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Space Capabilities for Crisis Management: Reducing Gaps, Improving Action

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Space capabilities for crisis management: reducing gaps, improving action

Introduction

Security, understood at European level as embodying "soft power" defence and projective operations, sometimes assembled under the general umbrella of a generic and all-encompassing "crisis management", is new. Ambition for a regional capacity to act in times of crises is fairly two decades old in Europe, and is slowly taking shape despite the emerging threats Europe and its citizens have to face today. Space activities in Europe, at national level, have been undertaken as early as the beginning of the Cold War, however only effectively at European level since the mid 1970s. At European Union level, where a common security policy is being built, space has only been tackled at the turn of the new Millennium. Although space is becoming an increasingly strong priority on the EU agenda, it remains that European space for security is lacking coherence, ambitions and efficiency.

This research aims at identifying current gaps and challenges facing the integration of space rationales and technologies in European security efforts, as piloted by the European Union and its Member States. Although it is clear that space-based capabilities are only one of the many elements required for effective crisis response in the broad sense and although space-based capabilities are not always the most adapted tools for a given situation, the increasing complexity and need for both independent and efficient decision-making calls upon the effective integration of space systems in overall security capacities. This Research thus only tackles the crisis capabilities issue from the point of view of space, both at policy and technical level. Particular emphasis is thus given to assessing Europe's ability to effectively use space assets in its security operations (whether civilian or military, or both) in light of its policy ambitions.

Finally, the attempt of this Research is to highlight those challenges that, in turn, impede Europe's security ambitions, but also its space ambitions. Through this analysis, this Research seeks to suggest crucial elements deemed necessary for a better, more efficient and cost effective space solution to Europe's security needs.

1.– A European need: Sustaining space applications for security and crisis management

1.1.– Space and Security in europe: ambitions and realities

The Treaty on European Union (EU) signed in Maastricht in 1991 established the first provisions on a Common Foreign Security Policy (CFSP), while including the potential building up of a common defence policy, which could ultimately lead to a common defence.[1] Through 1992, the Western European Union (WEU), as an integral part of the development of the European Union, agreed that military units of member states could be employed to perform the so-called Petersberg tasks: humanitarian and rescue tasks, peace-keeping tasks, tasks of combat forces in crisis management, including peace-making.

Such missions were subsequently included in the Treaty on European Union signed in Amsterdam in 1997.[2] The scope of CFSP widened and was reinforced by the Franco-British Summit in Saint-Malo in 1998, which called for independent action as well as for autonomous military forces so as to respond to international crises. Eventually, the Cologne European Council held in 1999, established the ESDP, placing **civilian and military crisis management** at the centre of CFSP development.[3]

1.1.1.– 1994-2006: Getting prepared for new defence/security missions

The evolution and strengthening of European security response, at a policy and operational level, has been the result of permanent civil/military divisions and calls for greater synergies. More precisely, in terms of military capabilities, the Helsinki European Council in 1999 further defined the headlines goals (HG) for 2003, with a view of covering the full range of the Petersberg tasks: the EU must be able to deploy 50.000-60.000 troops within 60 days and for a period of at least one year. Within such framework, the EU must be also able to provide smaller rapid response elements.[4] In addition, in 2002 the EU-NATO agreement dubbed "Berlin Plus", granted EU access to the collective assets and capabilities of the Alliance and the participation of non-EU European NATO member countries in ESDP.

Regarding the civilian aspects, the Santa Maria de Feira European Council in 2000 endorsed four priority areas for civilian crisis management: policing, civil protection, civil administration and rule of law. It was arranged that member states, cooperating voluntarily, would provide by 2003 up to 5.000 police officers for such international

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[1] Treaty on European Union, Title V, Provisions on a Common Foreign and security Policy, art. J.4.1 http://eur-lex.europa.eu/en/treaties/dat/11992M/htm/11992M.html#0001000001

[2] Treaty of Amsterdam, Declaration relating to Western European Union http://eur-lex.europa.eu/en/treaties/dat/11997D/htm/11997D.html#0092010003

[3] Presidency Conclusions, Cologne European Council, 3-4 June 1999. http://www.consilium.europa.eu/ueDocs/cms_Data/docs/pressData/en/ec/kolnen.htm

[4] Presidency Conclusions, Helsinki European Council, 10-11 December 1999.

tasks. Member states also agreed to build the ability of deploying up to 1.000 police officers within 30 days.[5]

These first "capability–oriented" decisions have paved the way to identifying new needs for space-based information and telecommunication that could be shared by the EU intervention forces on any crisis whether military or civilian.

Once the institutional framework was set up, although yet not completed, and the initial capabilities were developed, the EU was able to conduct its first crisis management operations in Bosnia Herzegovina, starting from January 2003, and in RD Congo, starting in June 2003.[6]

The following years were characterized by the creation of complex procedures, structures and capabilities-building, as gradually designed by the different European Council summits: organization of regular or *ad hoc* meetings of the General Affairs and External Relations Council, as appropriate including Defence Ministers; creation of a permanent Political and Security Committee (PSC), the EU Military Committee (EUMC) formulating recommendations to the PSC, the EU Military Staff (EUMS) including the Situation Centre (SitCen), the Committee for the Civilian Aspects of Crisis Management (CIVCOM); integration of WEU functions in the field of the Petersberg missions within the EU; appointment of the Secretary General/High Representative (SG/HR) for CFSP, Mr. Javier Solana.[7]

The Brussels European Council in June 2004 adopted a new "Headline Goal" for 2010 (HG 2010). Member states committed to be ready to respond rapidly and decisively to international crisis, based on the concept of "Battlegroups", formerly proposed by France and the UK, comprising 1.500 troops, deployable in less than 10 days for a period of up to 120 days. In addition, the establishment of a civil-military cell (CivMil Cell) within the EUMS was approved.[8] HG 2010 has added new missions such as:

- ⇨ Joint disarmament operations
- ⇨ Support to third countries in combating terrorism
- ⇨ Security sector reform
- ⇨ Border control
- ⇨ Demobilisation and reintegration

[5] Presidency Conclusions, Santa Maria de Feira European Council, 19-20 June 2000.

[6] Missions such as EU NAVFOR in the Gulf of Aden, or EUMM Georgia started in 2008 have largely demonstrated the need to adjust intelligence and telecommunication capabilities to sustain the declared political objectives. In these particular cases, the geographic areas covered as well as difficulties in cooperation with local actors have stressed the need for reinforced independent space-based data collection and telecommunication capabilities. See below.

[7] The list draws on the Presidency Conclusions of the Helsinki European Council, 10-11 December 1999; Santa Maria de Feira European Council, 19-20 June 2000; and Nice European Council, 7-9 December 2000.
European Councils Presidency Conclusions 1994-2009: http://europa.eu/european-council/index_en.htm

[8] Presidency Conclusions, Brussels European Council, 17-18 June 2004.

The necessity for EU Member States to have the capacity "to act before a crisis occurs" was explicitly underlined, making the availability of the relevant information tools for political and military monitoring a clear necessity.[9]

Several key European documents have been presented since, further outlining the parameters for a European security strategy and European defence[10]: In February 2006, "Generic space needs for military operations" was issued by the Secretariat General of the Council, introducing military applications for space based systems involving communications, navigation, Earth observation, signal intelligence, and early warning activities[11]. It should be noted, however, that if space capabilities in Europe have rarely been at the forefront of security planners' considerations, unlike other space-faring nations such as the US or Russia, and although space is clearly but one sometimes non-essential element of the capabilities-chain necessary for crisis response, it remains that integration of space capabilities in the carrying out of CFSP/CSDP has been long delayed or overlooked, surely impairing the EU's very ability to act efficiently. This view was completed by the Committee for Civilian Crisis Management of the Political Security Committee which added that "future EU-led systems involving space-based assets such as GMES could provide important additional capabilities and services to support civilian crisis management operations such as for example Police, human rights and border monitoring, SSR/DDR [NB: *Security Sector Reform and Disarmament, Demobilisation and Reintegration*] and fighting organized crime". [12]

[9] Council of the European union, *Headline Goals 2010*, 17-18 June 2004, see the address: http://ue.eu.int/uedocs/cmsUpload/2010%20Headline%20Goal.pdf

[10] "A Secure Europe in a Better World", Document proposed by Javier Solana and adopted by the Heads of State and Government at the European Council, 12 December 2003, Brussels; "A Human Security Doctrine for Europe – The Barcelona Report of the Study Group on Europe Security Capabilities", presented to the EU High Representative for Common Foreign and Security Policy, 15 September 2004, Barcelona.

[11] Generic Space Systems Needs for Military Operations, Council of the European Union, 7 February 2006, (6920/06).

[12] Generic Space Systems Needs for Civilian Crisis Management Operations, Council of the European Union, 27 June 2006 (10970/06)

Shortcomings have already been outlined. In October 2006, the European Space Agency (ESA), with which the EU has entered into a Framework Agreement in 2004, published an expert report demonstrating severe lacks affecting the information-gathering process as reported by a panel of defence and security user communities[13]. In particular, needs for improvements to be brought in the field of data collection and processing, data transmission capabilities and integrated tools mixing Earth Observation, mapping, telecommunication and navigation technologies were clearly stated by both experts and users.[14] Based on lessons learned from the most recent conflicts and as documented in the report, the following technical domains have been quoted as requiring corrective actions:

- Telecommunications: insufficiently reliable, secure wide bandwidth communications. This insufficiency is considered as "undermining both the security of the personnel deployed and their efficiency";
- Earth Observation-derived imagery and mapping: insufficient "high/very high resolution regularly updated imagery which is compatible with the available ground systems"; improvement of Weather forecast capabilities for fast developing storms/ fogs is also mentioned.
- SIGINT/ELINT space capabilities: increased intelligence capabilities are required as "ground-based signal intelligence is not always sufficient."
- Tracking, Positioning Navigation, Search and Rescue capabilities: Limitations are related to possible GPS signal degradation and to an insufficient "combination of positioning and telecommunication capabilities".[15]

- **As soon as 2004, the main elements supporting the building up of space-based capabilities for military and civilian crisis management users were identified.**
- **The necessary EU dimension of key space applications such as Earth observation, telecommunication and precision timing and navigation (PNT) were recognized, while an effort to better integrate those different applications for improving the service on the ground was also demonstrated.**

1.1.2.– 2006-2008: New EU Policy and Institutional Opportunities Calling for more appropriate Space Capabilities

In light of the lessons learned from the Western Balkans police missions, and especially of the difficulties met in their planning and conduct, the Brussels European Council in December 2004 further addressed the civilian dimension of crisis management. In terms of capabilities, the Civilian Headline Goal (CHG) for 2008 established that the EU should be able to conduct monitoring missions and provide support to the EU special

[13] "European Space and Human Security Working Group Report", European Space Agency, October 2006. See also previous key documents such as: the Council Resolution of 16 November 2000 on A European Space Strategy (2000/C371/02); "*ESDP and Space*" (11616/3/04 adopted by the Council of the European Union on November 2004; *Generic Space Systems Needs for Military Operations* (6091/06) from the EU Military Committee; *Generic Space Systems Needs for Civilian Crisis Management Operations* (10970/065) from the Committee for Civilian Crisis Management;

[14] "*European Space and Human Security Working Group Report*", Quoted Report, pp. 18-24.

[15] Idem, pp. 25-29.

representatives. Activities were extended to include security sector reform (SSR), support to third countries for disarmament and terrorism. Civilian capabilities must be deployable within 30 days from the launch of an operation.[16] At the end of 2007, with the conclusion of CHG 2008, the Ministerial Civilian Capabilities Conference set the CHG for 2010, so as to take it forward in parallel with the military HG 2010, envisaging a possible conjunction of the two capability development processes.

In the same way, the CHG 2010 further addressed the necessary synergies between military and civilian aspects, hence emphasizing a stronger civil-military cooperation – as well as inter-pillar cooperation, such as EUROPOL and EUROJUST – and foreshadowing the simultaneous presence of military and civilian actors on operational theatres.[17] Such a perspective was developed not only taking into account greater operational experience, but also by recognizing that crisis management operations should not longer be necessarily carried out separately by civil or military components. In fact, the ESS foresaw as complex operations as SSR, which require each type of expertise. It is expected that the 2010 financial crisis will increasingly strain national budgets dedicated to defence, and hence fuel the calls for futher civil-military synergies, as a cost effective solution (even if politically for efficient operations.

Regarding crisis management structures *per se*, starting from an informal meeting in Hampton Court in 2005, EU leaders decided to reinforce them within the Council General Secretariat, in order to reduce the military-civilian capability gap. Indeed, the Directorate for Civilian Crisis Management (DGE IX), within the Directorate General for External Economic Relations, progressively came to play a prominent role, initially as a strategic and operational headquarter for civilian missions. Over time, DGE IX and DGE VIII competences for political-military affairs have been increasingly integrated. Moreover, in 2007, the Civilian Planning and Conduct Capability (CPCC) was instituted as a new ESDP structure in charge of the planning, deployment, conduct and assessment of missions, which then resulted entirely carried out at the EU level.[18] Today, in the wake of the Lisbon Treaty, the Crisis Management Planning Directorate (CMPD), within the European External Action Service (EEAS), is expected to pursue this civil-military synergy and coordination task.

In 2006, regarding innovations in the civilian dimension of EU external action, Michel Barnier, former French Foreign Affairs Minister, upon request of the European Commission and of the Presidency of the Council of the European Union, presented his recommendations concerning the creation of a European civil protection force. The report was written in view of reinforcing and better coordinating EU action in the field of cross-border emergencies, by pooling national and Community resources and creating a specific competence for the EU, while making better use of existing instruments such as civilian crisis-management operations in the context ESDP, the Humanitarian Aid Office (ECHO), the Community Civil Protection Mechanism, the Health Emergency Operations Facility, and satellite observation capacities such as the Global Monitoring for Environment and Security system (GMES).[19]

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[16] Presidency Conclusions, Brussels European Council, 16-17 December 2004

[17] G. Grevi, D. Helly, D. Koehane, *European Security and Defence Policy – The First 10 Years (1999-2009)*, The European Union Institute for Security Studies, Paris, 2009.

[18] *Ibidem.*

[19] *For a European Civil Protection Force: Europe Aid* – Report by Michel Barnier, May 2006

Today, these positive institutional evolutions have not been effectively translated into clear progress regarding space capabilities, mainly because multiple actors have demonstrated dedicated yet fragmented actions and capability developments. It is perhaps for this reason, that the "security" aspect of GMES has not benefited from a clear priority in the setting up of a space-based capabilities agenda. However, it remains that Europe has been perceived as facing a diversity of defence and security challenges that have primarily required dedicated, flexible and high quality information systems. This demand for better and more reactive space capabilities has been sustained over the past years. It has also been recognized that space assets can bring both a unique and a complementary contribution to these defence and security information systems.

- **The EU has built its foreign and security policy around an evolving process merging civilian and military capabilities; as ambitions and operations expand, more will need to be done to bring coherence to the EU machinery and in the planning and development of appropriate capabilities, including in space;**
- **Until 2008, a slow but steady evolution in the field of civilian and security crisis management, has clearly highlighted the need for more communal (or dual-use) space assets, i.e. serving both military and civilian security missions and needs, trend which may grow in the near future.**

http://ec.europa.eu/commission_barroso/president/pdf/rapport_barnier_en.pdf

1.2.– New EU institutional opportunities for developing and using European space capabilities

1.2.1.– European security in a changing Defence and security environment

In the wake of the terrorist attacks in New York on 9 September 2001, the EU increasingly focused on the widening of the concept of security – and therefore of threat – in an evolving strategic environment shaped by globalization, the end of cold war dynamics and asymmetric threats. Such a reflection clearly emerged in the European Council summits held following 9/11 and, especially, in the European Security Strategy (ESS) adopted in December 2003. Indeed, the June 2002 Seville European Council already called for an active role of the EU through CFSP/ESDP in countering terrorism. In particular, it was decided to further develop conflict prevention instruments; to promote globally, through relations with third countries, the fight against terrorism and proliferation of weapons of mass destruction (WMD); to expand military and civil capabilities to protect populations against the effects of terrorist attacks.[20] In light of the broadening scope and action radius of the ESDP, the Thessaloniki European Council in 2003 started considering a dedicated European security strategy, tasking SG/HR Solana to thoroughly examine the challenges facing the EU in the field of security and defence.[21] The Brussels European Council held in December 2003 adopted the ESS, "A Secure Europe in a Better World", as submitted by SG/HR Solana.[22] The document recognized that the strategic environment, since the end of the cold war and following 9/11, had profoundly changed. While war on the Old Continent could still be possible, as the Balkans conflicts demonstrated, military attacks against the EU had become less and less likely. Terrorism, WMD proliferation , regional conflicts, State failure, organised crime are now representing new threats, calling for the combination of civil and military solutions, highlighting the EU's tendency to implement "soft power" policies:

> "In contrast to the massive visible threat in the Cold War, none of the new threats is precisely military; nor can be tackled by purely military means".[23]

In a complementary manner, the White Paper "Space: a new European frontier for an expanding Union – An action plan for implementing the European Space Policy", presented by the European Commission in 2003, emphasized the strategic importance of space for a number of EU selected policies areas, in particular for CSFP/ESDP. The Paper called for a strong and integrated action among the European Space Agency (ESA), national space agencies, research centres, and industry in order to enhance European space capabilities and to address the complex challenges identified by the ESS and its implementation report.[24]

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[20] Presidency Conclusions, Seville European Council, 21-22 June 2002.

[21] Presidency Conclusions, Tessaloniki European Council, 20 June 2003.

[22] Presidency Conclusions, Brussels European Council, 16-17 December 2003.

[23] A Secure Europe in a Better World, European Security Strategy, Council of the European Union, Brussels, 12 December 2003, p.7.

[24] *Space: a new European frontier for an expanding Union – An action plan for implementing the European Space policy*, Commission White Paper, 11 November 2003. http://europa.eu/legislation_summaries/research_innovation/research_in_support_of_other_policies/i23020_en.htm

In November 2003, the ESA Council adopted the Framework Agreement endorsed by the European Union Council a month earlier, thus providing a reinforced institutional framework for enhancing space coordination. Another steppingstone signalling that the EU would set a priority towards a space policy coherent with ESDP evolutions came from the adoption by the Council of the European Union in 2004 of a document on "ESDP and Space"[25]. It underlined that several analyses of the European capabilities in the framework of the HG process had identified a number of strategic and operational needs that were yet to be met. Satisfying those necessities by using space assets was one of the main objectives of the HG 2010, which clearly referred to the development of a space policy by 2006. The document also underlined that the EU approach to crisis management takes advantage of the existing and necessary synergies between civilian and military actors, and between ESDP and Community instruments. Traditional conceptions separating external and internal security as well as military and civil security, do not longer hold in a post-Cold War world. As a result, a global space policy was expected to emphasize the same synergies between civilian and military assets in order to carry out coherent and decisive EU action.[26] In line with the Council, the European Commission thus issued a Communication on a European Space Policy (ESP) in 2007, stressing the importance of space assets for the implementation of the ESS, and thus ESDP.[27]

EU and ESA Member States, through the 4th EC-ESA Space Council, jointly and unanimously confirmed this view which ultimately led to the setting up of a "structured" dialogue" between relevant Commission services, the Secretariat General of the Council (including the European Union Satellite Centre), the European Defence Agency (EDA) and ESA for better coordinating European efforts in the development and the use of space systems, particularly in the field of security. The joint management of key space applications like Galileo, GMES or more recently the Space Situational Awareness (SSA) programme have materialized this evolution towards a better coordinated space for security and defence policy at European level. A recent conference on space and security held in 2010 under the auspices of the Spanish presidency further concluded that "the European space policy highlights the need for the European Union, ESA and their Member States to increase synergies between their security and defence space activities and programmes. The Structured Dialogue has started this process. The workshop highlighted the need to increase and expand this coordination. "[28] As reiterated in the conclusions of the Spanish Presidency of the EU "Conference on Governance of European Space Programmes", held in May 2010 in Segovia (Spain), "Governance arrangements are a tool to deliver objectives. Clarity of vision and objectives must come first."[29]

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[25] *European Space Policy: ESDP and Space*, Council of the European Union, 16 November 2006.

[26] Idem.
http://ec.europa.eu/enterprise/policies/space/documents/esp_en.htm

[27] *European Space Policy*, Communication from the Commission to the Council and the European Parliament, 26 April 2007. http://ec.europa.eu/enterprise/policies/space/documents/esp_en.htm

[28] Conference on Space and Security, Madrid, 10-11 March 2010, Conclusions of the Co-Chairs.

[29] Conference on Governance of European Space Programmes, 3-4 May, 2010, Parador de la Granja, Segovia, Spain (Conclusions of the Co-Chairs)

FOCUS

May 2010: An endorsement of European Space governance principles

"The Treaty on the Functioning of the European Union (TFUE) provides a legal basis and an explicit competence in Space for the EU. This competence, which is shared with the Member States, calls upon the EU 'to coordinate the effort needed for the exploitation and exploration of space' and to 'establish any appropriate relations with the European Space Agency'. It then consolidates the triangle of European space actors i.e. EU, ESA and their respective Member States"

(…)

" The Conference widely recognized the technical expertise of ESA in designing and procuring European Space Programmes.

(…)

Future industrial policy should allow for the development of mechanisms to enable EU-ESA cooperation in space." (…)

(Source: Conference on Governance of European Space Programmes, 3-4 May, 2010, Parador de la Granja, Segovia, Spain (Conclusions of the Co-Chairs.)

In the field of security and crisis management, such objectives have been clearly stated. An adapted governance for security related space programmes can be tackled by the EU and ESA Member States and should represent an immediate collective challenge.

- **Namely building upon the "ESDP and Space" EU Council paper and on the ESP, the use of space for security and defence has been widely accepted and supported by EU and ESA Member States.**
- **De facto, a European space for defence policy exists today, built on EU political decisions and ongoing ESA-EU practice on joint activities;**
- **A more sustainable governance framework can now be considered as the next necessary step leading to dedicated and clarified European user-driven space programmes for defence and security, including the broader concept of crisis management.**

1.2.2.– *Initial investments in Space and Security R&D projects*

The European Space Policy and the subsequent report on its implementation drove the EU to focus and invest more significantly on services and research in the field of security. In fact, Europe's intent to address security services and hence research in technologies was at the root of the creation of a Group of Personalities (GOP) in 2003, tasked by the European Commission to develop a long-term perspective in the field of security research. The GOP, composed of two Commissioners, four members of the European Parliament, industry and security experts, produced a report entitled "Research for a Secure Europe", underlining the reasons for relying on technology and security research for a more secure Europe. Elaborating on the European Security Strategy, the report recalled that the EU needs a comprehensive security strategy to address global challenges, one that combines military and civil means. Indeed, civil, security and defence applications often draw on the same technological base, favouring constructive synergies between different research domains.

Given these capabilities, national or multinational space assets have rapidly been identified as a key element for the European Security and Defence Policy[30]. In this respect, the evolution of flagship programs such as GMES and Galileo has demonstrated how much European awareness about using space for enhancing the security has been raised over the last years, with clear mandates from EU political institutions calling for the development of such programmes. In diverse institutional forums, EU Member States have constantly reaffirmed this position as underlined in documents as diverse as:

- The 4th Space Council resolution on the European Space Policy 22 May 2007;
- The 5th Space Council resolution, Taking forward the European Space Policy joint resolution, September 2008;
- The European Parliament resolution of 20 November 2008 on the European space policy: how to bring space down to earth;
- The Opinion published by the European Economic and Social Committee, Proposal for a regulation of the European parliament and of the Council on the European Earth Observation Programmes (GMES) and its Initial Operations (2011-2013), 20 January 2010.

The versatility of space applications suits the diversity of EU security challenges. Those challenges have first been formulated by the GOP report and cover the areas mentioned in its tables reproduced below:

Table 2: Examples of the link between threats, capabilities and technologies

THREAT	TERRORISM / PROLIFERATION / ORGANISED CRIME			
MISSION	BORDER CONTROL			
AREA	Airport, Land, Harbour, Coast, Waterways			
CAPABILITY	Detection	Protection	Surveillance & Monitoring	Systems inter-operability
FOCUS AREA	Persons, cargo, vehicles, ships, etc.	Persons, vehicles, installations, etc.	Open water, coastline, underwater, cargo-handling areas, port boundary, etc.	Ship-to-shore, air-land, land-land, command centre and mobile platforms, etc.
TECHNOLOGY	Sensors	Space	IT	
	Radar, laser, acoustic, thermal, infrared, active/passive, CBRN, multifunctional	Earth observation, space based communication, positioning and tracking	Microwave feed systems, comprehensive secure networks, encryption, broad band capabilities, etc.	

THREAT	TERRORISM / ORGANISED CRIME		
MISSION	PROTECTION OF CRITICAL INFRASTRUCTURE		
AREA	Electricity, IT, Oil & Gas, Transport		
CAPABILITY	Security against Cyber-attack	Secure digital communication	Protection of network hardware
FOCUS AREA	LAN (local area networks), WAN (internet infrastructure and other wide area networks)	Hardware or software based communication privacy, fidelity and reliability	Building security, infrastructure redundancy, etc.
TECHNOLOGY	Fire walling and Virus protection	Encryption and Trusted Computing	
	Hard and soft fire walling, protection against virus, Spam, Spim, Trojan, Worm, VP Networking, DDOS resistance for root- and web servers and DNS	Client/server authentication; privacy and digital signatures in e-mail; authenticating web servers and encrypting communications with a web server. data integrity: message digest or hash algorithm.	

THREAT	TERRORISM			
MISSION	DISASTER MANAGEMENT			
AREA	Conventional attack, CBRN attack, Hostage			
CAPABILITY	Protection	Detection	Deconta-mination	Systems inter-operability
FOCUS AREA	Persons, critical infrastructures, strategic assets, etc.	CBRN agents and materials, etc.	Surfaces, buildings, persons, critical infrastructures, etc.	Inter-agency-communication, response concepts, hardware Interoperability, etc.
TECHNOLOGY	Neutralizers	Sensors	IT	
	High-pressure systems, vaporizers, Filters, vaccines, etc.	Microfluidic scanners, "smart dust" scanners, etc.	Secure networks, modeling and simulation, contamination response soft- and hardware, etc.	

It is thus demonstrated that space technologies, among others, provide a clear example of dual-purpose applications, i.e. that can be used for civilian and military purposes.

[30] Report of the panel of experts on space and security, March 2005 ; see http://ec.europa.eu/enterprise/policies/space/files/article_2262.pdf

The GOP then recommended developing a Community-funded (1 billion Euros per year) European Security Research Programme (ESRP) by 2007. On the one hand, it would be complementary to existing civil Community programmes, and on the other, on security and defence research activities conducted at the national or intergovernmental level. ESRAP should exploit the duality of technological applications and the increasing overlap of security functions to fill the gap between civil and defence research. In turn, research would provide support in developing systems adapted to guarantee security in a broad sense: within the EU (territory, sovereignty, critical infrastructures, etc.) as well as abroad (peacekeeping, conflict prevention, fight against proliferation, etc.).[31]

The development of related capabilities in the following domains is mentioned to deal with those threats:

- Intelligence capabilities;
- Assessment and analysis capabilities;
- Surveillance capabilities (for maritime security, border control or critical sites protection);
- Secured communications capabilities.[32]

As further suggested by the GOP's report, the European Commission created a European Security Research Advisory Board (ESRAB) in 2005. The Board was composed by various stakeholder groups: users, industry and research organizations, with the aim of contributing to the content and implementation of the ESRP, within the Commission's seventh framework program for research and technology development (FP7, 2007-2013). Such a program encourages collaborative research of a large range of participants (universities, companies, research centres, organisations, individuals, etc.) across the EU and other partner countries, focusing on different thematic areas. The latter included space and security, a relatively new topic in the agenda of the European Commission. In fact, the Commission's sixth framework program (FP6, 2002-2006) introduced space, with its implications and prospects for security, as a research theme.[33]

To develop a security research and innovation strategy, the precondition for operational services, the European Commission established the European Security Research and Innovation Forum (ESRIF), a strategy group in the civil security domain composed of three different clusters of stakeholders: users that will apply security research results, products and systems (EU, national and regional authorities; police; fire brigades; etc.), research and technologies contributors (universities; research centres; industries; etc.), and civil society.[34]

This forum has marked the latest step in promoting the integration the most innovative R&D and technologies in European security policy. Early on, space technologies had been identified as providing unique tools for security and crisis management: A

[31] *Research for a Secure Europe*, Report of the Group of Personalities in the field of Security Research, 2004. http://www.src09.se/upload/External%20Documents/gop_en.pdf

[32] Idem.

[33] On security research and development and respective programs, see the European Commission Enterprise and Industry's web site: http://ec.europa.eu/enterprise/policies/security/index_en.htm

[34] For further details, see the European Security Research & Innovation Forum's web site: http://www.esrif.eu/

Preparatory Action in the field of Security Research (PASR) launched in 2004 by the European Commission and supported by ESRAB provided the link between space and security as perceived by European Commission services[35]. This link especially focused on selective areas identified by the GOP under the form of preliminary security oriented R&D space projects. These first projects were initiated by teams of European industry and academia supported by a PASR budget. It is the case of the "ASTRO +" project, led by EADS Astrium, dedicated to the networking of operational users for applying space technology responses to crisis situation services with realistic field demonstrations. The ultimate goal was to prepare preoperational security platform meeting the operational service needs of security, i.e:

- Access to EO data, sharing of the National and European resources in full confidentiality, long term guarantee of sustainability of sources;
- Reinforcement of the connectivity of telecommunications: communication on the move and convergence with airborne and ground infrastructures;
- Integration of the advanced features of Galileo in the platform, including in-house navigation;
- Integration of space applications within a global security System;
- Reinforcement of the associated Space Segment.

These experimental programmes have prepared R&D efforts to be later deployed in the 7th Framework Programme. They have also been key in demonstrating the limits of existing space capabilities for addressing real-life crisis situations.

> FOCUS
>
> ***New Security Challenges for Europe***
>
> *Today, **terrorism, proliferation of weapons of mass destruction, regional conflicts, and organized crime** are often perceived as key threats for Europe. Taken alone or combined, they may have severe consequences for security. They are mostly associated with **non-state actors and with weak states**, therefore less visible and assessable. Moreover, other global challenges, directly or indirectly, become more and more relevant to both internal and external action of the EU: **poverty, disease, energy dependence, competition for natural resources can be quoted**. The ESS acknowledges that facing these **multifaceted and transnational** menaces requires a **comprehensive approach**, abandoning the traditional strict separation between security and defence. Such an approach includes the use of diverse resources of the EU (i.e. aid and cooperation), the **combination of military and civilian means**, and the involvement of numerous actors, both public and private, military and civilian.*[36]
>
> *Five years on from the adoption of the document, the Brussels European Council in 2008, adopted the Report on the Implementation of the European Security Strategy, **"Providing Security in a Changing World"**, submitted by SG/HR Solana. The report updates the content of the strategy and assesses the progresses achieved since its launch, identifying additional scopes and concerns for the CFSP/ESDP: **cyber security, energy security, climate change, fight against piracy and proliferation of WMD**. Once more, among steps aimed at achieving a more coherent and decisive action, the report calls for profound synergies between military and civilian aspects of CFSP.*[37]

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[35] *Meeting the Challenge: The European Security research Agenda, A report from the European Security Advisory Board*, September 2006 (ec.europa.eu/enterprise/security/doc/esrab_report_en.pdf)

[36] *A Secure Europe in a Better World*, European Security Strategy, December 2003. http://www.consilium.europa.eu/uedocs/cmsUpload/78367.pdf

[37] *Providing Security in a Changing World*, Report on the Implementation of the European Security Strategy, December 2008. http://www.consilium.europa.eu/ueDocs/cms_Data/docs/pressdata/EN/reports/104630.pdf

A number of projects financed by the European Commission in the 6th and especially the 7th Framework Programme have been dedicated to experiments related to the use of space assets in situation of crises, involving man-made or natural disasters, or security issues dealing with border control, protection of critical infrastructures, humanitarian support or maritime surveillance.

This effort has been sustained on the basis of the initial goals and requirements, not only by the European Commission but also by ESA or by EU agencies. A first view of the rationale of these preliminary space-related efforts is summarized in the table below:

SUMMARY OF EUROPEAN UNION SECURITY AND CRISIS MANAGEMENT FRAMEWORK AND REQUIREMENTS

Domains	General political issues	Expected operational qualities	Context issues	Some relevant EU policy documents
Maritime Surveillance	- Domain favourable to an EU wide security approach - security of transports -security of goods and people -Blue Border Control - Environment Security and safety - Possible specificities of maritime illegal activity monitoring (mixing civilian and military sources)	- provide a situation awareness capability - complement non space/coastal system and interact with those systems (possibly upgrading their performance) - must demonstrate responsiveness and timeliness - must guarantee the protection of sensitive data	- Active international policies in place - Open Water surveillance as a key issue for demonstrating the use of space - must be coordinated with non space systems for a coherent approach	Bortec Report, December 2006, (FRONTEX)
Land and Infrastructure monitoring	- Wide domain with heterogeneous applications - Border Control and Critical infrastructure monitoring perceived as a top priority - Importance of taking into account the national regulations (especially for Event planning contribution) - Specificities of treaty monitoring activity (mixing civilian and military sources)	- Provide a Situation awareness capability - provide a continuous observation and related data about the use of soil, terrestrial resources and land environment (subsidence phenomena, flooding risk assessment, routes, etc.) - provide a multi-source information based on satellite imagery - interoperable with non space systems - Must be user-friendly	- For Border control, any system must take into account the 4-tier access control strategy: - Within the Member States - At the External Border - Across the External Border - In third Countries… … and their associated requirements	*Generic Space Systems needs for military/Civilian Crisis Management Operations*, Council of the European Union, 6920/06-10970/065 *A European Civil Protection Force: Europe Aid –* Report by Michel Barnier, May 2006
Human Relief and Reconstruction	- Specificities of an activity that mixes private/public, military/civilian actors	- Provide a situation awareness capability - provide a multi-mission infrastructure - Provide ready-to-use end products	- must foster a better coordination of the civil security forces - must participate to the provision of early warning indications for conflict or crisis prevention	***A European Civil Protection Force: Europe Aid –*** **Report by Michel Barnier, May 2006**

As an illustration of the link with the political framework described in the table above, the following projects funded by the EU R&D budget can be quoted as exploring the possible contribution of space systems to these initial requirements:

EXAMPLE OF EUROPEAN UNION SPACE AND SECURITY RELATED PROGRAMMES

Recent or On-going EC Funded Project	Funding Institution	Duration
Global Monitoring for Stability and Security (GMOSS)	EC FP	2004-2008
Building Operational Sustainable Services for GMES (BOSS4GMES)	EC FP6	2006-2009
Land/Sea Integrated Monitoring for European Security (LIMES)	EC FP6	2006-2010
Telecommunications Advanced Network for GMES Operations (TANGO)	EC FP6	2006-2009
GMES Services for Management of Operations, Situation Awareness and Intelligence for regional Crisis (GMOSAIC)	EC FP7	2009-2011
Services and Applications for Emergency Response (SAFER)	EC FP7	2009-2011
Link-ER	EC Preparatory Action 2008	2009-2011

These programmes have contributed to refine initial operational requirements by collecting more precise needs as well as feedbacks from reference users. While very straightforward the expectations from end-user communities are very demanding. In particular, the need for more responsive and adapted space systems remains the dominant requirement. It is clear that the ability of European institutions to field new generation space applications that fully answer those basic but stringent requirements will condition the whole legitimacy of the European efforts, including of the Europe's space policy.

To summarize these technical and operational expectations, three categories of needs emerge from these considerations.

➡ 1. The need for more accessible and responsive space systems

Responsiveness does not entirely depend on space assets themselves. These can be inefficient in some situations, or simply unnecessary. However, in complex or remote situations, space assets, within a system-of-systems architecture, can be critical. Hence, the need for highly responsive space systems and associated procedures is frequently underlined. In essence, the lack of responsiveness in a crisis situation make space assets, and hence their investments, somewhat useless. This need is usually modulated according to the different phases structuring a crisis management situation. In short, five consecutive phases can be considered for any given crisis management situation:

a. Preparedness/prevention;
b. Political/security related international consultations;
c. Crisis management and conduct of support and relief operations;
d. Reconstruction;
e. Recovery monitoring.

Phases b and c usually appear to be highly constraining in terms of responsiveness, whether in the maritime crisis situation environment, in critical infrastructures protection or humanitarian support operations. **Insufficient responsiveness is today the major blocking factor preventing end user communities from incorporating space generated products in their operational procedures during the crisis management phase**. This responsiveness is measured against the slowest reactive element of non space-related information systems usually employed by the end-users. The reactivity characterized for example by revisit time of the system (space and ground segment) as well as the freshness of the received information (the date of the information) are obviously key criteria. Beyond, the easiness and the speed for tasking and using the space system when needed is another element considered as crucial.

This is particularly true in the following situations:

- Detection and identification of pollution sources at sea;
- Detection and identification of illicit trafficking at sea involving highly mobile targets;
- Control and safety of life at sea;
- Rapidly evolving man made or natural disasters (forest fires, sudden floods, expansion of atmospheric or water pollutants for example);
- Detection and monitoring of migrating populations after a humanitarian disaster.

2. The need for more autonomy: fulfilling the European political objectives

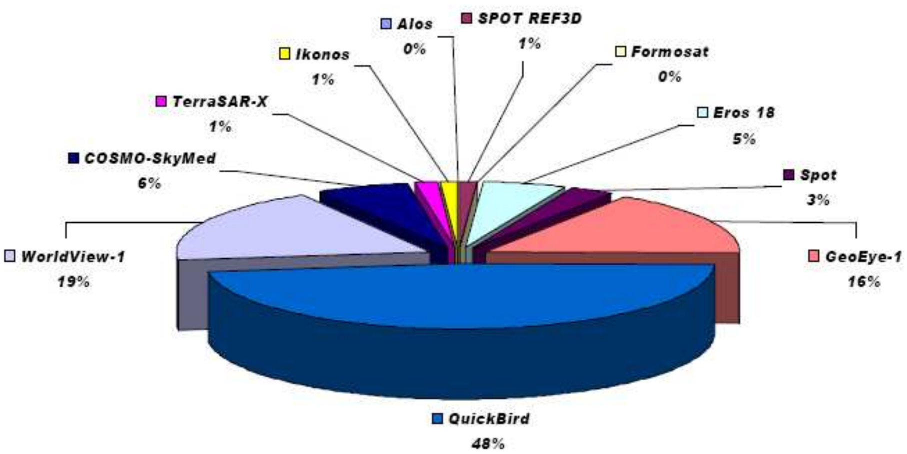
As stated in the ESP in 2007, "the development of a truly European Space Policy is a strategic choice for Europe, if it does not want to become irrelevant. Space systems are strategic assets demonstrating independence and the readiness to assume global responsibilities."[38] The determining factor for Europe to engage in the Galileo programme has in fact been this inherent and justified strategic consideration. As a consequence, any space architecture dedicated to the security of European citizens must be under European control in order to ensure the integrity and the continuity of the flow of data and information. **The risk of not having guaranteed access to crucial data where European lives or property are at stake, in political terms, is far greater than the cost of investing in autonomous capabilities.** Today, most of the monitoring and surveillance activities in the field of security are performed using a variety of space assets mixing European and non-European, public and commercial capabilities. This has been the case for a few experiments for wide area maritime surveillance or "Hot Spot" monitoring carried out with the support of private operators, whether European (in the case of satellite imagery provision for example) or non European (in the case of large area radar imagery of for Space-based AIS signal collection, provided by ORBCOMM in some instances).

This is also true in the case of the European Union Satellite Centre (EUSC), that represents today the main CSDP operational agency providing analysis of satellite imagery in relation with crisis management operations, general monitoring of areas of interest, contingency planning and non proliferation control. In 2009, EUSC has processed 116 tasks related

[38] European Space Policy, Sec.(2007), 504,505, 506, Brussels, 26, 4/2007, Com(2007), 212 Final, p. 4.

to the missions described above, using mainly commercially provided imagery. About 90% of this imagery has come from non European sources (see chart below).

SOURCES OF COMMERCIAL IMAGERY USED BY EUSC IN 2009[39]



This current situation can be questioned regarding the availability (technical and procedural) of space assets. The exact knowledge of such availability is a prerequisite for operation-planning which thus gives decision-makers full confidence in the data which must be acquired during operations. In short, whether 100% dependant on evolving commercial conditions or dependant on redirected non-European satellites, e.g. European civil protection units would not be in a position to fully rely on space systems, surely thereby reinforcing difficulties in inserting space systems in European operational procedures or degrading operational units trust in space systems.

In addition, a number of experimental projects show that space systems will be increasingly used as an element of a global system of information that may need to be protected and partially classified in some of its uses for some security missions (e.g. illicit traffic monitoring, legal cases and prosecution of e.g. human rights violations). It is today apparent that these are situations where European control over each step of the chain of information is required.

➨ 3. The need for better adapted space systems via the integration of operational and integrated services at the platform and service level

Users need integrated services which can be provided either via integrated or via isolated infrastructures, but the issue surrounding the responsive space debate today is often summarized into a rather simplistic issue of volume, rather than actual solutions. The layman would indeed argue that a fully responsive system would require multiple constellations of satellites, which are obviously unrealistic and non-cost effective solutions. In turn, this highlights the need to have an affordable and sustainable strategy for the development of the related infrastructures on which these services rely. The fact remains that in any user mode, space systems must be fully integrated allowing the furniture of ready-to-use customized products mainly based on a combination of Earth

[39] Annual report on the Activities of the European Union Satellite Center in 2009, Brussels, 21 May 2010, The Council of the European union, PESC 653, COSDP 436, p. 11.

observation, telecommunication and navigation tools provided from space. Indeed, experience has shown that such an integrated approach is the solution of choice for state-of-the-art deployable/mobile command centres and intervention units in crisis and emergency situations. It provides solutions for:

- An enhanced autonomy based on the use of a well-mastered computer environment on the field;
- A mutual understanding of the crisis situation, including real time monitoring and mutual localization of the units on the ground (comparable to the so-called Blue Force Tracking –BFT– as used in the military vocabulary) during the actual operations;
- A better mutual understanding between the different actors involved in the management of a crisis on the terrain.

Until now, such objectives have been explored at service-level only, relying on external or commercial data sources specifically tailored to user needs via adapted software. While often efficient, such service-oriented solutions cannot guarantee the user with permanent availability and with full control over the data source. In this respect, such services have been initially tested in many R&D projects (such as FP6 or FP7 projects) but can hardly transition into a fully operational delivery system.

Considering the above-mentioned criteria, accessing data, information and capacities in a fully controlled manner will logically require European-controlled space-based systems in a sufficient number for delivering the expected quality of service in terms of reactivity and performance. Such a goal is not an easy one to reach. Indeed the number of satellites required to fulfil such a goal must be minimized in order to keep such an architecture in line with budgetary and operational constraints.

One solution should thus be to explore the possibility of integrating different functions at the platform level (LEO Earth Observation and data collection functions, GEO Earth Observation and telecommunication coverage, etc.) in order to keep the development of new space-based capability needs at a minimum. High-level system integration strategies would then be required to make a European reactive and autonomous system become reality. Obviously, once consolidated, such a system configuration could then be completed by well-known existing "external" services capable of increasing the global performance of the guaranteed initial service.

These three characteristics are usually considered as prerequisites for a fully operational use of space systems by the relevant end-user communities. Improvements leading to better performances in those respective areas are described below in chapter 3.

- **Space assets are but an element of the crisis response chain of capabilities; However, space systems may be crucial in specific complex cases falling within the ESS' perview of action;**
- **When users must rely on space systems, these need to be responsive and under full European control, or run the risk of being irrelevant investments;**
- **In order to be cost-effective, services need to be operational, user-driven and integrated, calling for creative yet challenging solutions for integrated architectures.**

1.2.3.– Developing operational space programmes for refocused European security and crisis management user institutions

Finally, the Treaty of Lisbon amending the Treaty on European Union and the Treaty establishing the European Community, signed in 2007, brings some innovation to the institutional framework of ESDP. These innovations seek to prepare more forceful operational requirements regarding crisis management and space capabilities as the EU institutional architecture becomes more integrated. The EU is granted legal personality and the pillar structure is abolished (at least on paper), with the inclusion of both the CFSP/ESDP and the Judicial Cooperation in Criminal Matters (PJC) in a single framework subject to the Treaty on the Functioning of the European Union (TFEU, former Treaty Establishing the European Community). However, the unanimity rule remains in place when taking decisions.[40] The Lisbon Treaty then introduces a set of specific "Provisions on the Common Security and Defence Policy" (CSDP), which refers to ESDP.[41] In addition, the role of the High Representative of the Union for Foreign Affairs and Security Policy (former SG/HR) is considerably strengthened. In fact, he is responsible for both CFSP and CSDP, contributing directly with proposals to the development of EU action in these policy areas. Moreover, he/she is supposed to preside over the Foreign Affairs Council and to cover the role of Vice-President of the European Commission, thereby guaranteeing overall institutional EU coherence. Finally, but particularly relevant to this analysis, the Petersberg missions are considerably extended as suggested by the European Security Strategy of 2003, presented below.[42]

Regarding CFSP, the legal personality conferred by the Lisbon Treaty enables the EU to take legal actions including those in the area of the CFSP, meaning that these are presumed actions of the EU and not of the Member States:

> "The Union may conclude an agreement with one or more third countries or international organisations where the Treaties so provide or where the conclusion of an agreement is necessary in order to achieve, within the framework of the Union's policies, one of the objectives referred to in the Treaties, or is provided for in legally binding Union act or is likely to affect common rules or alter their scope."[43]

The establishment of the EEAS is key in the setting of a coherent EU's external relations policy, and will be the HR's support service, overarching in areas previously divided between the Commission and General Secretariat of the EU Council. In particular, it has been explicitly mentioned that the EEAS "should play a leading role in the strategic decision-making"[44]. The scope of the EEAS is conceived as allowing "the High Representative to fully carry out his/her mandate as defined in the Treaty."[45] In the

[40] Treaty of Lisbon amending the Treaty on European Union and the Treaty establishing the European Community, art. 31 and art. 38. http://europa.eu/lisbon_treaty/full_text/index_en.htm

[41] *Ibidem*, art. 42-46

[42] *Ibidem*, art. 43. These tasks include joint disarmament operations, military advice and assistance tasks, conflict prevention and post-conflict stabilization; they can contribute to the fight against terrorism, including by supporting third countries countering such threat.

[43] Art. 216(1) of the TFEU.

[44] Council of the EU, "Presidency Report to the European Council on the European External Action Service", Brussels, October 23, 2009, 14930/09.

[45] Idem.

framework of the new CSDP, the CMPD, a Civilian Planning and Conduct Capability (CPCC) and the military staff (EUMS) are expected to be part of the EEAS. It should also be noted that the EUMS has developed a liaison officer at the UN HQ in New York (since December 2008) – which has brought essential coordination of communication together – extremely timely for both the EUFOR Chad/RCA and EUNAVFOR Somalia missions. The CMPD, CPCC and EUMS will be attached directly to the HR. The Situation Centre (SitCen) – the Member States Intelligence sharing hub – shall also be part of the service, as will the elements of the Commission Crisis Response and Peace-building unit.

- **By reinforcing its policy and operational entities, the EU has sowed the seeds for improved action and ambitions, including in operations or capability planning and development.**
- **Those institutional weaknesses being progressively remedied, the EU is now in a position to seize unprecedented opportunities for transitioning worded policies into action**

1.3.– *Organising Space for Security*

1.3.1.– *National, bilateral, multilateral satellite systems: steps forward*

Historically, France has been the first country in Europe to launch autonomous space tools for its defence needs, as space telecommunications and intelligence were considered necessary to support French nuclear capabilities: telecommunication satellites as well as earth observation (EO) satellites were developed to provide a national autonomy in the management of the strategic deterrence. Today, increased military observation capabilities in terms of performance and flexibility with the introduction of the new Helios-2 have been corresponding to new military and intelligence needs. The extensive use of telecommunications for French military forces worldwide has also been supported by the Syracuse-3 satellites series, introducing higher transmission volumes and data rates. The increasing overlapping between civil and military competences in ESDP implementation and especially the growing cooperation between defence and non-defence actors in crisis management led other European countries to create **dual-use** EO space programs. Italy has signed in 2004 a contract to provide a four-EO satellite constellation, called COSMO SkyMed. This constellation has been conceived as a dual-use civilian and military program. Because it has been funded by both the Ministry of Research and the Ministry of Defence, it therefore provides EO services for both communities. It is important to underline that COSMO SkyMed has been defined to provide services to public users, from military to civilian, for security missions and to the enhancement of security.[46] The dual-use concept, actively promoted by Italian authorities, is providing a solution to the blurring of CSDP missions, typically crisis management and the new operations identified by the ESS (i.e. SSR and support to third countries for disarmament and terrorism).

[46] COSMO SkyMed overview. http://www.asi.it/it/attivita/osservazione_terra/cosmoskymed

The example of COSMO SkyMed illustrates interesting trends and highlights a transformation of the defence function, which accepts, for some systems, to define a more open multi-user system. As such, the program is not isolated: it has been developed within the ORFEO French-Italian bilateral agreement signed in 2001 in Turin, which called for an integrated cooperation between Italian COSMO SkyMed and French Pléiades EO satellite constellations.

Pléiades optical satellites will be launched between 2010 and 2011.[47] Pléiades is a Centre National d'Etudes Spatiales (CNES) program funded through the Ministry of Research, but it is defined and budgeted as a dual use security and defence program. The Pléiades program stems for an essential evolution of French space policy, as a dual use asset, with partial commercial exploitation, which takes into consideration the new defence and security needs.

Also on the satellite communication side, the expanding military needs in terms of data transmission capabilities have pushed European countries to develop telecommunication satellite systems (French Syracuse, Italian Sicral), to define service contracts (UK Skynet 5) or, at occasions, to buy commercial telecommunications capabilities.

The multilateralization of some dual-use space systems, like those established by French, Italian and German bilateral agreements based on the exchange of capabilities, i.e. outside a multilateral or EU-coordinated framework, signalled the need to shape a **more European system** in order to solve the problem of national ownership and return on investment, but also the implementation of objectives provided for by the same Member States in the EU Treaties. In this sense, the European Commission plays a key role through its "flagship" initiatives. In recent years, as important and diverse EU documents demonstrated, space has come to represent a high profile policy for the EU, yet inheriting a complex and divided environment characterized by strong national influences and initiatives (even within multilateral organisations as ESA). In fact, the tight cooperation between the European Commission and ESA, within the framework agreement concluded in 2003 has allowed taking forward a coherent space policy. Such cooperation made possible the development of the **Global Navigation Satellite System GALILEO** and the **Global Monitoring for Environment and Security** program (GMES). The former, already envisaged in the 1990s, was officially launched in 2001 and, following an initial troubled phase, was reorganized in 2008. GALILEO is a multi-application system, designed to provide the EU with an **autonomous positioning and time synchronization capability** for civil and military purposes.[48]

Differently, GMES aims to provide an **independent European EO capacity** to deliver services in the **environmental and security fields**.[49] The 2001 GMES action plan emphasized the potential contribution of a network of systems for ESDP, also referring to emerging needs for crisis management. From the beginning the "S" of GMES described the setting up of services in order to empower EU security missions. This analysis shows similarities with the Italian and French dual-use space policy mentioned earlier. The idea behind GMES is that of the coordination of existing capabilities, along

[47] Programme 193: Recherche Spatiale.
http://www.minefi.gouv.fr/lolf/downloads/501_operateurs_recherche_spatiale.pdf

[48] GALILEO Homepage, European Space Agency. http://www.esa.int/esaNA/GGGMX650NDC_galileo_0.html

[49] GMES Homepage. http://www.gmes.info/

with development of new assets (the Sentinel satellites). Since 2001, GALILEO and GMES have considerably progressed and benefited from EU funding through FP7. Starting from 2008, four pre-operational services have been launched (land monitoring, marine, atmospheric composition and emergency response). However, today, both climate change and security services seem to require further definition before entering the pre-operational phase. These differences in the path of implementation show the difficulties to gather an EU security community able to empower a common monitoring network of systems. The European Union "flagship" programs GALILEO and GMES clearly indicate the awareness of the importance of a space policy for Europe. GALILEO and GMES constitute a service oriented approach, as they launch future services combining positioning and monitoring. Those capabilities also correspond to the need for a comprehensive approach to complex challenges and missions.

It must be noted that these different capabilities compose a very diverse landscape of space systems with a variety of operational arrangements and exploitation frameworks. In particular, put together, those systems cover a wide range of public and/org commercially exploited assets with respective advantages and limitations.

Regarding the three criteria mentioned above, i.e. the necessity for a greater reactivity, for a better integration and for a fully guaranteed European access, the following issues can be raised:

➨ With regard to responsiveness, while fully nationally owned asset may provide a good reactivity, their complement with other assets, possibly commercial, may make sense as it increases *a priori* the number of space systems available. However, it must be reminded that:

  ⇨ Nationally owned assets may not imply a greater availability for the European users in cases of emergency and crisis management;

  ⇨ Commercially owned assets may not be fully available, considering the relative importance of other "customers" with traditional programming difficulties when colliding with other "customer orders". in addition to a "shutter control" obstacle, commercially-owned means cannot fully guaranteed availability when needed.

➨ With regard to better integration, it can equally be noted that current limitations are based on segmented customer-basis for national systems as well as on insufficient commercial base for emergency related missions on the commercial side. Again here, the current public-private balance of space assets does not fully reflect the need for more integrated space systems dedicated to the range of European crisis management missions. Regarding European missions, whether EU or ESA-led, their internal institutional and financial divisions have led to influence-proof programme elaborations, hence playing against creative yet necessary integration opportunities.

➨ With regard to the necessity of a full European control and autonomy, any commercially owned or operated space system cannot fully guarantee that this ownership of operating level will remain controlled by European actors for ever. Although commercial ownership is always a suitable option, political decision-makers, through appropriate data policies, must however make sure that the operator will treat public needs in priority and fully abide by stringent confidentiality standards. In addition, the notion of data control and integrity must be raised as many security and crisis management users regularly insist on the reliability of the data for their missions. Again, only a fully institutionally controlled asset can guarantee a complete reliability of the data, whether at the collection, the processing or the dissemination level. From this standpoint, any commercially-owned asset should rather be viewed as a possible means for *completing* an already existing European controlled capability without substituting to it.

- **The evolution of European space activities, mostly national from the onset, are progressively taking a more multilateral perspective, via ESA and now via the EU and the Lisbon Treaty's opportunities;**
- **Although ESA and EU Member States still have their space competences, the case of security is specific insofar as efforts are still very much national, or undertaken in nonESA and non-EU cooperation frameworks;**
- **Current budgetary and capability challenges in implementing the new European ambitions in CSDP will however require greater Europeanization of space for security programmes: current space for security governance remains in its infancy and ambitious political decisions must be made by EU Member States to further build Europe's crisis response capabilities.**

2.– Implementing European space for security ambitions

The existence of European domains of excellence possibly contributing to effective crisis management architectures can be counted among the most obvious returns from the aforementioned projects and experiments.

2.1.– A European know-how for Cooperative information

Besides a proven technical competence in space and ground systems, Europe has clearly demonstrated its know-how and its capability to handle complex data and information in national and shared processing and exploitation chains. Historically, this ability has already been experienced in most stringent cases where EU Member States have put in common resources for security and defence.

2.1.1.– The defence and security experience

A first example has been the case for information coming from Electro-optical and Radar satellites (namely Helios and SAR-Lupe) which data can be exchanged between the different Member States involved in these projects. While French Helios has remained a protected military asset with an initially heavily centralized information system, a first slight evolution showing the need for an enlarged distribution has been noted with the entry into service of the second satellite Helios 1-B in 1999.

As mentioned earlier, such an evolution has been linked to increased uses by operational chains of command for military operations and planning phases. A later development has extended the main centres in Europe with installations in Belgium and in Germany. Some 15 distant "cells" have also been directly implemented in operational locations enabling the users to get links to those cells functioning as "mini-centres". These changes brought from one generation to the other can be summarized as offering the possibility of tasking orders directly from the distant cells and to exploit the produced data in the operational centres. Paving the way for more distributive concepts, and based on Common Operational Requirements established by 6 European countries, these evolutions have naturally translated into more cooperative concepts presiding over exchanges between Helios and the German military SAR satellites, SAR-Lupe. It has also helped innovate for the new dual-use system Pleiades-Cosmo based on EO and SAR satellites respectively built by France and Italy.

While the Common Operational Requirements document (BOC) has been a first step to harmonize on-going national programmes as much as possible, the 6 countries (plus Sweden as an observer country) have decided to deepen this cooperative endeavour by engaging in a collective definition of the future generation of observation satellites. The future system, called MUSIS (Multinational Space-BaSed Imaging System for Surveillance, reconnaissance and observation) aims to answer the whole range of data collection requirements, from the political decision making support to the military operation support. Such an architecture would benefit from the diversity of the technologies and of the orbits used by the different national components with the main following mission categories:

- ⇨ Intelligence and targeting;

- ⇨ Improvement of the detection of activity indicators on limited zones of specific interest;
- ⇨ Improvement of all-weather day/night revisit capabilities with an increased reactivity as seen from military users;
- ⇨ Improvement of environmental data production.

In this respect, MUSIS is to cover a wide range of data collection techniques, allowing a better collective use of these data through much improved imagery access and exchange procedures set up between the partnering States. It is worth noting that **increased needs for timely and flexible space information has constituted one of the main drivers for intensified exchanges and cooperation**. It must also be noted that capacity exchanges in the field of telecommunication satellites has also become a European standard in the most demanding situations. Some examples of cooperative information mechanisms applied to European space systems are recalled in the table below:

FOCUS

Existing or in-project cooperative space mechanisms in Defense and Security in Europe

- Germany and France have agreed to exchange services provided by Helios (optical EO) and SAR-Lupe (radar EO) in order to obtain information independently of weather conditions on a 7/24 basis.
- Spain, Belgium, Italy and Greece participate directly to Helios program with 2,5% quota each.
- In addition to NATO, the German Defence Ministry has leased the equivalent of two SHF transponders on Syracuse 3A for five years while waiting for its two Satcom Bw military telecommunications satellites to become operational. The Belgian Defence Ministry also has leased a small amount of capacity, leaving French forces with just 45% of Syracuse 3A for their own use.
- The Helios Partners have engaged into the project of a Multinational Space based imaging System (MUSIS) program with Helios partners (Belgium, France, Germany, Greece, Italy and Spain, ,) aimed to provide initial architecture studies for a multinational observation system for security and defence purposes.
- An Inter Governmental agreement between France and Italy was formally established by the two heads of Government on the 29 January 2001. This so-called "Torino Agreement" aims at establishing a dual system comprising an optical component under the leadership of France (the Pléiades programme component) and a radar component with 4 satellites and the dedicated ground segment under the leadership of Italy (the Cosmo-Skymed programme component). The Inter-Governmental Agreement highlights the dual-use character of the programme, implying the definition of principles for adequate resource[50] sharing, imagery ownership and diffusion[51] officially creating a cooperative effort named ORFEO (standing for Optical and Radar Federated Earth Observation). The general management of the Agreement is ensured by a Steering Group composed of French and Italian Representatives.

[50] The notion of "resource" being defined in term of satellite tasking.

[51] *The Pleiades Optical High Resolution Program*, IAC-06-B1.1.04, IAF Congress, Valencia, Spain, October 2006.

- **Although GMES is today the key and determining European space for crisis response initiative, existing national or multinational programmes show how much States perceive the sustained need for space systems with performances usually higher than what is currently envisioned for GMES capabilities.**
- **Considered from a more European point of view, building upon European programmes such as GMES, augmenting European capabilities for more demanding missions would contribute to narrow this enduring gap and build a more efficient European space architecture (EU and national) for the efficient delivery of the CSDP.**

2.1.2.– Organising the "S" of GMES on a cooperative basis: some recent advances

As pointed out in a previous table, several ongoing security-oriented space projects, financed by the 6th and 7th Framework Programmes, aim at integrating fully cooperative information systems for ensuring better efficiency (at experimental level only). Among these:

➡ **LIMES (Land and Sea Integrated Monitoring for Environment and Security)**

LIMES tackles cross-border issues and relies on a European of multilateral institutional framework, trying to reinforce European information capabilities to better protect Europe against the effects of disruptive events (such as humanitarian crisis, hostile maritime transport or attack, emerging and threatening networks).

The LIMES team has been investigating several areas of interest to the ESS:

- ⇨ Organization and distribution of humanitarian aid & reconstruction.
- ⇨ Surveillance of EU borders (land and sea).
- ⇨ Surveillance and protection of maritime transport for sensitive cargo.
- ⇨ Monitoring of critical infrastructures and sensitive natural and industrial locations.
- ⇨ Protection against emerging security threats (e.g. terrorism, illegal trafficking, and proliferation of WMDs).

The LIMES service development has chosen to concentrate on three "clusters" (i.e. Maritime surveillance, Land and Critical Infrastructure Monitoring and Humanitarian relief and reconstruction), to be then tackled in specific issues:

- ⇨ Maritime Surveillance
- ⇨ Open-water surveillance
- ⇨ Sensitive Cargo Surveillance
- ⇨ Costal surveillance
- ⇨ Area surveillance outside the EU
- ⇨ Land and Infrastructure Surveillance
- ⇨ Land Border Monitoring

- Critical Infrastructure Monitoring
- Treaties Monitoring
- Event Planning
- Humanitarian Relief and Reconstruction
- Population and Resource Monitoring
- Humanitarian Crisis Operational Support
- Reconstruction Support

It must be noted that among the objectives of this project, some address:

- The building up of documentary databases and accessible services (infrastructures, etc.) on the theatre.
- The homogenisation of data exploitation at the European level.
- The possibility of a wide dissemination of open resources to all while retaining the possibility of sharing classified data between authorized entities only.

Several experiments conducted in 2008 and 2009 have been using existing space and ground segment resources in Europe demonstrating the possibility to build future operational cooperative information systems capable of improving the quality of the services produced for security purposes.

G-MOSAIC (GMES services for Management of Operations, Situation Awareness and Intelligence for regional Crises)

Within the context of GMES Initiative, the G-MOSAIC FP-7 Collaborative Project aims at identifying and developing demo and pre-operational products, methodologies and pilot services that can be applied to early warning and crisis prevention as well as to crisis management and rapid interventions in hot spots around the world. It aims at identifying and developing products, methodologies and pilot services for the provision of geo-spatial information in support to EU external relations policies and at contributing to define and demonstrate the sustainability of GMES global security services. G-MOSAIC brings together industrial operators, public sector research, and academia and gathers the main players of GMES Security services in Europe.

The project has been first activated on January 14th by the United Nations in order to produce geo-spatial products in rush mode to assist relief efforts in Haiti. Satellite imagery acquired immediately after the disaster were processed by G-MOSAIC rapid mapping partners in rush mode and the first geo-spatial information delivered to users on January 16th.

G-MOSAIC is intended to develop services for security to:

- Support Intelligence & Early Warning, with the objective of deploying and validating those information services which contribute to the analysis of the causes leading to regional crises, such as weapons proliferation, fight for natural resources, population pressure, land degradation, and illegal activities. One important aspect will be the development of crisis indicators.

- Support Crisis Management Operations, with the objective of deploying and validating those information services which contribute to support the planning for EU intervention during crises, the EU intervention itself and citizen repatriation during crises, the post-crisis management, reconstruction & resilience.

TANGO (Telecommunications Advanced Networks for GMES Operations)

The objectives of TANGO, a three-year European Commission programme, have been to, integrate, demonstrate and promote new satellite telecom services dedicated to GMES (Global Monitoring for Environment & Security) requirements. The project gathers 24 research and industrial partners and aims at developing and providing operational telecommunication solutions to the immediate GMES services needs, and at preparing the definition of optimized satellite telecom infrastructures to expand future GMES services.

The programme has been focusing on:

- Improving the service area through the dissemination of GMES applications wherever it is needed; reach communities with no other non-space solutions – for instance over oceans or following a natural disaster – deployment of *ad-hoc* networking for crisis management
- Improving the reactivity and freshness of the data through faster scene and *in-situ* data collection; speeding up the transfer of data expected as these prototypes services become operational and allow higher volumes to be processed;
- TANGO implements a bottom up approach to identify the requirements for telecommunication services that are not met for the delivery of GMES services. The consortium structure enables privileged cross links with key GMES projects addressing all GMES themes.

TANGO demonstrations has been mainly contributing to two European Commission identified fast tracks (the marine and emergency response core services) through the integration of satellite telecommunication solutions with on-going GMES developments in the framework of security and crisis management, fisheries management, maritime surveillance and humanitarian aid.

Other FP 6 and 7 projects such as RESPOND, SAFER or LinKER could also be quoted as investigating the specific contribution of space systems for crisis or emergency situations. All this is paving the way for a more reactive architecture and shows that there is no blocking issue in fielding such architecture in Europe. Issues related to governance and data policy are now a work in progress in several security related fields (mainly dual-use) and illustrates the relative mature state of such architectures. In this respect **Europe has now reached the point where it can capitalize on this extensive experience** accumulated over the years and recently highlighted in brand new collective security space projects.

However strong **limitations** subsist:

- First, those capabilities remain severely limited regarding the minimal performances expected in crisis management situations. This issue will be further addressed below.
- Second, it must be pointed out that efforts produced for GMES-related R&D projects are now depending on existing federated (and sometimes commercial) capabilities that provide necessary data for those pre-operational programmes. In this respect, it must be made clear that none of these R&D projects have been envisioned as fully operational programmes, but rather as test-beds for demonstrating and better understanding the potential role of satellites in security operations.

FOCUS

Some limitations in the exploitation of space systems for crisis management operations in 2010

It must be recalled that today most of the existing projects have an experimental character that severely limits their real exploitation by professional users, a limitation linked to the sustainability of the proposed approaches. For example, in the case of LIMES, acquisition of pre-planned imagery have been necessary to implement a one-month maritime surveillance demonstration in the Caribbean during the Summer 2009. This material was composed by imagery produced by electro-optical and radar satellites such as SPOT-5, Formosat, Envisat, TerraSar-X ordered a few months in advance. In the same vein, most of the high resolution imagery used in FP related projects is based on the extensive use of non European systems (such as Worldview, Geoeye, both owned by U.S. companies in this case) as no such system currently exist in the European toolbox. This example clearly shows the limits of existing capabilities that both cannot guarantee instant availability and require mid-term advance planning.

But intrinsic response limitations to existing capabilities can also be stressed apart from such experimental projects. For example, in the case of the Xynthia storm which hit France in Spring 2010, limited airborne sensors were available at that time for use by the civil protection as they were grounded, obviously, due to bad weather conditions. Space systems have appeared, in theory, as a logical alternative to deal with such conditions. However, no data and imagery has been available before 6 full days. Insufficient number and revisit time of European space-based SAR assets (e.g. notably TerraSAR-X) did not allow the users to be informed of the situation in a meaningful time.

2.1.3.– Effective EU capabilities for security

A.– Navigation and Security

Navigation satellites represent the only global system providing users with metric-class positioning and time synchronisation capabilities wherever on the globe. Recent military conflicts as well as day-to-day security or rescue operations have demonstrated how much such systems are used in modern security organisations, especially providing a higher precision and improving coordination and tempo of any operation conducted at sea, in the air or on the ground.

In addition to precise navigation and localisation, such systems also provide a highly precise time reference which is to become a standard in a number of distributed information systems, for communication, energy distribution, banking, etc. Indeed, one condition of the efficiency of these systems lies in a full integration of the generated data in the global telecommunication architecture.

Possibly by 2014, following a joint EU/ESA initiative, Europe will manage a new Global Navigation Satellite System (GNSS), called Galileo[52]. This system will consist in a constellation of 30 satellites providing users equipped with the proper receivers the possibility of knowing with extreme accuracy their position as well as having access to advanced navigation services.[53]

Currently, European users, including defence, use the only available GNSS system: the American Global Positioning System (GPS). GPS provides two different services, an open one for all users and a restricted one (GPS-M) dedicated to US forces and their allies. GPS has been developed according to US Department of Defence requirements and the ultimate control of the GPS system is in the hand of the US Security Council; it is explicitly foreseen that GPS services can be disrupted by US authorities according to specific security situations.

Despite its widely known and publicly acknowledged civilian character, the European Galileo GNSS system has intrinsic security implications and uses. Possible hostile uses of the positioning signal must be expected and should be avoided by a strict control on access by the supervisory authorities, thus allowing disruption and distortion of service where and when needed. Moreover, the Galileo "Public Regulated Signal" (PRS) can be compared to the GPS-M signal, the military-only precise and jam-resistant service provided by the US for its military and to the closest allies. Therefore, the use of the PRS signal by military and security forces cannot be excluded. The optimal configuration would be a dual-capable PRS and GPS-M system, thus incrementing precision and availability and maximum asymmetrical potential use (which implies negation of Galileo signals and access by potential adversaries).

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[52] For precisions see Giovanni Gasparini and Gustal Lindström, *The Galileo satellite system and its security implications*, EU-ISS occasional papers, n°44, Paris, April 2003.

[53] Due to the multi-signal capacity, Galileo can provide different services. In fact, different services and different related data protection (open, encrypted, classified data) are ensured by the different signals and carrier frequency.

Open services (OS) a basic level dedicated to consumer applications and general-interest navigation. Services are provided for free and still guarantee a high-level performance.

Safety of Life (SoL) Service highly stringent service for users where safety of life is critical. The information is provided as integrity data for the navigation data given in the open service. The data could probably contain digital signature (authentication) to ensure the users on the origin of the information (Galileo satellites). There is also the possibility of encrypting the integrity information.

Commercial Services (CS) restricted-access service level for commercial and professional applications requiring superior performance to generate added-value. The service is subject to fee and provided by using ad hoc encrypted signals.

Public Regulated Services (PRS) is a restricted service for governmental applications that provides classified information.

Search and Rescue (SAR) it consist with the participation of Galileo to a wider program (COSPAS-SARSAT) to assist SAR activities by providing data to the international community for free (not encrypted).

B.– Satellite communications for security

Military and security communities are increasingly relying on commercial systems to provide larger bandwidth necessary for complex security systems. For example, it is now well-known that roughly 80% of the satellite telecommunication needs of the United States during the second Iraqi conflict has been satisfied by the use of leased commercial satellite channels. Current so called Milsatcom architectures are mainly conceived as comprising two levels of services:

- The "general purpose service" is destined to ensure non protected military communications (routine communications, day-to-day support or personnel communications) that can be transited through reasonably reliable and guaranteed commercial service. Nowadays, international organisations like Intelsat can be considered as principal operators for the U.S. military. These services are usually provided as support in the SHF portion of the spectrum allowing a reasonably wide band for large volumes of transmissions.
- The "hardcore service" deals with highly protected military transmission. For this reason, it is observed that higher frequencies (in the EHF region) are used as they simultaneously provide more capability with enhanced security and robustness for the users. The complexity in mastering the related technologies makes these hardly accessible and non viable for any developing commercial business. Robust SHF capabilities are also available to answer core military needs.[54]

In Europe, only a few countries have developed EHF capabilities. It must be noted that two of these countries, namely France and the United Kingdom, are nuclear countries and as such must ensure the most secure communications.

At national level, France, Germany, Italy, Spain and the UK have developed national space capacities, although the nature and the scale of these efforts have differed. Historically, the United-Kingdom uses the Skynet system (managed under special conditions by the private firm *Paradigm*), a constellation of three dedicated satellites with worldwide coverage for the British armed forces. Technically, this Skynet family has formed the backbone of the NATO Satcom effort with the NATO Satcom series. In August 1998, the British government decided to develop Skynet V, a new generation of military telecommunication satellites, under a so-called "Private Finance Initiative" (PFI), whereby the system is fully dedicated to national authorities in times of crisis, but the managing commercial entity is allowed to commercialize the capability surplus the rest of the time (see Paradigm/Skynet approach description below).

The French armed forces have first used the civilian satellite platform, Telecom-2, carrying military transponders. UK and France first signed an agreement in 1995 to extend the coverage of their systems and to lend each other their capabilities in case of a defect in one or the other. France signed other agreements of this kind with NATO in 2000 and Spain in 2001.

Dependence on a civilian system has required the French Ministry of Defence to pay for capabilities even when they were not needed. This extra cost, and new requirements for

[54] For example, a total of 600 stations are envisioned to be in service in 2014 for French core military use. Complementary needs are covered by commercial agreements with ASTEC-S and INMARSAT capabilities. In the future, the Ka band could be used to extend these latest capabilities.

higher data rates and more robust telecommunications, has prompted French military authorities to opt for a new military dedicated system. This military-only programme, Syracuse III, consists of two satellites, one launched in 2005 to ensure service continuity, and the other launched in 2006 to ensure full coverage. A third satellite is planned by 2010.[55]

Italy, with its satellite SICRAL-1 also has some limited capacities. It must be noted that SICRAL-1 is designed for a 10-year lifetime (until 2011) and can also operate in the EHF broadcast frequencies. A second model, SICRAL-1 B (3 UHF transponders, 5 SHF transponders and 1 EHF transponder) is to complement the first SICRAL satellite with a lifetime until 2019. A new generation satellite, SICRAL-2 would be operational starting from 2011.

In March 2006, Spain has launched its own dedicated telecommunication military satellite, Spainsat, developed by the US firm Loral, and operated by the Spanish ministry of defence in the SHF bands (with a small capacity – 1 transponder – in the EHF band). It must be noticed that the contract with Loral implied the construction and the launch of a second Spainsat-class satellite as a possible back-up capacity. This second satellite, XTAR-Europe is operated by the Spanish operator Hisdesat in collaboration with Loral, today providing extra capacities to US and Spanish authorities (and other possible customers). This arrangement follows the Paradigm model already mentioned for the United Kingdom.

Finally, in October 2009, Germany has launched the first model of two SatcomBw satellites with an operational life of about 15 years. Signed in July 2006 with EADS Astrium as prime contractor, the contract is managed by Milsat Service GmbH, a joint venture established for this purpose by EADS Astrium (74,9%) and ND-Satcom (25,1%), a subsidiary of the commercial satellite broadcasting firm, SES ASTRA. Milsat Service GmbH will have the German Ministry of Defence as its direct customer, also providing the German military with commercial transmissions, for example by using Intelsat satellites when possible.

These NATO-compatible satellites will provide sufficient capabilities for transmitting a range of communications, from telephone calls to multimedia connections. To this end, these satellites carry both UHF and SHF transponders.

Two types of terminals will be available:

- ⇨ Large terminals with all telecommunication possibilities serving as node for local on-theatre communications and for installing fixed data networks.
- ⇨ Smaller portable terminals are also able to use broadband services such as video and internet access. These terminals will be delivered in large numbers.

Milsat GmbH delivers the terminal, an extension of anchor stations in Germany and a new central network management and facility.

The French, Italian and British capabilities, pooled together, have been chosen by NATO to provide a first so-called "Satcom Post-2000" architecture for SHF communications.

[55] The current operational service contract envisions the maintenance of 18 secure (anti-jamming transponders) until 2018.

Again, the multiplication of national capabilities has ended up with a credible collective resource, giving birth to both a European and a NATO resource.

C.– Other existing EU space capabilities for extended security missions

➡ Early Warning Demonstration programme

One particular application of Earth observation consists in the surveillance of ballistic missile capabilities and early warning associated functions. This activity relies on infrared optical observation, usually placed on a geostationary orbit (or on very elliptic orbits) and calibrated for the monitoring of the thermal emission produced by the ballistic missile's engines. Thanks to the localisation of the thermal emission, the space system allows the identification of the missile launching site and, possibly, its trajectory and its final expected impact zone. Such a system can contribute to the protection of targeted populations and can also provide intelligence regarding the proliferation of WMDs.

In Europe, no such operational monitoring and early warning system exists today. However, a exploratory activity has been started by France in 2004 under the form of a 124 million Euro Ministry of Defence demonstrator programme called "Spirale" and awarded to EADS Astrium SAS as the prime integrator, and Alcatel Alenia Space as the payload developer. This programme includes the conception and the development of the space segment which is composed of 2 micro-satellites (120 kg-class on an elliptic orbit). The primary mission of these micro-satellites is to collect terrestrial backgrounds in infrared mode and test the ability to detect missile signatures in selected bandwidth. In addition the demonstrator comprises a specifically developed ground segment.

➡ ELINT perspectives

Electronic intelligence capabilities are contributing to the global intelligence performance with specific uses regarding military activities, during mission planning phases or during operations. ELINT systems can be terrestrial, sea, air or spaceborne. In this field, the French government has decided to finance a space demonstrator called ESSAIM composed of 4 micro-satellites (120 kg-Myriade platform family – see above) flying in controlled formation allowing for frequent revisit time. Launched in 2004, this programme developed by EADS Astrium is maintained by CNES and is transmitting its data to the *Direction générale de l'armement*'s (DGA) weapons electronic centre located near Rennes. One of the missions of the programme is a better characterisation and mapping of the terrestrial electromagnetic environment in the military communications domain.

Another demonstrator, ELISA (ELInt SAtellite) is scheduled for launch in 2010. This DGA programme awarded to the French firms EADS Astrium and Thales will consist in developing 4 micro-satellites (ESSAIM class) operating on a sun-synchronous orbit with the objective of identifying radar emitters worldwide. This experiment should start in 2010 for a 3-year experiment in orbit.

While requiring a strict control of the dissemination of the data due to their "intelligence" content, technical as well as industrial cooperation in the ELINT/SIGINT domain is not perceived as presenting fundamental differences with the cooperation under the MUSIS model. Such cooperation has been recently mentioned by France as a possible MUSIS framework.[56]

2.1.4.– Synergies status

As discussed earlier in this Research Paper, while several European documents and agreements have already been endorsed to enhance synergies in space,[57] the necessity remains of defining the basic principles of a realistic European architecture for security and crisis management.

Manoeuvring room exists today to make cooperative schemes evolve in a decisive manner. Past experiences with multinational cooperative projects (illustrated by the Helios programme for example) have shown that, at least in the case of monitoring activities, a large part of the data requested nationally were indeed of mutual interest and that those requests could be shared for a better optimised use of satellite and ground segment resources. New arrangements should then be found to better organize at least part of this activity for military and security purposes. Beyond this step, on-going projects (such as the Franco-Italian Pléiades-Cosmo programme) or architectural studies (such as MUSIS) show a promising way forward, with advanced cooperation structures organized early-on, even before the actual definition of the space systems. It should be emphasized that such projects already consolidate respective national responsibilities and competences (by organizing in the case of MUSIS the breakdown between the different national parties for the future imagery and the radar capability conceptual studies).

Concerning the sole military domain, based on these experiences, any progress will be evolutionary rather than revolutionary given the still limited number of European States involved in these efforts to date, and considering the still complex political issues attached to the sharing of sometimes sensitive information and data. However, recently expressed national political readiness to deepen the cooperation for former very sensitive domains, such as high level precision imagery or even some ELINT capabilities,[58] can give new impetus for a more integrated space and ground segment architecture.

On a more optimistic note, it is clear that technological advances, both in the observation and in the telecommunication fields, render the use of dual systems or services for civilian and military constituencies increasingly appealing. Surely some technical differences will remain to satisfy specific military needs. But it is widely recognized that technological advances have made dual-use technologies more ready to answer a large part of the security and the military needs.

In the field of security space applications, synergies have largely relied on cooperative efforts building on first bilateral return of experience (Helios 2-SAR Lupe, Pleiades Cosmo in particular) to transition from still nationally-based systems to more cooperative

[56] See "Let us make more space for our defence...", French Ministry of Defence, February 2007, already cited above, p. 23.

[57] It can be reminded that the Headline Goals, the European Space Policy as well as the 4th and 5th Joint ESA-EC Space Councils decisions or the new institutional developments included in the Lisbon Treaty framework have all in common to actively support those evolutions.

[58] Idem, pp. 22-23.

and integrated space and ground segments. A first step has consisted in extending those architectures by increasing common satellite tasking procedures as well as common exploitation of the imagery. This could ultimately lead to an enlarged interoperability capability as far as the ground segment is concerned. Such European integrated space-based systems could also fully benefit from existing high performance non-military systems.

This "step by step" approach may appear a balanced way forward that may benefit from reflections that have already been engaged for future systems at horizon 2015-2020. Such an evolution would obviously directly benefit from innovative uses of European dual-use satellite highlighted in many R&D GMES related projects and those that remain to be developed.

Similarly, it is clear that a European telecommunication military in-orbit infrastructure could be seen as a combination of existing models and innovative ones fulfilling security requirements. It could be composed by:

- several national satellite systems ("hard core" usage, national control);
- a set of large European satellites ("shared" usage), developed in cooperation, using generic design and flexible mission, based on a common requirements set shared between the nations through existing multilateral mechanisms;
- commercial satellites providing the European telecommunication system with additional bandwidth.

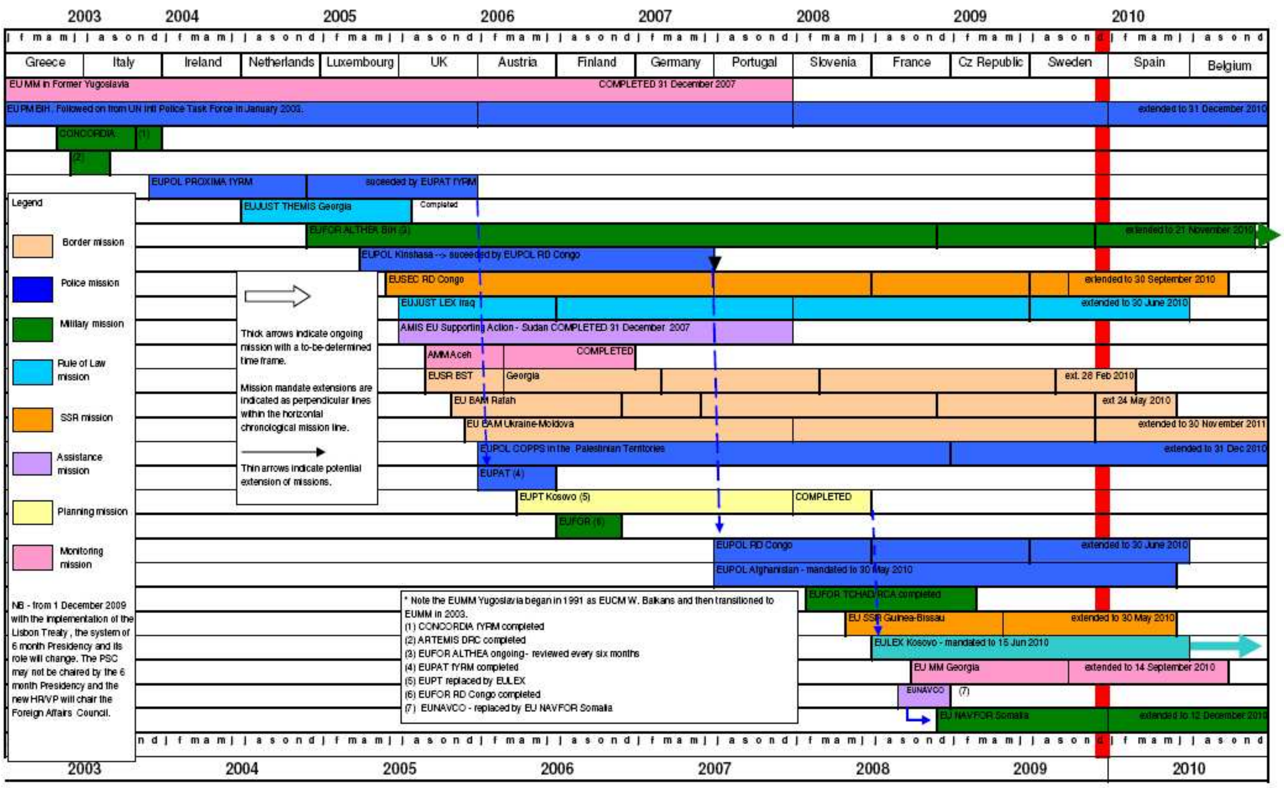
In any case, any of these options would benefit from the institutional advances brought by the new terms of the Lisbon treaty that may facilitate the involvement of European Union defence and security authorities in the management of security related programmes (such as GMES) and data. This past experience in collaborative space defence and security schemes, as well as on-going attempt to federate some defence-oriented national assets at European level provide a sound basis for the development of genuine European Earth observation, telecommunication and navigation assets, under the form of more integrated programmes with European security objectives.

- **It is clear that on-going parallel efforts for improved synergies have intensified both at Member State, EU and ESA levels. However, while politically legitimate, such dual-use systems raise many governance issues related to the control of such systems, to their associated data policy (at national or European, military or civilian levels). Today, only the EU (European Commission with the EEAS) would have the authority, capacity and ability to carry out further synergies, in turn reinforcing its CSDP ambitions.**
- **It must be noted that any data policy associated to dual-use space systems raise the issue of the nature of the sensors (national/European, civilian/military) as well as the nature of the collected, processed and disseminated data.**
- **Producing a fully shared set of data policy rules will be a prerequisite for any security and crisis management oriented space programme beyond GMES.**
- **These issues will be solved by involving all the key institutional actors (i.e. the EU, ESA and their associated Member States) at the governance and data policy conception stage. In this respect, the opportunities offered by the Space Clause in Article 189 of the Lisbon Treaty is a formidable opportunity which Member States may decide to seize.**

3.– Capitalizing on the European experience: lessons learned

3.1.– An already large experience in EU Security crisis response missions

The European Union has already gained extensive experience related to several types of crises faced since the early 2000s. The scheme below provides a summary of the main missions conducted by EU forces:



As of December 2009, a total of 14 CSDP and EU missions are in an active status among which six in the Western Balkans, Caucasus and Eastern Europe, three in the Middle East, one in Central Asia and four in Africa.

Region	Military	Military Coordination Support	Civil Police	Civil Rule of Law	Civil-Military SSR	Civil Border	Civilian Monitoring	Planning
Africa	EU NAVFOR (Somalia)		EUPOL RD (Congo)		EUSEC RD (Congo) EUSSR (Guinea-Bissau)			
Balkans/Caucasus/ East Europe	EUFOR Althea		EUPM BiH EULEX Kosovo			EUSR BST (Georgia) EUBAM Ukraine/ Moldova	EUMM (Georgia)	
Asia			EUPOL Afghanistan					
Middle East			EUPOL COPPS (Palestine)			EU BAM (Rafah)		

With 13 EU missions already completed, the list above demonstrates the wide-ranging type of monitoring and support missions achieved by EU forces in a variety of geographical situations. These missions have ranged from maritime surveillance missions (EU NAVFOR) to monitoring missions (EUMM Georgia) to be implemented in possible non-cooperative contexts. A few examples can be examined to illustrate the increased EU needs in terms of information capability and reactivity:

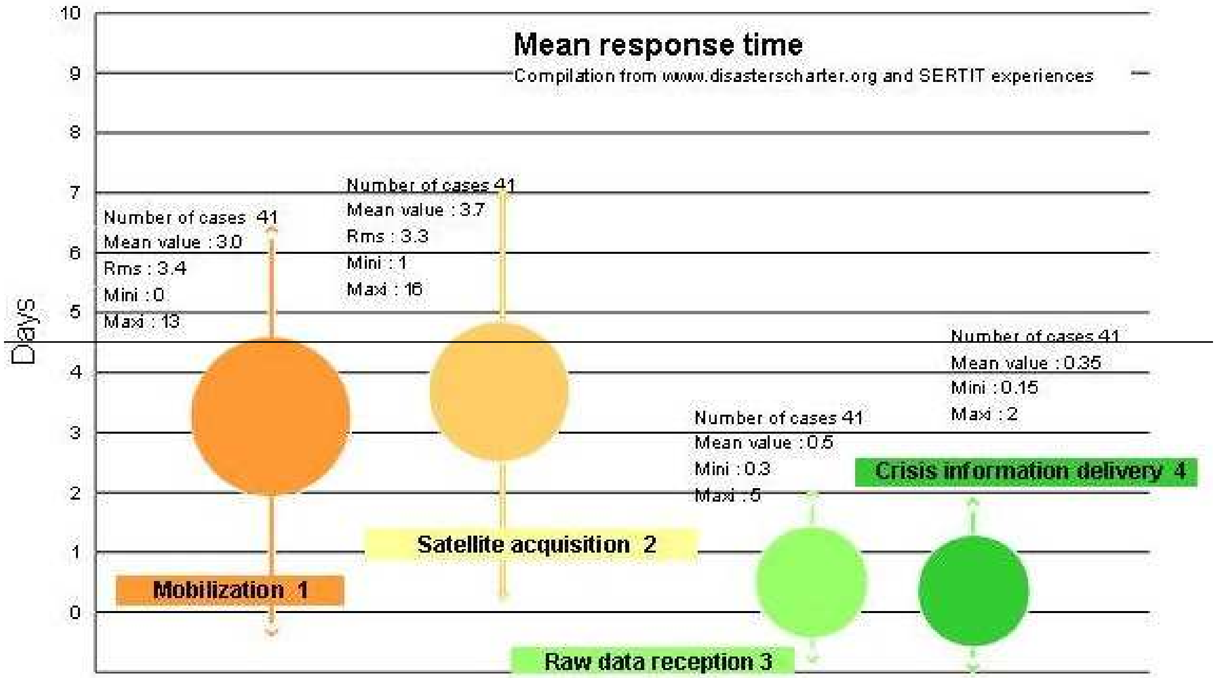
EU NAVFOR Somalia (Atalanta): This EU mission continues to escort ships of the World Food Program, and has to date allowed the provision of 300 000 tons of food to Somalia. Through the establishment of the Maritime Security Centre (MSC), the EU mission provides protection to merchant ships. The MSC website allows commercial vessels to register to the programme and receive information on pirate activity and the MSC helps to coordinate the escort service to these ships which is provided by Atalanta. While around 30% of the commercial ships do not register to MSC yet, then unable to benefit from the escort service provided by the EU, some attacks have been reported at 1000 nautical miles of the coast and underline that pirates have significantly extended their area of operation. This extension proves to be a challenge both in terms of covered areas as well as for organizing any timely response at sea. For such a mission, coverage, revisit time and certified timing of information clearly appear as key elements for success.

EUMM Georgia: Following the outbreak of violence between Georgia and Russia on 7 August 2008, the EU Monitoring Mission (EUMM) was established to monitor the implementation of the 12 August and 8 September 2008 ceasefire agreements. The mission was deemed a success because it successfully managed to stabilize the situation. EUMM was also praised for its speedy deployment. However, the mission faced practical capability challenges which hindered its capacity to fulfill its mandate successfully. Currently the mission has to deal with an extremely complex situation. Since Russia has recognized the independence of the breakaway region, the Kremlin denies the access of the mission to South Ossetia and Abkhazia. The litigious dimension of the six point agreement is the definition of the territory of Georgia. To counter the lack of accessibility, Ambassador Haven, the Head of Mission of EUMM, has called for Unmanned Aerial Vehicles (UAVs) to be used to monitor the breakaway region by air. As the mission cannot implement its mandate in the separatist regions, its role of confidence builder is thereby hindered, but the most alarming feature is that the mission remains unable to investigate the Georgian claims of ethnic cleansing in South Ossetia. In this instance, the availability of high performance and reactive reconnaissance satellites partially or completely replace unused air capabilities and provide independent information to EU authorities.

3.2.– *The challenge of satellite products acquisition and exploitation*

Confronted with recent climate or catastrophic events, several European users have criticized the relative difficulty in obtaining meaningfully reactive products from space for crisis management operations. This difficulty was already mentioned in the case of the storm that hit France early 2010. Typically, in the best case scenario, an order of magnitude of one day between the ordering of an image and its reception on end-user display terminals must be considered today as a “good” performance. In the case of the earthquake that occurred in L’Aquila, Italy, in 2009, the first SAR image (Cosmo-Skymed) was requested by the Italian Civil Protection less than 3 and a half hours after the event and the image was actually “acquired” 14 hours later. This timeframe does not include the processing and dissemination procedure that must be added to the timeframe. While users are requiring increasingly reactive and complete space-based information systems (with cycles of a maximum of three hours in some instances), including the data acquisition itself, but also their processing and their dissemination to the final end-user, current performances clearly don’t match these expectations.

In reality, such satellite data dissemination usually takes several days. A recent study showed that, in the case of the activation of the International “Space and major disaster” Charter, the satellite acquisition phase, the reception of data flowing from receiving stations and their delivery to the project manager accounted for the most time-consuming phase, then creating incompressible delays in responding to emergency situations. This phase includes the validation of the received data by the project manager and archiving or possibly new requests by the project manager. The average time for this phase to be completed is between 3 and 4 days, mainly due to the acquisition time itself. It must be noted here that this acquisition procedure heavily depends on the nature of the requested space capabilities (single satellite or constellation), on the sensor type (optical or radar with an obvious impact from the weather conditions), on the satellite revisit time, on the capability of rescheduling, on the means of acquisition in terms of recording capacity, direct access, memory emptying, receiving stations (number and geographical location). A minimum duration time for this phase has been one full day, while 16 days have sometimes been recorded as a maximum.



Source: TANGO project, D2.1-1, "Synthesis of requirements for Integration of telecommunication services in Risk & Crisis management Platforms", 2007 (http://www.teladnetgo.eu/index.php?option=com_remository&Itemid=28&func=startdown&id=104)

3.3.– Main limitations highlighted in some GMES related experiments

GMES is the EU's second flagship programme, and in several ways is a comprehensive answer to many challenges raised in the ESP, giving Europe the capabilities in needs to tackle several key challenges, including its security. Its complexity and novelty, however, are elements that have called for adequate and pragmatic handing by the European Commission. In turn, GMES is becoming perhaps the central component of an EU capability to tackle crisis management. It is thus a centre piece for any evolution of space for security policy in Europe.

The challenges facing the making operational the use of space assets for crisis management and emergency support are addressed by R&D projects under the umbrella of the GMES programme and of the Framework Programmes for Research and Development. As indicated above, different projects have been exploring the way to render the provision of space products more efficient in situations of crises, whether these situations address unintentional or intentional threats or disasters. Mainly, such projects consider three thematic areas of investigation: industrial or natural disaster management (involving the management of critical infrastructures); Humanitarian disasters involving the use of space systems for support, relief and reconstruction; and maritime surveillance involving safety and security-related issues.

These projects have been based on experiments conducted in reference to operational scenarios developed with actual user communities, with implications on real operations as often as possible.

3.3.1.– Flexibility and integration to be developed

Satellite-based services must be organised in a complementary fashion with other contributing resources, especially for monitoring, detecting and identification phases. Satellite services dedicated to maritime security must benefit from other tools ensuring, for example, prior surveillance on terrestrial zones of interest as these may show preliminary signs of threats at sea. Experimental tools already allow integrating several data sources: e.g. systems on board (VTS) and the AIS system; coastal radars (operated by the Coast Guards or Navies when the ship is close to the coast) and satellite imagery. The integration of those tools provides a clear added-value, whereas satellite imagery provides information of potential threats when the two previous sources of information are not available (i.e. in case of not cooperative ship presence and in case of shipping off).

However it is crucial that satellite services provide enough technical and operational flexibility to allow such a complementarity/interoperability. In short, experimental systems have delivered a fully "recognized maritime picture" every 48 hours to Navy headquarters on selected wide area. This delay remains linked to the limited number of available satellites.

3.3.2.– Sensor Performances and diversity to be improved

Current R&D projects organized under the Framework Programme umbrella have shown that the performance of space systems available for European crisis management do not fully match the needs. Obviously, limited image resolution remains a pre-requisite for any efficient use of space-based systems in any given situation. Recent EU experiments have brought out serious shortcomings in the use of space systems:

- In the case of maritime surveillance the determination of a minimum size of the vessels and limits about the nature of detectable vessels by SAR radars, combined with a pirate's way of acting (an obvious difficulty is to distinguish pirates from other small vessels like fishing vessels for example) makes the very high resolution as well as multi-sensor use a highly required improvement. It has been observed that the same challenge is identified for Search and Rescue operators that need to identify small vessels that may have to be rescued. **Recent technical demonstrations have shown recurring difficulties to detect ships less than 30 meters long with available space systems on an operational basis.** In the field of maritime surveillance, this makes such systems more interesting for the survey of wide and non-crowded areas, allowing the orientation of dedicated non-space surveillance means. It appears from current experimental projects that this area could largely benefit from improved space-based sensor performances.
- **Users involved in the prevention of industrial and critical infrastructures related disasters (pipe-line and sensitive installations monitoring) frequently cite increased resolution as a first rank requirement as assessed against commonly available performances**.

Additionally, several experiments have shown that optical and radar sensors mainly complete each other, with a frequent inability of optical sensors to deliver the requested information due to frequent clouds over the observed areas (e.g. over tropical maritime zones). The performance of SAR sensors, while not affected by atmospheric weather condition remain depended by sea conditions when used in maritime surveillance related activities. It is now recognized that a sea conditions above 4 does prevent current SAR sensors to produce exploitable results.

This must lead to the development of a larger number of space-based sensors, both electro-optical (with high performance value for small ship detection for example) and more dedicated high performance SAR sensors (for day-night and all weather conditions).

3.3.3.– Better space systems reactivity needed to ensure that a frequent and fresh information is delivered to the user

While space assets are usually appreciated for their persistence and their capacity to repeat the collection of information over time, more tactical-oriented users indicate needs for better revisit as well as for better reactivity of the space-based information chain. In many instances related to land and critical infrastructure monitoring for security as explored in R&D projects, it has been noted that two images a day (which represent the average product ratio attainable via existing European space-based systems) is not enough to support a response action (especially, but not only, in case of fire), even if it can be very useful for preparedness and recovery actions, as well as for the monitoring of events lasting more than one day.

The revisit of current space-based systems has also been regularly questioned, for example in relation to maritime surveillance experiments which demonstrate that two images a day is usually not enough, especially when vessels are approaching coasts. The possibility of benefiting from a reactive access to a space resource is also requested in some instances. **For sensitive maritime surveillance areas, recent experiments have shown an average reactivity of 36 hours needed to modify the spotted areas[59]. It is widely recognized that new possibilities should be given to the users so they can program selected satellites in an emergency mode, i.e. in delays better than 36 hours**. Such a capacity is perceived as possibly satisfying requirements linked to actual security operations conducted at sea or on the ground. In particular, such reactivity would match the progresses that have been demonstrated in recent experiments to improve the freshness of the information (i.e. the age of the information when it is delivered to the users). In some instances documented in LIMES[60], some users have had at their disposal information collected by satellites within a maximum of two hours. These performances have thus been demonstrated in experimental conditions but remain to be consolidated on an operational basis by better adapted and more reactive space systems (some 30 minutes picture "freshness" have often been quoted as an operational requirement for maritime safety and security).

For users, decisive improvements would rely on increasing the number of satellites as well as decreasing picture refresh time[61]. Innovative solutions should be pursued including the development of an increased responsive launch and orbital segment based on the reactive launch of smaller high-performance satellites. Better phased low earth orbit constellations would also mark a definitive improvement in optimizing the use of space platforms by providing a better time response as compared with existing non-

[59] See LIMES project recommendations at http://www.fp6-limes.eu/index.php?page=custom&page_id=133

[60] Idem.

[61] Idem.

phased and disparate capabilities. Other solutions should consider the development of more integrated platforms performing complete functions in coherence with defined security missions.

In other cases, land border users also stress the issue of the frequency of the updating of the data regarding environmental conditions. This aspect is considered an important condition to make such services operationally useful. In this instance, the speeding up of the process of the information remains a major requirement for improvement. This addresses in particular the processing chain that remains to slow for the associated operational needs.

In cases linked to crisis management, improvement of telecommunications and data transmissions with positioning of the different intervention teams remains a constant requirement. **At this stage, the possibility of using space-based services is mostly considered from the "strategic" point of view**, possibly within Crisis Analysis Units such as the one existing in the EU Border Control Agency FRONTEX, in order for example to assess level of borders permeability and vulnerability.

3.3.4.– Better merging of space systems and space-based information with other existing info-structures

Satellite images are not considered a tool replacing existing technologies; the best value can be achieved by merging EO images with other available information, completing and improving the result. This issue was raised in several experiments. For example, the limit of EO images in the land border case is the impossibility to monitor covered areas, e.g. forests and lakes, where parts of the borders run. This fact highlights once again the importance for EO images to be merged with (and not replace) others sources of information.

The key issue of mixing space and non space sources is commonly raised for the whole range of sea or land crisis management missions.

- **Current priorities in EU funded projects, e.g. within the EU-led GMES flagship, have signalled Europe's clear willingness to develop capabilities for operational crisis response; these experiments have however been marred by some shortcomings, as emphasized by users.**
- **A long-term strategy, in line with the objectives of the ESS and requirements of security operations must be elaborated, with consideration to the progressive integration of services and infrastructures, and stronger national/European an civil/military synergies.**

4.– Seizing opportunities to improve the implementation of the european security strategy (ess)

4.1.– Areas for improvements

This rapid overview of the actual use in Europe of existing or planned space systems in support of crisis management and security offers a contrasted picture: It shows an increasing understanding of the role of space systems, in complement of non space systems, in crisis management and security situations. The catastrophic natural events that took place over the last years, including the earthquake in Haiti in 2010, have demonstrated the EU's reactivity in providing useful information collected by space systems to its own forces or its allies. In particular two European Union R&D projects, SAFER and G-MOSAIC have been able to produce and deliver information elaborated within days following those events. A constant analysis of the user needs has offered ever better-focused information to the international organizations involved in local relief and support. However, these progresses, as well as an increasing number of projects dealing with the organization and the use of space systems for crisis management also allow for a better understanding of the remaining weaknesses of the existing capacities:

- **Insufficient reactivity in highly dynamic situations**: on average, pace systems clearly remain used as complementary means and can only match the challenge of responsiveness of highly dynamic catastrophic events with difficulty. Most of the recent experiments have shown the insufficient number of satellites to guarantee a seamless and reactive use of space capabilities on the ground. While some experiments have shown that the users can, in the best conditions, benefit from a space data one hour or less once it has been collected in space (i.e. the age of information), they have also shown that a low number of space systems did not allow the users to benefit from fresh information on an operational basis.
- **Questionable availability for European users**: the use of space capabilities remains essentially linked to their real-time availability that cannot be guaranteed today due to the diversity of sources (in some instances commercial or non European). Users thus cannot always benefit from priorities in the programming and in the use of these capabilities. While international mechanisms like the International charter for major disasters have illustrated progresses made in the coordination of space organisations and operators, their activation and actual use are affected by structural delays that can hardly match immediate needs.
- **Enduring compartmentalization of space systems and operating organisations:** Most of the recent experiments have demonstrated existing needs for better integrated space applications supported by customized and user-friendly tools. In particular, the ability to provide users with space based imagery or informed cartography in conjunction with localization and navigation capabilities supported by fully autonomous satellite display and communicating portable devices has become key to consolidate the actual role of space systems on the ground. To support such services, an affordable approach for the building of integrated space infrastructures must be developed.

4.2.– Way forward

For Europe, facing these issues will represent a critical challenge if it wants to increase the security of the European citizen and its ability to respond in an efficient manner to crisis situations, in the territory of the European Union or worldwide. Ever increasing needs for security and safety whether related to natural or man-made disasters or to maritime safety and security issues that have become a shared responsibility on the international scene (such as the monitoring and use of satellite date in the prosecution of human rights or war crimes), present the opportunity for Europe to take benefit from one of its domains of excellence by improving its space capabilities and their use by the relevant communities.

In relation with the main weaknesses noted above, increased efforts may have to be made in the following areas:

- **Increasing of the number of European high-performance and integrated multimission space platforms** in order to match new needs from users confronted to highly dynamic and large-scale situations. This implies keeping an active development policy of high-performance space systems in the field of electro-optical and radar platforms with capabilities matching the requirements for reactivity (availability and fast programming/re-programming capability by the user), for revisit and coverage (allowing the spotting of any area in a few hours, especially at sea, and linked to the number of platforms available), and for resolution (allowing the detection and the identification of small vessels or capable of good precision in difficult weather conditions – i.e. high-resolution SAR radar).
- **Rethinking the whole space architecture allowing a better reactivity of the different space components**, in particular via a better use of space telecommunication and new relay capabilities.
- **Ensuring European control over the data used in crisis situations:** the capacity to keep Europe in control of a core space capability related to crisis management remains a pre-requisite for guaranteeing the availability of those capabilities to stakeholders involved in support, relief and security operations. This minimal level of core space capacities must be assessed in relation with the evolving needs of the users as explored in the most recent European experiments. This analysis must constitute a reference for the next space capability goals in the context of an international cooperation.
- **Ensuring a better integration of space capabilities to deliver products to the user:** Recent European R&D space projects (e.g. ASTRO+, LIMES, G-MOSAIC) have paved the way for better integrated space techniques allowing the user to benefit of instant combined information displayed "on the move" on portable devices. These user-oriented capabilities remain to be fully developed in an operational manner, obviously implying the full deployment in Europe of key elements such as Galileo or improved telecommunication and relay platforms in addition to necessary new Earth observation platforms. It also requires the involvement of a diversity of actors and operators to coordinate the availability of such different systems, possibly leading to new governance schemes to fully "operationalize" those techniques.

These issues can be tackled by now reinforced European Union institutions. Because such efforts have to deal with technical issues and improvements as much as with political choices and orientations (as implied for example by the European autonomy criteria, by the involvement of national and EU stakeholders and by the short to mid-term improvement of the security of the European citizen), a collaborative scheme at European level should be put in place following the main principles below:

- Firstly, **it is crucial that such orientations are validated by the political institutions of the European Union**, starting with the European Parliament that is expected to gain a key role in the management of the ESP, as well as the EEAS. A legislative endorsement of the need for a more responsive space system chain to be used in case of crisis and emergencies would set a new political horizon both for EU users and systems providers. The European Commission would lead and implement these high level guidelines through the European Space Policy that will fix the programmatic roadmap in the different space and ground segments considered for improvements or change.
- Secondly, **these orientations should be refined and stabilized by giving a prominent role to the European users**, via for example the new EEAS, that would be used as a coordinating framework for security and emergency users. Providing harmonized operational requirements in the main domains covered by the EEAS remains a pre-requisite that will clarify European expectations and transform them into “reference operational guidelines”. Obviously, the EEAS would also act as the main user coordinator at EU level.
- Thirdly, **the European Space Agency should act as the main space technology provider and as the prime space system architect**, as it naturally derives from the current institutional balance, in compliance with the reference framework provided by the European Space Policy.

These institutional arrangements would provide the necessary mid-term stability allowing the development of a complex set of space systems that will compose, if well balanced and modelled, the first existing comprehensive crisis management space system of systems in the world, confirming Europe’s dedication to the use of space assets for human security.