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BIOGRAPHY

Martin U. Ripple joined EADS shortly after the merger of DASA, Aerospatiale Matra and CASA in 2000. His original position was head of the Group Strategic Planning process. Since July 2002, he has been responsible for the Galileo program within the EADS SPACE division. He graduated with a degree in mechanical and aeronautical engineering from the Eidgenoessische Technische Hochschule (ETH), Zurich, in 1994.

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ABSTRACT

On December 8, 2004, the President of the United States of America authorized the new U.S. Space-based Positioning, Navigation and Timing Policy. This new policy sets forth a forward-looking framework for the management of GPS and its augmentations. In particular, the new U.S. policy mentions interaction with other satellite navigation systems. Following the establishment of a U.S.-E.U. framework agreement for cooperation between GPS and Galileo, signed on June 26, 2004, European policy makers and industrialists expected clear statements on cooperation and interoperability issues from the new U.S. GPS policy. Regrettably, the related recommendations hold short of the need for cooperation as it focuses on space supremacy and military usage. The future coexistence of separately run and managed GNSS constellations raises many questions in security and safety related areas. Here, constructive and collaborative work is more than necessary, as the first Galileo satellite is planned for launch by December 2005. So far it looks like further action has to be envisaged in order to achieve the maximum of the framework negotiation in terms of cooperation. The ambitions of both the U.S. and the E.U. to cooperate in the satellite navigation area can rely on strong foundations on which to build, thanks to former transatlantic cooperation in space. The present decisive period for space policies therefore constitutes a window of opportunity which requires concrete actions to begin a new form of active collaboration. If GPS and Galileo are destined for a peaceful cohabitation in space, there is still much work ahead of us. The creation of joint, international offices, involving public institutions and industry, would be of great interest to further develop positioning, navigation and timing services worldwide. It would allow nations to better serve their own interests through coordinated activities in maintenance tasks or upgrades as well as for the commercialization of dedicated satellite services.

INTRODUCTION

Positioning, Navigation and Timing (PNT) systems have been used for long. The United States have been leading the development of satellite navigation with the Global Positioning System (GPS) for more than two decades. In addition to its Russian equivalent, GLONASS, other systems are emerging worldwide, either dependent or as an augmentation, which now suggests the coordination of the countries involved to offer enhanced PNT services to end-users. Galileo, Europe's own global satellite navigation system is now underway, and efforts have been put forward to foster transatlantic cooperation in this field. This paper attempts to summarize what has been done so far to prepare the cooperation between GPS and Galileo, and provides an analysis of the new U.S. GPS policy from a European perspective.

SATELLITE NAVIGATION CONTEXT

GPS, the American Satellite Navigation System

Overview

The NAVSTAR GPS program was initiated by the U.S. Department of Defense in 1973, as a replacement for the Transit satellite system – the U.S. military's first

navigation satellites. It is owned by the U.S. Government, and consists of a constellation of military radio positioning and navigation satellites, which provides worldwide passive, all-weather, and all-altitude precise three-dimensional position, velocity, and time. An Initial Operational Capability (IOC) was declared on December 8, 1993, and the U.S. Air Force Space Command (AFSC) formally declared the GPS satellite constellation as having met the requirement for Full Operational Capability (FOC) as of April 27, 1995.

Today, GPS provides two levels of service: the Standard Positioning Service (SPS) and the Precise Positioning Service (PPS). The SPS is a positioning and timing service which is available to all GPS users on a continuous, worldwide basis with no direct charge. The PPS is a highly accurate military positioning, velocity and timing service which is available on a continuous, worldwide basis to users authorized by the U.S. PPS was designed primarily for U.S. military use, and can be denied to unauthorized users by the use of cryptography. PPS will be made available to U.S. military and U.S. Federal Government users. Limited, non-Federal Government, civil use of PPS, both domestic and foreign, will be considered upon request and authorized on a case-by-case basis, provided [1]:

- it is in the U.S. national interest to do so;
- specific GPS security requirements can be met by the applicant;
- a reasonable alternative to the use of PPS is not available.

Current Status & Planned Modernization

As for the first generation, four blocks of GPS satellites have flown in the constellation: Block I, Block II, Block IIA, and Block IIR. As of July 2005, there are twelve Block IIR satellites in orbit. Block IIR satellites boast substantial improvements over the previous blocks.

As for the second generation (2005-2018), eight Block IIR satellites are being modernized to broadcast the new military (M-Code) signal, more robust and capable, as well as the more robust civil signal (L2C). The first modernized Block IIR (designated as the IIR-M) launch has been postponed several times since December 2004, with no launch as of July 2005. Block IIF will provide further improvements including a new civil signal on a third frequency (L5). The first Block IIF satellite is scheduled to launch in 2007.

As for the third generation, Block III satellites will further improve system accuracy and availability, as well as increase anti-jam power and provide potential integrity improvements. The first Block III satellite is scheduled to launch in 2013 [2].

Galileo, the European Satellite Navigation System

Overview

Having identified the problems of continued reliance on third countries' satellite navigation systems, such as the U.S. GPS and the Russian GLONASS, the European Commission decided in 1998 to investigate the development of a European Global Navigation Satellite System (GNSS), in coordination with the European Space Agency (ESA).

The program is being developed in four phases. The public sector will be responsible for the **Definition Phase** and the **Development and In-Orbit Validation (IOV) Phase**, covering the detailed definition and subsequent manufacture of the various system components: satellites, ground components, user receivers. In particular, this validation will require the launch and testing of prototype satellites before June 2006, in order to fulfill the frequency allocation requirements imposed by the International Telecommunication Union.

After successful completion of the IOV Phase, a private concessionaire will take over responsibility for the full **Deployment Phase** as well as the **Operation Phase** under a concession contract on a 20-year period. This will consist in completing the 30-satellite constellation, as well as ensuring the full deployment of the ground infrastructure, and provision of the Galileo satellite services to the users.

The last EU Transport Council held on December 10, 2004 [3], has confirmed that Galileo will offer the following five services:

- an open service, free of user charge,
- a commercial service, providing the users with enhanced performances,
- a 'safety-of-life service', serving safety-critical applications such as aviation,
- a 'search and rescue' service, as a support to emergency operations,
- a governmental service, known as 'public regulated service (PRS)', for authorized users.

Current Status

The Development and IOV Phase started after the completion of the Definition Phase, and a Preliminary Authorization to Proceed (PATP) was signed on December 21, 2004, between ESA and Galileo Industries, a consortium specially formed by European space companies to contract the Galileo infrastructure [4].

In parallel, the Galileo Joint Undertaking (GJU), a joint EC/ESA entity, is responsible for the selection of the future Galileo concessionaire. The negotiations have

started in July 2005 after the GJU agreed on June 27, 2005 to the merger of the two competing consortia [5].

The deployment of the Galileo System is expected to start by 2009, with the view of achieving Full Operational Capability by 2010. Part of the concession contract, the replenishment of the Galileo constellation would start with the launch of second generation of satellites in 2017.

The Need for Cooperation Recognized

The early years of "cooperation" could be summarized as political. Initial transatlantic disputes can be traced to a different thinking about satellite navigation. GPS was indeed originally designed to serve military purposes, but has been markedly used for civil, scientific and professional applications as a matter of fact. Galileo, however, will constitute the first global navigation satellite system under civil control, to serve civil purposes, with evident applications for public safety and security.

Whereas both GPS and Galileo systems have been purposed differently, the duality of satellite navigation technology has rapidly raised many common political, strategic, security and commercial issues on both sides of the Atlantic. So did the international outreach of such satellite navigation program as Galileo, since third countries – e.g. China – have agreed to participate.

After trying to persuade the E.U. that there was no need for Galileo, and that Europe should rather concentrate its funding efforts on pure military capabilities, the U.S. shifted its position on the European initiative in 2003 [6]. The need for cooperation in the field of satellite navigation then emerged as a top priority element of the future U.S. space policy.

As a matter of planning, Figure 1 displays the envisaged modernization schedule of GPS [7] as well as the current milestones for Galileo.

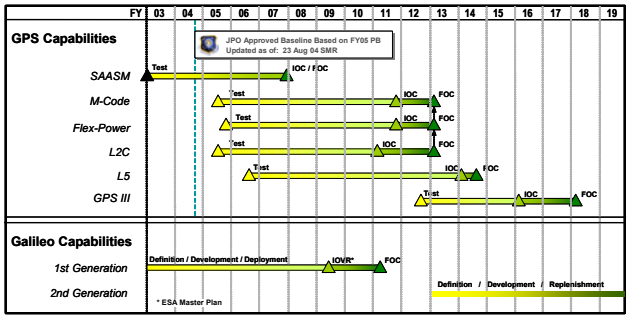

Figure 1: Comparison GPS & Galileo Planning

The above schedule shows that there are still several years before both systems can actually cooperate. Nevertheless, the development and deployment phases of both Galileo and the modernized generations of GPS cannot afford delays. This has been realized for a couple of years, and efforts have been initiated on both sides of the Atlantic to improve the situation.

TRANSATLANTIC COOPERATION

Early Cooperation Initiatives

Concerning Galileo, the approach towards a transatlantic cooperation can be described in three phases since the first studies were conducted in the mid 90´. The first phase dealt with the establishment of a framework agreement outlining overarching principles for cooperation during the European Galileo development. This was addressed by the Agreement on the Promotion, Provision, and Use of Galileo and GPS Satellite-Based Navigation Systems and Related Applications, signed on June 26, 2004 by the United States and the European Union [8].

The signature of the U.S.-E.U. agreement then launched the second phase of co-operation with the establishment of four working groups, with the view to ensuring maximum benefits of interoperable constellations:

- a working group on radio frequency compatibility and interoperability for civil satellite-based navigation and timing services,
- a working group on trade and civil applications,
- a working group to promote cooperation on the design and development of the next generation of civil satellite-based navigation and timing systems, and
- a working group on security issues relating to GPS and Galileo, including information exchange on possible applications for secured governmental services, and including interactions between their respective signals.

Each working group will include participation, as appropriate, from the competent authorities of the U.S. and the E.U., whereas third party participation in working groups shall be only by mutual consent of both parties. This phase is currently ongoing and the expectations as far as relevance of the outcome is concerned, differ on both sides of the Atlantic.

Eventually, a third phase shall follow swiftly as first Galileo elements become operational, in order to address longer-term issues such as policy and future system planning, interface data and day-to-day coordination.

New U.S. GPS policy

On 8 December 2004, the President of the United States of America authorized the new U.S. Space-based Positioning, Navigation and Timing Policy [9]. The long-waited policy, which supersedes the Presidential Decision Directive (PDD) dated 28 March 1996 [10], sets forth a forward-looking framework for the

management of GPS and its augmentations. In principle, it addresses '*international cooperation with foreign space-based positioning, navigation, and timing services*', which shall be read as to include Russia's GLONASS and Europe's forthcoming Galileo system. The actual message is however perceived to tackle two issues in particular:

- the civil use of GPS, and
- the security aspects.

Recognition of Civil Applications

The policy recognizes that '*commercial and civil applications of the Global Positioning System have continued to multiply and their importance has increased significantly. Services dependent on Global Positioning System information are now an engine for economic growth, enhancing economic development, and improving safety of life (...).*' Consequently, the U.S. GPS industry has welcomed this new GPS policy as an evidence of U.S. authorities´ full support to sustainable long-term growth of navigation-related economy.

The obvious recognition of commercial, civil and scientific applications is further materialized by the formal involvement of civil government bodies, in an area that has previously been the predominant responsibility of the U.S. Air Force. The PNT Executive Committee which has been established includes, in particular, representatives from the Departments of State, Commerce, and Homeland Security, the Joint Chiefs of Staff, and the National Aeronautics and Space Administration.

In addition, and as a service to GPS users, the Department of Transportation has established the 'Navigation Information Service' (formerly 'GPS Information Service'). This is intended to become the point of contact for civil GPS users, operated and maintained by the United States Coast Guard.

Focus on Security Aspects

As a dual use technology, the importance of satellite navigation is obviously emphasized in the new policy. It stresses the underlying importance of the GPS, as a critical part of U.S. national security, transport safety and homeland security. Its applications are furthermore recognized as '*integrated into virtually every facet of U.S. military operations*'.

The need to increase efforts to identify and head off possible threats is concretely reflected in the responsibilities given to the various governmental departments and agencies. The Department of Transportation (DoT) shall work closely with the Departments of Defense (DoD) and Homeland Security (DHS) in order to ensure the security and continuity of GPS civil services. Furthermore, the new policy tasks DoT to maintain enhanced PNT services thanks to augmentations and backup capabilities. It also tasks the DHS, in close cooperation with the Departments of State, Transportation and Defense, to protect GPS from intentional and unintentional interference. The Central Intelligence Agency is also asked to identify, monitor and assess the development of foreign threats and provide information to support the development of countermeasures.

Vision from Europe

European policy makers and industrialists expected clear statements on cooperation and interoperability issues, including implementation guidance for U.S. governmental bodies in the new GPS policy. Regrettably, these recommendations hold short of the need for cooperation as it focuses, objectively, on space supremacy and national security/military usages.

This opinion happens to be shared also west of the Atlantic, as Mr. G. Gibbons, founder of *GPS World* publication, explains [11]. The present paper shall not be read as a criticism to the content of the new U.S. GPS policy. Again, the dual use of satellite technology requires careful identification of potential threats, assessment of the related risks for public security, as well as anticipation through relevant preparation and the corresponding focus on security aspects appears duly justified. The point rather lies in cooperation aspects, which though suggested as common objectives, are not properly developed to allow for subsequent actions. According to the scope of the policy, it provides in particular '*guidance for (...) international cooperation with foreign space-based positioning, navigation, and timing services',* and defines accurately the words '*interoperable*' and '*compatible*'. It also mentions, later as background information, emerging foreign services which could either '*enhance or undermine the future utility of the Global Positioning System'*.

A national policy which attempts to foster the development of its own satellite navigation system over foreign systems and services cannot be criticized as such. The same would be expected in any country other than the U.S., and the strong support from the E.U. and its Member States for Galileo goes in the same direction. However, it seems that the presidential policy fails to provide concrete tasks and directives for the implementation of secure, compatible and interoperable satellite navigation services. Objectively, this does not look as a step forward for international cooperation, at least not as promised by the recent efforts put and materialized by the U.S.-E.U. agreement. Progresses of these working groups which were established were proposed to be reviewed once a year and therefore results are expected shortly. Nevertheless, it looks like further

action has to be envisaged in order to achieve the maximum of the framework negotiation in terms of cooperation.

In parallel, the U.S. signed further agreements with other nations active in the field of satellite navigation, with the joint statement with Japan, signed on 18 November 2004 [12], and the joint statement with Russia, signed on 14 December 2004 [13]. The latter states, in particular, that '*both sides will work together to the maximum extent practicable to maintain compatibility and promote interoperability of GPS and GLONASS for civil user benefits worldwide',* and *'intend to establish working groups on matters of development and use of GLONASS and GPS and their respective augmentations*'.

The worldwide industry can only welcome such cooperation initiatives. It is in its interest to do so. From an industrial point of view, there is little doubt in the progress of such working groups, despite lack of visibility in the results. Therefore, the idea comes to mind that the involvement of the industry can be of great support to foster international cooperation.

RECOMMENDATIONS FOR FURTHER COOPERATION

The future coexistence of differently run and managed GNSS constellations raises many questions in security and safety related areas. In particular standards, certification and regulatory policies are important to U.S., European as well as worldwide users. Here, constructive and collaborative work is more than necessary, as the first Galileo satellites are planned to transmit signals by December 2005 [14].

A common governance structure for a virtually single large constellation run by two different operators is certainly not conceivable, but the idea comes to mind that a joint technical entity or ´liaison office´ could be created to foster cooperation in satellite navigation, in particular concerning technical and standardization issues.

Signal Interference and Vulnerability

Recognized as a priority by the presidential policy, the identification, localization and mitigation of any interference event is indeed essential to protect the use of positioning, navigation and timing services, especially in the case of applications related to critical infrastructure. In particular, Departments and Agencies detecting or receiving reports of interference are asked to '*provide timely reports to the Secretary of Homeland Security, the Secretary of Defense, and the Director of Central Intelligence*'. As satellite navigation systems provide PNT services on a global scale, with broadly the same technical features, creating an international civil interference and vulnerability reporting office would constitute an efficient way:

- to deal with vulnerability of such services, particularly critical given their widespread and growing dependence of military, civil and commercial systems on GPS and other systems;
- to deal with interference events and provide recommendations to such organizations as the Federal Communications Commission, and the International Telecommunications Union notably, with the view to enabling appropriate investigation, notification, and/or enforcement action;
- to jointly consult and objectively evaluate such situations that may require jamming or degradation of civil signals for the security of worldwide citizens.

The presidential policy has tasked the Department of Homeland Security with developing *'a central repository and database for reports of domestic and international interference to the civil services of the Global Positioning System and its augmentations for homeland security, civil, commercial, and scientific purposes*'. The idea would be to expand such an initiative at international level to the benefits of the civil users, in an efficient way.

Certification and Standardization

Given the global outreach of GNSS and the promising market prospects, standardization and certification issues will be essential to the sustainability and furthermore to the development of satellite navigation services and applications. The usual example to this comes from the aviation sector, where the introduction of any safety-critical system is subject to certification. Here, given the international outreach of satellite navigation systems, the industry, the certification authorities as well as institutional players will need to interact and cooperate tightly in order to deliver the expected benefits of such a technology on time. Another example can be derived from emergency applications, whereas both the U.S. [15] and the E.U. [16] are promoting the need for accurate location of any emergency call.

Here, there is a need for harmonization and coordination in particular:

- to foster the introduction of GNSS within the global market, and trigger a rapid penetration within the most constraining applications in terms of certification;
- to optimize the standardization of GNSS elements of great interest for the industry as well as the end users;
- to ensure the non-discriminatory approach with respect to trade in goods and services provided by private industrialists and/or service providers.

This could be materialized by the creation of a joint office for certification and standardization, in line with, but as a concrete follow-up to the relevant working groups established after the U.S.-E.U agreement. Also, this would help to fulfill one of the objectives of the presidential policy to '*seek to ensure that foreign space-based positioning, navigation, and timing systems are interoperable with the civil services of the Global Positioning System and its augmentations in order to benefit civil, commercial, and scientific users worldwide*'.

Performance and Constellation Status

Performance assessment is another area of primary importance which shall be commonly addressed. Especially with the emergence of foreign augmentations systems, an increasing number of PNT services are being offered from global to regional and local scales. Beyond the strategic need for independence, which generally drives the development of an own system, the need to reach certain levels of performance is also essential to some applications such as aviation. There lies the need for cooperation on performance assessment and monitoring, which could be materialized by a common, international technical office. Such an active technical collaboration would eventually serve economic, political and strategic interest of both parties. In addition, reporting global GNSS constellation status, including all GPS, GLONASS, Galileo and other emerging systems, would be of great interest to the civil users. Behind such a level of interoperability lies the idea of a global 60- or 80-satellite GNSS constellation, from a user point of view, although owned by different regions of the world, offering various levels of PNT services with a global status report of system health and performance.

CONCLUSION

The ambitions of both the U.S. and the E.U. to cooperate in satellite navigation area can rely on strong foundations on which to build, thanks to former transatlantic cooperation in space. The present decisive period for space policies therefore constitutes a window of opportunity which requires concrete actions to begin a new form of active collaboration.

If GPS and Galileo are destined for a peaceful cohabitation in space, there is still work ahead of us. In particular, specific cooperation offices could be created to better coordinate efforts on a global scale, as well as to ensure efficient interaction between public and private sectors. Here, the involvement of the industry is highly recommended, both for today's operations and next generation of PNT services. The selection of a Public-Private Partnership for Galileo will certainly provide great benefits in this direction. EADS, the main actor in the Galileo program, intends to support such initiatives. It can rely on strong experience in transatlantic cooperation with U.S. partners in all aeronautics, defense and space domains.

REFERENCES

[1] NAVSTAR GPS Joint Programme Office, *GPS Fact Sheet*, http://gps.losangeles.af.mil/jpo/gpsoverview.htm, as per 8 August 2005.

[2] J. E. Augustine, *Updated U.S. Policy, GPS Modernization and Augmentation Expansion*, European Navigation Conference, Munich, Germany, 20 July 2005.

[3] Council of the European Union, *Press Release 15472/04 (Presse 345) on the conclusions of the 2629th Council Meeting on Transport, Telecommunications and Energy*, Brussels, Belgium, 9-10 December 2004.

[4] ESA, *In-Orbit Validation contract: a further step forward for Galileo*; Press Release, Paris, France, 21 December 2004.

[5] Galileo Joint Undertaking, *Galileo Concession - The Galileo Joint Undertaking (GJU) will start negotiation*, Press Release GJU/05/6533/HPM/ms/rod, Brussels, Belgium, 27 June 2005.

[6] J. A. Lewis, *Galileo and GPS: From Competition to Cooperation*, Center for Strategic and International Studies, United States, June 2004.

[7] Lt. Col. M. Crews, *GPS Modernization*, CGSIC - 44th Meeting, Long Beach, United States, 20 September 2004.

[8] The White House and the European Commission, *Agreement on the Promotion, Provision and Use of Galileo and GPS Satellite-based Navigation Systems and Related Applications*, USA/CE/en, signed at Dublin, Ireland, 26 June 2004.

[9] The White House, *U.S. Space-Based Positioning, Navigation, and Timing Policy – Fact Sheet*, Washington D.C., United States, 15 December 2004.

[10] The White House, *Presidential Decision Directive NSTC-6*, Washington D.C., United States, 28 March 1996.

[11] G. Gibbons, *On Second Thought*, GPS World, 1 March 2005.

[12] U.S. Department of State, *Joint Statement of the United States of America and Japan on Global Positioning System Cooperation,* Washington D.C., United States, 18 November 2004.

[13] U.S. Department of State, *United States – Russian Federation Joint Statement*, Washington D.C., United States, 14 December 2004.

[14] ESA, *Galileo satellite arrives at ESA-ESTEC for testing*, Press Release, Paris, France, 2 August 2005.

[15] Federal Communications Commission, *Wireless Enhanced 911 (E911) Program – Phase II*, original rules and further acts, Washington D.C., United States, 1996-2005.

[16] European Commission, *Recommendation on the processing of caller location information in electronic communication networks for the purpose of location-enhanced emergency call services*, Brussels, Belgium, 25 July 2003.