to enhance the civil and commercial service. This initiative is on-track and the budget further advances modernization by incorporating some of the new features on up to 18 additional satellites that are already awaiting launch or are in production. We will continue to provide all of these capabilities to worldwide users free of charge.

My decision to discontinue SA was based upon a recommendation by the Secretary of Defense in coordination with the Departments of State, Transportation, Commerce, the Director of Central Intelligence, and other Executive Branch Departments and Agencies. They realized that worldwide transportation safety, scientific, and commercial interests could best be served by discontinuation of SA. Along with our commitment to enhance

GPS for peaceful applications, my administration is committed to preserving fully the military utility of GPS. The decision to discontinue SA is coupled with our continuing efforts to upgrade the military utility of our systems that use GPS, and is supported by threat assessments which conclude that setting SA to zero at this time would have minimal impact on national security. Additionally, we have demonstrated the capability to selectively deny GPS signals on a regional basis when our national security is threatened. This regional approach to denying navigation services is consistent with the 1996 plan to discontinue the degradation of civil and commercial GPS service globally through the SA technique.

Originally developed by the Department of Defense as a military system, GPS has become a global utility. It benefits users around the world in many different applications, including air, road, marine, and rail navigation, telecommunications, emergency response, oil exploration, mining, and many more. Civilian users will realize a dramatic improvement in GPS accuracy with the discontinuation of SA. For example, emergency teams responding to a cry for help can now determine what side of the highway they must respond to, thereby saving precious minutes. This increase in accuracy will allow new GPS applications to emerge and continue to enhance the lives of people around the world.

Source: http://www.ngs.noaa.gov/FGCS/info/sans_SA/docs/statement.html