



Space for Defence

A European Vision

Report presented by the working group of the Space and Defence Committees
of the Académie Nationale de l'Air et de l'Espace
and by the "Space-Defence" workshop of the International Commission
of Association Aéronautique et Astronautique de France

Faced with the political, economic and social challenges of the 21st century, the European Union, now enlarged to 25 member states, must access to the dimension of a first class world power. The availability of an autonomous European capacity to intervene for peacekeeping or peace enforcement, for the fight against terrorism, will allow Europe to ensure the economic and social development that it aspires to.

By sharing their analyses of threats and by developing a collective strategy that they can implement without political constraints or procurement limitations, the member states of the European Union must support technical innovation and support their industrial production. Some very visible programmes have already demonstrated European industry's technical competence and its commercial strength

Some European countries already acknowledge the strategic character of space, for military and for political, economical and industrial reasons. However, this view is not equally shared by all member states in Europe. It is therefore necessary for all members of the Union to invest in space systems and to define a common vision in the medium and long term, leading to the deployment of operational capabilities. To this effect, it is important to not only develop the necessary assets, but to share them and operate them jointly.

Thanks to their discretion, their efficiency and their generic capability, Space systems contribute more and more to the monitoring of situations, including ballistic missiles threats, to peace keeping operations and to tactical support for military operations.

Up until now, the discrepancy of space assets between the United States and Europe is so large that a dialogue across the Atlantic and their respective contributions within NATO are not properly balanced.

A strengthening of technology research and the deployment of space assets adapted to requirements, supporting an active and independent foreign policy, will reinforce the Alliance and consolidate European sovereignty.

To this effect, the European space infrastructure needs to be reinforced, as shown with the Galileo satellite navigation programme, and access to space, thanks to the Ariane programme and to the European launch base in French Guiana, must remain independent.

The proposed plans by certain nations to deploy offensive weapons in space could lead Europe to reinforce protection of its space systems.

The development of space applications to defence is a must for Europe. This report, drawn up by the Space and Defence committees of the Académie Nationale de l'Air et de l'Espace (National Air and Space Academy) and by the Space and Defence working group of the international commission of the Association Aéronautique et Astronautique de France (French Society for Aeronautics and Astronautics) describes why and suggests some principles for the construction of a space infrastructure serving the European Union member states and their citizens.

Executive Summary

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Europe, now grown to include 25 members and more than 450 million inhabitants strong, with a significant scientific, technological, industrial and cultural heritage, should now provide itself with the attributes of a major world power.

In order to satisfy its Common Foreign and Security Policy (CFSP), in particular the so-called Petersburg missions, Europe should have the means at its disposal that will allow it to intervene efficiently to maintain or re-establish peace, autonomously or in the NATO framework, or perhaps within international alliances, notably with the United States. The European Union should have the means that will permit it to satisfy the Helsinki (1999) objectives to “develop an autonomous capability to decide, and when NATO as such is not involved, to launch and conduct military operations under the direction of the European Union in response to international crises. Since then, in the proposed Constitutional Treaty, the presentation of the missions of the European Union has become broader and more precise, notably to include “all missions which contribute to the fight against terrorism, including the support given to third party States to combat terrorism on their territory.”

In addition, at the European Council meeting in Thessalonica in June 2003, the heads of state and of governments asked the High Representative in charge of the CFSP, Mr Javier Solana, to take the fight against terrorism and risks of proliferation of weapons of mass destruction into account in the framework of the definition of a security strategy. As a consequence the contribution that space can bring to the surveillance and the protection against proliferation is incorporated within this dossier.

In the domain of security and defence, Europe should be able to dialogue in the position of a major partner with the powers of the planet, first among them the United States, but also the other great nations: Russia, China, Japan, and the other emerging powers.

To attain these objectives, a European intervention force must be formed, relying on standardized weapon systems and communication networks which meet operational requirements, and are

available without procurement limitations. To do this, member states should be able to share the same analysis of risks that might threaten peace in the European Union and at its frontiers. They should converge towards a common desire to obtain an autonomous capability, guaranteeing the implementation of their strategy without obstacles of a political nature. It is particularly up to those countries that possess the most effective means of defence to show the way to cooperate, and to place their financial, technical and industrial resources in common. The signature of a Letter of Intent in July 2000 between 6 countries (France, Germany, Great Britain, Italy, Spain and Sweden) is a first sign along these lines. Three other countries should join them, proving that the approach can be successful at the European level. The ECAP (European Capability Action Plan) exercise, which has identified a first level of space assets necessary, and the creation of a European Defence Agency, which should be completely operational by 2005, are so many steps to improve and harmonize decisions, programmes and assets between the Union’s member countries.

The existence of NATO is still justified, even if, so often, the United States demonstrates its determination for world domination in a unipolar vision. This ambition is hardly compatible with Europe’s more multipolar vision, and its desire to be master of its own destiny through economic and social development, by maintaining the peace, and when necessary, pacifying certain conflict zones. Joint interventions within the framework of the European Union should be supported by interoperable weapon systems. A Single European command structure, inter-ally and inter-army, for military operations would only be conceivable if the assets provided by the member states are more in balance that they are today.

This report, dedicated to the analysis of the contribution of space systems to defence capabilities, is deliberately placed in a European context. It doesn’t take into account, therefore, strictly national aspects of security and defence, which still preoccupy a certain number of European countries.



1 Introduction

While the construction of European Defence has been given a new impetus with the proposed European constitutional treaty, and although the European Defence Agency was officially created on July 12, 2004, the contribution of space to European Security and Defence Policy (ESDP) of the European Union should be taken into account in reflections on future European space policy. It was discussed in the White Paper on Space adopted by the Commission in November 2003. After its publication, the Commission set up a High Level Space Policy Group in mid 2004. It is composed of experts representing the Member States who provide orientation and recommendations in view of drawing up a "European space programme" for the end of 2005. At the same time, an ad hoc group of experts on questions of security (SPASEC) undertook a study of requirements for space systems for security. The report from this group's work was published in March 2005. Space has been recognised by the Council of the European Union as a domain of major interest, indispensable to economic and social development, and to the needs for Security and defence missions. (See document 11616/2/04, Rev 2 "ESDP and Space" adopted by the Council in November 2004).

In the United States, the Administration has announced its determination for "Space Dominance", and has mobilized means with no common measure to those of the sum of the other countries on the planet. Presently, some two hundred American military satellites are revolving around the Earth. In addition, six major programmes for satellite constellations devoted to communications, reconnaissance, anti-missile early warning, electronic intelligence, meteorology, and navigation are currently in the development phase, representing an investment of more than \$50 billion. Even more worrisome, some research work has already begun, which seems to indicate that the United States could decide to place offensive military devices in orbit. Russia, China, and India have strongly reacted, and officially announced objections to a new arms escalation. We must stress, however, that no political decision to proceed with such a deployment has been taken.

Confronted by the hegemonic attitude, Europe globally has very limited means. It is not in a position to talk as an equal. Autonomy of resources that an active and independent diplomacy entails, is only partially valid for those few countries that have agreed to invest in the use of secured

observation and communication satellites: France, Great Britain, mainly, and Germany, Italy and Spain, which are now carrying out their own programmes. The other countries with the exception of Belgium and Greece, little inclined to participate, limit themselves to "American goodwill", under NATO's umbrella.

This situation can evolve in time. A new equilibrium in terms of assets aiming at a "balanced cooperation" assumes none the less that a major financial effort be granted by European Union countries, all of them if possible, and that the participants be associated in the exploitation of the satellite assets set in place. The strengthening of autonomous European capabilities goes along with a strengthening of the Alliance globally, and a guarantee of more efficient military and industrial partnerships, which offer more potential in political, economic, technological and cultural terms.

It seemed useful that the Defence and Space Committees of the Académie Nationale de l'Air et de l'Espace, ANAE (National Air and Space Academy), associated with the International Commission of the Association Aéronautique et Astronautique de France, AAAF (French Society for Aeronautics and Astronautics, which are composed of many experts on these questions – propose their reflections and submit their recommendations on this subject.

The list of participants is given in the Appendix.

2 Some preliminary considerations

The military engagements that have occurred over these past few years, the Gulf war in 1990-1991, Kosovo in 1995, Afghanistan in 2002, and Iraq in 2003-2004, witnessed a rapidly growing dependence on space assets. They brought to light the importance of intelligence gathering before a crisis, due in particular to the discretion of space systems and their capacity to investigate any region of the globe with impunity. They also make it possible to set up well-adapted communication networks for very mobile ground forces operating in enemy territory, and provide navigation and guidance aides, in particular for ever increasingly efficient weapon systems. Generally speaking, space systems have the necessary characteristics to efficiently fulfil the needs of politicians in peacetime, and those of armed forces in a crisis.

The priority granted by the United States to the deployment of many major space assets is often a source of amazement. It is certainly driven by the

desire to “master” the loop of collecting, processing and disseminating information, but it also incorporates a new vision of space assets as federator in a new concept of information management before and during a conflict.

This approach is not shared by all of the European countries, often less ambitious in their vision of the contribution of new technologies, but also obliged to bow to budgetary constraints which are more difficult for their defence programmes and, therefore, are less inclined to adopt new architectures. Their joint analyses are often still embryonic, and in spite of some recent progress, such as the common expression of needs in the field of observation (Besoin Opérationnel Commun, BOC), the launching of a European group to make an inventory of European capabilities (ECAP), there is no clear vision of the systems that could be shared without renouncing the traditional desire to have 100% control of the assets that they implement in their national security and defence systems. The resulting situation is very preoccupying. While the general sentiment that we must reach a European dimension is beginning to be taken into account, the practical implementation is being delayed, and in the mean time programming for investments is going forward without integrating the correct level of preparation for future space systems. It is indispensable that this situation of inaction comes to an end. European partners must be aware of the importance of the challenge and the coming role for space in security and defence assets, and must define a common vision for the medium and long term (2020-2030). In a first approach, this vision should be drawn up as an absolute, with no constraints. Only with such an approach can one describe the needs within the framework of a truly exhaustive vision. Afterwards of course, the responsible authorities, taking into account their unavoidable budgetary constraints, will establish priorities, determine the means of satisfying the requirements, and make the choices which will result in programmes and allocations of the funding necessary. The opposite approach, which starts with an assumption of the States’ budgetary resources, even federated, would lead to a restrictive vision of the real needs, and to prejudicial assumptions in the choice of programming. One can think that with such an approach, the resources really available will be larger than those one generally imagines.

It is also to be stressed that the above approach is resolutely aimed at European convergence. This goes along with a progressive diminishing of purely national objectives by substituting objectives that, if not communitarian, are at least aimed at ad hoc cooperation between the countries interested by this or that programme.

3 The contribution of space systems to security and defence functions

3.1 The role of space in security and defence missions

The security and defence missions that space assets are able to satisfy are in general well known, and it doesn’t seem necessary to mention them again here in detail: telecommunications and data transmission missions, in particular to external theatres of operations, intelligence gathering and surveillance missions for strategic and sometimes tactical purposes, positioning and guidance systems, electromagnetic intelligence, early warning. They should not be limited to missions of operational support, their main contribution being provided before the development of crises. The result is that a great deal of attention should be given to what is specific to space assets, because irreplaceable: the capacity for observation on a global scale with the highest degree of discretion, the instantaneous nature of information gathering, and the capacity of satellites to relay information without delay.

The notions of crisis and of operations are naturally understood in the military sense, but can also be applied to situations of crisis following natural disasters or acts of terrorism.

We must, however, recall to mind that needs in telecommunication capacity grow by a factor of ten every ten years due to the modernization of information and command systems, and the data banks that support them.

With its operational systems, Syracuse for telecommunications, Helios for optical observation and Graves for space surveillance, and demonstrators like Essaim for electro-magnetic intelligence, Spirale for preparatory experiments in view of the definition of a future early warning system, Lola for laser links, France is, relatively speaking, more active than its European partners, but it is hindered more and more by economic and budgetary considerations. The same is true of the other countries active in the space domain: United Kingdom, Italy, Spain, Belgium and several others. At this stage it is truly advisable to find a new dimension at the European level to ensure the follow-ons to the systems in service or at the eve of their deployment, and especially to design, develop and implement the new services. An interesting example is the joint proposal presented to NATO by the United Kingdom, Italy and France to supply the future secure NATO telecommunications service, which was finalized by a contract at the end of 2004.

One notes also that among the defence missions that can be satisfied with space systems, many can be shared with European countries partners of France, either through conventional modes of cooperation where investments are also shared (like Helios I or II), or through exchanges of capacity between autonomous systems, as is the case for the German radar observation system SAR Lupe and Helios II. In the latter case, capacity sharing signifies the setting up of ground systems able to process various types of data simultaneously, and therefore, requires a new concept of architecture integrating in an optimum way different characteristics of space observation, optical and radar.

Beyond this, in a medium term perspective (beyond 2010-2015), one should take into account the progressive appearance of new threats that include the proliferation of ballistic missiles and weapons of mass destruction, at a later time, even the possible appearance of space weaponry, which might entail killer satellites or even the threatening presence of nuclear or chemical devices in orbit. In such a case, the capabilities to oppose them should be developed.

It is no doubt premature for Europe to plan for neutralizations weapons placed in orbit, but it is now urgent that reinforce its capacity for monitoring space, which means having at its disposal precise knowledge of all objects in space including debris, and to be able to identify them. Space monitoring is of dual interest also, because it helps, in particular, to prevent the risk of collision and to predict fall-out zones for space objects, ensuring the safety of the population.

Secondly, concerning military threats, another form of surveillance means having systems in space able to detect missile launches, and provide early warning. The first of these missions consists of monitoring a given geographical zone, detecting ballistic missile launches by the signature of the plume and determining the location of launch sites. The second mission, early warning, can play a role in the context of deterrence thanks to its ability to identify the aggressor. It is also an essential component of anti-ballistic missile defence.

The implementation of an anti-missile system in Europe, or rather in certain European countries, is under discussion in the context of the American proposition to participate in their own anti-ballistic missile defence programme. Concerning French thoughts in this domain, besides the report written in 2003 on the subject by the Académie Nationale de l'Air et de l'Espace, the Defence Advisory Scientific Committee (Conseil Scientifique de Défense) has also delved into the subject, and both recommend a progressive approach, based on a significant research and technology effort, susceptible to place European industry in a stron-

ger position in the negotiations which would take place should Europe decide to participate.

Lastly, an ultimate stage in the militarization of space would entail putting in question the Outer Space Treaty that was adopted by the United Nations General Assembly in 1966. It entered into force by ratification by the main countries concerned (among whom the United States and the Soviet Union) on January 27, 1967. It would be dangerous not to pay attention to the aggressive declarations of the leaders of certain nations in the world, which, if they were followed by decisions, would lead to the crossing of a decisive line, and to letting space play a new role supporting what it is now called "the weaponization of space". An in depth reflective effort concerning this new menace is indispensable.

Generally speaking, a prerequisite to the question of European cooperation in space infrastructure for defence is that notions of national sovereignty concerning the control of certain systems must evolve. In most cases, with the notable exception of specific systems for nuclear deterrent forces, it seems that national sovereignty is not placed in jeopardy by sharing, if the rules for employment of shared systems are negotiated precisely beforehand. A new notion of European sovereignty should progressively take the place of the more traditional one of national sovereignty. Only a strong political vision can promote the emergence of this notion, but is this not exactly what is currently happening with the implementation of the Galileo programme?

3.2 Duality of certain space assets

To satisfy certain defence missions, space assets to be used can be civil systems, commercial or otherwise (mobile telecommunications via INMARSAT, meteorological satellites like Meteosat, oceanographic satellites such as Topex-Poseidon and Jason), or assets with a dual purpose (Galileo satellite navigation system, observation satellites, or mapping satellites like SPOT, or later on, Pleiades). The advantage of using commercial or dual purpose assets, besides the economy of setting up a dedicated infrastructure, is the possibility in case of a crisis to call upon available capacities in a very short time, if the legal and contractual arrangements have been anticipated. In the case of the European satellite navigation system Galileo, a specific service of Galileo, the public regulated service (PRS) is planned for applications with controlled access. In the same way, civil observation systems like SPOT 5, thanks to its stereoscopic instrument "HRS", are very efficient tools to generate the digital terrain models anywhere on the globe, which are very useful for certain weapon

systems. It is similarly remarkable to see that the United States are calling more and more often upon commercial sources for high resolution imagery (Nextview programme with the companies Digital Globe and Orbimage). From this point of view, the Franco-Italian agreement signed in Turin in January 2001 represents a remarkable step forward, since it confirms a resolutely dual approach for future optical (Pleiades) and radar (Cosmo-Skymed) observation satellites.

Generally speaking, a well thought out approach to duality leads to carefully distinguishing between systems which are dual in their objectives, whose specifications for military requirements were taken into account from the very conception, and systems for dual usage, where specific military needs were not part of the initial design. Clearly, systems in the former category should benefit from adequate financing from defence budgets. The programming of the next generation of observation satellites that will follow Pleiades in France, SAR Lupe in Germany and Cosmo-Skymed in Italy, should thus be taken into account in the defence budgets at the European Union level.

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4 The indispensable independence of access to space

The very concept of space systems for defence necessitates the control of operations for their launching, and therefore, for the European states to have an autonomous capacity to place their own satellites into orbit. The United States, make no mistake about it, forbids the launch of satellites funded by the Federal government by non American launch vehicles or from a base not located on American soil.

Europe must continue to maintain its independent access to space, access well ensured up to now thanks to the Ariane family and to the French Guiana launch site. The unavoidable necessity of independent access to space is increasingly better understood by the European partners. In future, this access could also rely on light launchers like Vega, well adapted to the launch of small satellites in low orbit, or, up to a certain point, the Soyuz launcher which could be launched from Kourou starting in 2007. It is advisable to keep the characteristics of launch vehicles in mind when designing the spacecraft that will be needed by the European States for the satisfaction of their ambitions for security and defence.

This autonomy of access to space has its price: the cost of maintaining the launch base, the installations and the industrial teams necessary for the production of the launchers, the cost of the development teams that prepare vehicle evolutions and guarantee performance. It is advisable to take this into account in budgetary provisions for space activities concerning security and defence in Europe, while not losing sight of the necessary benchmarking to avoid any insupportable spiralling of costs.

Beyond the current generation of launchers, the means necessary for this ambition should be adapted to operational requirements, in accordance with the evolution of the characteristics of satellites, notably their mass and their missions (orbits, integration into wider systems, support to ground operations). A robust R & D policy is the only guarantee of maintaining the capacity for innovation necessary to the development and exploitation of future launch systems. It should also seek reliable and economical technical solutions, so that the cost of access to space weighs less heavily on the economy of new programmes.

5 Necessity to strengthen efforts in technological research

A continuous and substantial research effort in key technologies is indispensable at the European level to benefit from advances in basic technology in the best manner, and to apply civil solutions in the most optimised fashion when they are pertinent, in an operational context. The rapidity of progress in the fields of micro- and nano-technologies, for example, make it rather easy to imagine revolutionary new designs for on-board systems (inertial micro-sensors, sensors actuators), but progress must be made to increase their reliability in the space environment. In the field of imagery, research efforts should target responding to requirements for increased resolution and permanence of observation, which are indispensable for intelligence gathering and identification. The need for all weather, day and night observation should incite a continuous research effort aimed at improving the performance of on-board radar imagers. In any case, the evolution towards platforms of small dimensions allowing group launching should make it possible to use satellite constellations to increase the repetitiveness of observation.

If the R & D effort should integrate rapid progress accomplished in the civil domain, it should also be oriented toward the specific requirements of the defence sector. It should also endeavour to eliminate its dependence on sources of supply outside of Europe for critical components or equipments. Concerning the United States, the ITAR regulations (International Trade in Ammunitions Regulations) is a situation that is difficult to accept, and which should encourage Europeans to seek greater technological independence.

Particular attention should be given to technological breakthroughs, which can rapidly render certain architectures obsolete, and to the contrary, open the door to new designs for high performing systems. Concerning technologies for platforms, major advances are anticipated in certain domains, for example:

- Increased autonomy for satellites making it possible to reduce the reliance on ground station control, reconfiguration in uncertain environment, etc...
- Missions involving the flight of several independent satellites in formation, subjected to autonomous and precise relative control, and providing distributed measurement: the flight in formation provides greatly improved performance in precision and sensitivity (by use of interferometric techniques for example) sharing the payload on small, low cost platforms.
- The manufacture of large synthetic telescopes, which, placed in geostationary orbit, will permit real time and permanent observation of the planet over vast zones.

Technological research aimed at defence requirements should also integrate new architectures for weapon systems in the logic of centralized networks: in particular key technologies allowing the implementation of information relay infrastructures from a theatre of operations should be the subject of a particular effort (high speed optical transmission between drones and satellites, for example). For these different subjects, technology research activities should be followed by orbital demonstrators to validate the performance that would be attained by the operational systems, and to verify their integration into the space system.

In addition, as stated above, it is advisable to continue long-term efforts in the specific domain of access to space in the area of performance, and therefore, the cost of placing payloads in orbit, as well as in the area of developing new generations of launch vehicles.

Finally, the optimised use of space in an operational context can require, when there are no satellites in reserve in orbit, reactive, rapidly available

launch vehicles for access to orbit (in the order of a few hours). A particular area of study should be undertaken to analyse in depth the various possible solutions to satisfy this need, since it has implications that touch the entire satellite-launcher chain.

All of the efforts of technology research should be part of consolidated and coordinated programmes at the European level, to be taken into account both by European civil budgets and by those that the European Defence Agency could federate, going beyond the national budgets, which are due to diminish as the communitarian efforts develop.

6 The industrial dimension

The industrial capabilities of a state or a community of states like the European Union, is the basis of the credibility of its defence. Generally speaking, the security of states depends more than ever on the sum of intellectual capabilities and technical means, which are available in part within its administration (legislative and regulatory framework, overseeing the implementation of public infrastructures, procurement) and, in part within the tissue of industrial and research capabilities upon which industry depends. This European industrial and technical base ensures the security of supply and the autonomy of the public actors in security and defence, the freedom to use the equipment that they have fielded and the possibility of exporting the systems and equipment to friendly countries and allies.

To set up programmes in an intra-European cooperative framework, the European Industrial and Technological Base can be organized in two different ways:

- Firms joining together in ad-hoc consortia to design and implement programmes of interest to several European countries,
- More recently, the progressive constitution on the European level of large industrial groups in the aeronautic, defence and space sector (EADS, Thales and Alcatel Alenia Space, for example) is a sign of a major evolution in the industrial scene, susceptible to strengthen Europe's collective industrial capacity while maintaining competitiveness on the international market. These consolidations and joint ventures, which will certainly continue during the coming years, have a strong

political impact because they facilitate the convergence of the expression of requirements (see, for example, the military transport aircraft A400M) and interoperability of equipment within armed forces. They also lead to a rationalization of the industrial infrastructure by eliminating duplications that result from national policies of states, thus improving competitiveness of the whole.

Europe's policy for security and defence should consolidate this trend and provide it with new perspectives in the domestic market, susceptible of favouring both an intelligent rationalization of resources, without loss of substance, and increased competitiveness on the export market. This should apply to the space field as in other sectors of industry, with the particularity that, with perhaps the exception of the launch vehicle sector, the space field rarely has the opportunity of producing in series.

10 But the space industry, like other high technology industries, needs to be permanently irrigated by an adequate influx of new technologies and innovative concepts, which result from a global effort of the nation or the community of nations concerned in terms of educating the younger generations and in terms of research. In addition, to ensure that all the competence and the technologies necessary will be on hand when needed, it is essential to provide industry with medium and long term visibility by defining targets for foreseen capabilities and programmes to be developed. The evolution of financial structures for advanced research in Europe, whether in the European Defence Agency, the future Security Programme, or the future organization of the European Union's future Framework Programme for Research and Technological Development, should take into account an increased and better coordinated long term research effort in all technological areas that could be of interest to the security and the defence of Europe. The recent Eurospace position paper published in January 2005 (Eurospace Position Paper on Security, 29 January 2005) highlights this need for a better coordination at the European level of security related R&D in Europe.

7 The vulnerability of space systems: the need for minimum guarantees

The theme of the vulnerability of space systems is frequently mentioned today because of the increasing dependence of the main space powers on these systems. The recognition of this vulnerability comes firstly from the inherent risks of occupying the space environment which is, in itself, a hostile and demanding milieu that puts technologies to the test, and multiplies the risks of breakdowns or mission failures. It is also nourished by fears of strategists regarding possible attacks on the systems, which are currently deemed "vital".. For some countries like the United States or China, better protection for satellites and their associated ground segments has even become a priority, leading them to oppose each other on the question of possible deployment of weapons in orbit, the one arguing in favour, the other, to the contrary, wanting it strictly forbidden. It must be mentioned that after the recent public announcement by the United States that they intend to develop such capabilities, whether they be ground-based or in space, this issue has become newsworthy. But before going farther, some definitions: We must distinguish between the "militarization" of space, and the "weaponization" of space.

Militarization of space

The militarization of space includes all space assets that enable armed forces to improve their military efficiency. This means, for example, the use of satellites for intelligence gathering, (observation or eavesdropping), encrypted telecommunications, early warning, navigation and positioning. In this case, the states that master access into space and the use of space for defence motives use space in a non-aggressive and pacific manner, which conforms to the Outer Space Treaty of 1967.

Weaponization of space

Today, in the UN documents, the term "weaponization of space" is clearly used to define the process that leads to the deployment of weapons in Space.

The use of space to place in orbit the assets able to attack military satellites belonging to other states is of a completely different nature, since it means using space to an aggressive and warlike end. It is currently agreed to call this also weaponization of space. Thus, after having militarised space, we can say that the United States is preparing to weaponize it.

In Europe, space assets such as Helios, Skynet, Sicral or Syracuse are part of the planning and conducting of operations, but they do not intervene in the warlike management of a space operation. Europe is, therefore, not implicated in the weaponization of space.

With this being called to mind, it is important to clearly state that the weaponization of space will, in the long term, constitute a real threat for our own space systems.

Europe should thus take this new dimension into account in its future plans for the use of space, whether the applications are essentially civil or concern its defence directly.

The risks

Independent of natural risks or those linked to the great amount of debris in orbit, the modes of action susceptible to endanger space systems or their operations are many. They can take the form of intrusion into the system, including the ground segments (to prevent usage or to falsify information, for example), but also electronic jamming, preventing the satellite or the whole system to function properly. More spectacular, some other methods are sometimes mentioned in extreme military scenarios like the effects of ionization and electromagnetic pulse which could be produced by a nuclear explosion at high altitude, or the use of kinetic energy or high energy microwave or laser anti-satellite weapons from the ground or in space.

In this context, it is not up to Europe to imitate the United States. It has neither the means nor probably the necessity. None the less, facing a possible threat, and in the framework of a space and defence effort, it is important that Europe strengthen the protection of its systems and that it develop autonomous means to monitor the space environment around the Earth, so as to have a better understanding of this environment, and to be able to identify possible hostile or illegitimate acts.

Protection

The protection of systems notably implies the hardening of electronic components that equip satellite platforms. These developments naturally increase costs. If these measures can be taken for the construction of dedicated military assets, they are a handicap in civil applications for commercial systems. At a time of increased duality in space technology, thought should be given to the balance necessary to the viability of such measures, notably in concert with industrial partners and operators. At the same time, the security of ground segments is part of the protection of a space system and should be considered with attention.

Today, the vulnerability of our space systems is more linked to their ground segments. An antenna for command and control or for reception of telemetry is, in fact, very vulnerable to a command-type attack, and we should ask ourselves how best to limit this risk.

Monitoring and surveillance

Space surveillance systems should be developed to enable Europe to monitor and to characterize any abnormal event that takes place in orbit. Some things have been done on an experimental level with, in France, the bi-static radar Graves or in Germany, the FGAN-TIRA radar, and in the United Kingdom with the PIMS optical instruments, which provide a capacity for detection, orbitography, catalogue management and identification of objects in orbit. It is important to maintain this effort with an increase of these capabilities on a European level, but also to explore the possibilities of cooperating beyond the European frontiers in the prospect of collective security. The subject remains highly sensitive, and one must proceed in the mutual interest of space nations, which implies evaluating the type of interoperability desirable for these systems as well as the necessary ensuing legal arrangements.

Summary

These two categories of measures are prerequisite to the setting up of a credible space and defence policy. Within Europe's reach, they do not imply radical changes in its general posture concerning the non militarization of space, but they show its ability to take into account in the medium term, evolutions that seem unavoidable today. Beyond this, they condition the perpetuation of the status that Europe enjoys today as a major player in space.

Beyond this, and if weaponization of space is taking place, it will be necessary to study the means to neutralize satellite systems in order to build a "space dissuasion" capability.

8 What organisation in Europe to set up and exploit space assets for defence?

The adoption of the European Constitutional Treaty will lead to the creation of specific organisations, some with dual competence, at the European Council level as well as at the executive level, to deal with questions of security and defence: strategic orientations, selection and development of programmes, planning and carrying out operations. These instances should be given the necessary powers and adequate and appropriately interfaced means. In the domain of space, in particular, optimal coordination between these new entities and the European Space Agency seems indispensable.

The European Defence Agency (EDA)

The European Defence Agency is currently being implemented. Its terms of reference covers the whole range of defence programmes, including space programmes, and its creation constitutes a unique opportunity to propose an efficient liaison between the new agency and the European Space Agency for the those programmes.

The executive body of the EDA will act in four directions:

- Identification of the capabilities needed by Europe for its security and defence missions, in particular, the so-called Petersberg missions, the fight against terrorism, the surveillance and the protection against proliferation of weapons of mass destruction,
- Transformation of these capabilities into programmes under development for new weapon systems. The agency should at this stage play a role of inciting Member States who will determine whether or not to participate in these programmes on a case-by-case basis. When a programme is approved with its participants identified, its development should, in the majority of cases, be carried out within the framework, and under the responsibility of OCCAR (Organisation for Joint Armament Cooperation).

13 - Analyses and dialogue with the European Commission concerning the structuring of Europe's defence industry. It is for all practical purposes, a responsibility of industrial policy ,

15 - Coordination and management of defence technology research, which remains to be confirmed, and which should have a specific budget for activities to be conducted by the Agency. The

amount of this budget should increase with time, but views concerning this differ very significantly from country to country, from several tens to several hundred million euros per year.

Organisation in the development phase

The European Space Agency (ESA) should play a major role in the development phase of projects. Three major reasons argue for its implication in these military space programmes:

- The specificity of space programmes, whose management methods and technologies require teams that have recognized experience, that it would be unfortunate and costly to have to duplicate in Europe, and that exist within the European Space Agency,
- The frequently dual nature of programmes that can give rise to a common line of satellites, with specific satellites using similar technologies: this is the case in the families of "Earth Observation" and "Telecommunications" spacecraft. Duality can also lead to the complementary use of two types of satellites to satisfy military needs: this is the case for SPOT and HELIOS. It can also lead to the use of a single satellite to fulfil both civil and military needs: the most striking example is the one given by the GALILEO satellite navigation system, designed for civil needs without explicitly taking military requirements into account, but which will play an essential role in the construction of European defence.
- The necessity of taking future requirements for military satellites into account in the advanced planning for launch vehicles, which is under the responsibility of the European Space Agency. This is of major importance, since past errors have led to the present situation, which is hardly satisfactory for defence requirements.

A possible link between the European Defence Agency and the European Space Agency

Neither the new Agency, nor OCCAR presently have competent personnel in the space domain. The European Space Agency can bring a major contribution to each of the four main missions of the European Defence Agency:

To identify capabilities, they could, on request, supply the European Defence Agency with experts bringing space competence to working groups wherever this competence seems necessary. ESA's vocation to identify and federate all of the competence for space existing in the different European countries should be reinforced in the future, thus making it a particularly useful partner for the European Defence Agency.

Concerning the development of new military space systems, their management could be delegated totally or partially to ESA, which would play

a role similar to the one planned for OCCAR in other sectors. ESA's methods of functioning for optional programmes lend themselves rather well to such an approach. A programme committee would be set up with representatives from the participating countries to supervise each new programme under development, the management being entrusted to ESA's executive team, who would set up a project management team including personnel seconded by the defence ministries of the countries concerned.

Concerning geographical return, adoption of similar rules to those in force at OCCAR should be envisaged: a "juste retour" guaranteed to participating states applied to the totality of programmes, and not to each and every programme by itself. This makes it much easier to satisfy the constraint, and limits any possible negative consequences on the programmes overall cost.

Concerning industrial policy, a general agreement on the rules should be established between the two agencies, and completed by a permanent consultation mechanism. Whenever specific industrial policy requirements would result from security or defence considerations, this agreement would provide the framework for discussions necessary to take these requirements into account.

Lastly, for technology research programmes, cooperation could take different forms:

- Permanent consultation on activities going on in the civil space field and in the military domain, so as to maximize the efficiency of technology research efforts;
- Supplying experts from ESA to assist in the choice of research activities in the military domain;
- Possibly delegating the management of certain technology activities financed by the European Defence Agency to ESA.

Setting up these different modes of cooperation should be spelled out in an Agreement between the two agencies, and could lead the European Space Agency to create, with the agreement of its Council, a Defence Space Systems Directorate.

Organisation for the operational phase

The exploitation of the assets that will be developed and validated in orbit in the framework of an agreement between the European Defence Agency and the European Space Agency should be given particular attention: ESA does not have a vocation to operate such systems beyond the testing phase, and besides, it has always in the past, transferred the responsibility for operations to operational entities for which it has been called upon to play the role of "developer". This was the case for telecommunication satellites in the 1970's

(EUTELSAT), then for meteorological satellites in the 1980's (EUMETSAT). In both cases, the hand over of operations to the two operational organisations created for this purpose was followed by a progressive take over of responsibility for procurement of operational satellites and definition of needs for future generations of satellites by these entities. The proximity to the user communities that finance these organisations put them in a good position to operate the space systems and associated ground segments in a cost effective manner and in accordance with the expectations of their customers.

For defence systems, the same reasoning should apply, taking the constraints for security and confidentiality into account from the beginning of the design of the system. It will be necessary to make a concerted effort for the definition of requirements at the European level, which will require considerable efforts on behalf of the military institutions of the countries participating in these programmes. This specification of requirements, as well as the setting up of operational structures to operate the systems, should no doubt be coordinated by the European Chiefs of Staff and appropriate organisational plans should be envisaged. Certain approaches could implicate industry in very significant ways, as was the case for the Paradigm programme in the United Kingdom, or for the Galileo programme.

The more or less rapid creation of structures for operational exploitation will have direct consequences on the delegation of responsibility given to ESA for the development of the new systems. A space system is, in fact, composed of two segments:

- A "space segment", including the satellites and its control stations, launch operations and in-orbit monitoring,
- A "user ground segment", composed of ground installations necessary for the operational exploitation of the system.

When there is an entity for operational exploitation, that structure is naturally called upon to take responsibility for the user ground segment, which leads to delegating the management of the development of the space segment alone to ESA. For the first generations of satellites, for which operational structures will only be progressively put into action, it would be wise to give ESA the total responsibility at first, creating a user ground segment team within ESA with specialists coming from the various Defence Ministries concerned.

9 Conclusions and recommendations

The strategic character of space, for military purposes as well as for political, economic and industrial reasons, is beginning to be recognized in Europe in different degrees from one country to the next. Generally speaking, it is vital to encourage the European states to recognize the importance of the challenge, and of the ever increasing role that space systems play in strategies for security in the larger sense and for defence, and to incite them to define a vision for the medium and long terms (2020-2030) leading to the development of new operational capabilities. This approach should also integrate the essential strategic nature of access to space, as well as the imperatives for space surveillance, taking into account the only slightly disguised threat of certain countries to militarize space, in spite of the spirit (if not the terms) of the 1967 Outer Space Treaty.

Beyond this recognition of space as a major domain of interest for Europe, calling as such for a European space policy integrating both the objectives of civil governmental programmes and defence programmes, a new threshold must be crossed: the transposition to the collective European level of Europe's ambitions and space developments for defence, as we have been able to do in a convincing manner for civil programmes.

To achieve this, a series of recommendations can be set forth:

1. Continue creating European entities with the necessary authority and means to handle the security and defence matters at the level of the European Council (political decisions) and at the executive level: choice of means and coordination, planning, leadership, and control of operations.
2. Focus with a high degree of priority on the calendar for decisions relative to future space systems which will (i) take over from the systems now in operation (satellites for optical and radar reconnaissance, telecommunication systems), and seek, via the European Defence Agency, formulas that will enable their deployment and operation in a framework of European cooperation and, (ii) develop new space capabilities beyond those for telecommunications and observation, by calling upon those European countries that have played and are playing a pioneer role in certain areas like electromagnetic intelligence or early warning, and who propose that other countries join them in these projects.
3. Take into account the significant duality of space technologies and systems. Defence should not hesitate to contribute financially to civil systems with dual purpose (observation, telecommunications, navigation, etc.) either at the initial investment level, or through an "anchor tenant agreement", where the defence community is a priority customer. In compensation, the exploitation of data from defence systems could be made more easily available to all the actors concerned with security.
4. For advanced technology research, give financial priority to emerging technologies that have been identified as having great potential for the future and which might revolutionize operations.
5. In all pertinent areas, launch research and development activities which will allow establishing for Europe a strong negotiation position with major partners with whom concrete cooperation programmes are considered.
6. Participate in the consolidation of Europe's independent access to space capability with launch vehicles, launch base, and industrial infrastructures (ESA's EGAS programme approved in 2003) by a determined policy of public procurement and support for research and development efforts in the domain.
7. Progressively set up a European network for space surveillance extrapolated from systems existing in Germany, France and the United Kingdom that will allow Europe to measure the threat resulting from the multiplication of objects in orbit, and from the probable "weaponization" of space.
8. If "weaponization" of space does happen, study the means to neutralize menacing space systems, which would potentially give Europe a "space dissuasion" capability.

9. Encourage the European Defence Agency and the European Space Agency to establish a cooperation agreement that defines their respective roles to conduct space programmes for defence, maximizing synergies at the level of technologies and architecture between civil space systems and systems for military missions.

10. Delegate the management of space defence programmes to the European Space Agency, in particular their space component, in the design and development phases, up to the acceptance of the systems.

11. Create within the European Defence Agency a Directorate for Research and Technology that would be inspired by the methods of America's DARPA, and would have a significant budget, and delegate to the European Space Agency the management of advance research activities which are specifically space oriented, often dual use, with the objective among others, of reducing Europe's dependence on American technologies because of the constraints of export controls (ITAR) which affect the space technologies in particular.

12. Seek, at the level of the European Chiefs of staff and the national Chiefs of staff, the adequate formula for an organisation to operate the common military space assets, for example on the model of Eumetsat or other models (Paradigm, Galileo), depending of the requirements for security and efficiency.

Appendix

List of participants in the "Space for defence" study group from the Space Committee of the French National Air and Space Academy (ANAE) and the International Commission of the Aeronautics and Astronautics Association of France (AAAF).

Co-Presidents:

- Gerard BRACHET, president of the Space Committee of ANAE
- Bernard DELOFFRE, International Commission of AAAF

Members of the ANAE Group:

- Jacques ARNOULD (CNES)
- Anne BONDIOU-CLERGERIE (ONERA)
- Jean-Claude CAZAUX (Midi-Pyrenees Region)
- Gérard CHAUVALLON (Vice President ANAE)
- Jean DELACARTE (ANAE)
- Fredrick ENGSTRÖM (ANAE)
- Pierre FAUCOUP (EADS Astrium)
- Laurent GATHIER (Dassault Aviation)
- Patrick GEISTDOERFER (Marine Academy)
- Jerome MAFFERT (MBDA)
- André MOTET, (ANAE)
- Louis LAIDET (AAAF)
- Anne-Marie MAINGUY (ANAE), ONERA
- Bernard MOLARD (ANAE), EADS
- Bertrand de MONTLUC, (Ministry of Defence, DAS, then Ministry of Foreign Affairs, CAP)
- Xavier PASCO (FRS)
- Philippe POISSON-QUINTON (ANAE)
- Yves SILLARD (Vice President ANAE)

Members of the AAAF Workshop:

- Pierre BESCOND (AAAF), Director I-Space Prospace
- Didier COMPARD (ECTI)
- Alain GAUBERT (Eurospace)
- Claude GOUMY (AAAF)
- Philippe HENRY (AAAF), Snecma
- Jean JAMET (AAAF)
- Louis LAIDET (AAAF - President of the Internationale Commission)
- Anne-Maie MAINGUY (AAAF) ONERA
- Bernard MOLARD (AAAF), EADS
- Bertrand de MONTLUC (AAAF), Ministry of Foreign Affairs, CAP
- Serge PLATTARD (AAAF), ESPI, Vienne
- Marcel POULIQUEN (Snecma)