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Executive Summary

SatCom, as satellite communications, are space-based technologies providing communication (point-to-point) and broadcasting (point-to-multi-points) services. SatCom services includes fixed satellite services such as TV & radio broadcasting, and mobile satellite services such as for crafts in the air or for ships at sea.

SatCom are one of the most successful applications of space technologies. The related industrial sector generated a worldwide commercial market volume of around 84 Billion US $ in the year 2009. The majority of revenues were generated by direct-to-home broadcasting services with a quota of 83%. Then, 5 Billion US $ were originated by satellite manufacturers and launch service providers, while actual transponder lease generated 11.6 Billion US $. The sector presents an average of 10% compound growth rate for which SatCom will reach 93 Billion US $ by 2019. The European market share is in terms of 48% for manufacturing activities, 40% for transponder leasing, 15% of terminal equipment manufacturing and 10% of Value-Added-Services. The sector involve a workforce of 45.000 employees belong all the SatCom industrial segments in Europe. In addition, the European SatCom sector is more patent intensive than the other regions, such as USA and Japan. This leadership is recognised by a relevant volume of export sales to customers in the Rest of the World, in terms of € 1.2 billion.

Considering this economic magnitude, the study presents SatCom as an enabling element of different European policy initiatives that can be grouped into four clusters, namely, *space policy*, *Lisbon strategy* and its policy for growth, *industrial policy*, and *international relations*. Among these ones two policy priorities have been identified such as the *Digital Agenda* for the development and deployment of broadband in Europe and the *industrial policy*.

The first cluster is analysed through the seven Space Councils from 2004 to 2010. The conclusion of this analysis is that by not developing a specific policy line for SatCom, its key-role in a coherent European space policy has been lost. This means that a huge potential for dynamic growth and competitiveness of the whole space sector, including manufacturers, launchers, operators, downstream service providers and equipment manufacturers, has been lost as a direct result of failing to foster a relevant policy framework around key SatCom applications. The main attention of European space policy focuses on the delivery of the two flagship programmes, Galileo and GMES, losing, at the same time, the necessary interaction with SatCom. SatCom shall play a crucial role in Galileo-derived applications and services and in maximizing the value of GMES data. The absence of efforts to develop SatCom means, in a certain way, reducing the autonomy of Europe. SatCom provides the largest number of launches thus enhancing the performance of the European launcher – Arianne-; it permits Europe to fill the orbital positions assigned by ITU that would otherwise be lost, it sustains European know-how in digital communication in terms of patents and international relationships from the scientific, military and commercial points of view.

Concerning the second cluster there are several reasons why SatCom should be included as an element for the Lisbon Strategy and the updated strategic plan through *Europe 2020*. The principal ones concern the innovation benefits from advanced digital communication systems and technologies and the highly qualified job-skills required. These points fit into policies such as *Innovation Policy, New Skills & Jobs* and *Youth on the Move*. Moreover, *Europe 2020* requires *smart*, *sustainable* and *inclusive* growth. SatCom can contribute to delivering the *Digital Agenda* by filling the digital divide of remote locations, mostly populated by low-income people. In this sense, SatCom can also be seen as an element of the policy initiative as *Fighting Poverty*. In addition, SatCom can provide services used in the management of energy power plants and oil and gas networks providing connectivity to offshore platforms, and applications for management of prevention and precaution of potential disasters. All these examples show how SatCom can be a contributor to *Resource Efficiency & Energy*. Among these policy initiatives, the study focuses attention on the issues to delivery of the Digital Agenda in Europe. In 2010 the EC issued a communication on the Digital Agenda[1] with the ambition of providing

broadband for all European citizens with the following specific targets:

- *Basic broadband* for all by 2013: basic broadband coverage for 100% of EU citizens;
- *Fast broadband* by 2020: broadband coverage at 30 Mbps or more for 100% of EU citizens;
- *Ultra-fast broadband* by 2020: 50% of European households should have subscriptions above 100Mbps.

It is one of the *priorities* for the growth of Europe. These three targets basically require two types of technological action: *extending the network* and *upgrading the network* in terms of higher capacity. The *basic broadband target* mostly needs of the first action; the other two targets require the *upgrading of the network* assuring higher capacity for faster speediness and interactions among the users. There are different technologies to be chosen and implemented, each of which has *pros* and *cons* in terms of technical achievements and socio-economic resources. A matrix is proposed to compare the magnitude of required resources per each technology in order to implement the two technological actions. Each matrix identifies the three groups of technologies, as fixed communication technologies including the wired ones, terrestrial wireless technologies and SatCom. Then the dimension of the *investment* in terms of necessary economic resources is considered in order to satisfy the system requirements like the *backhauling* as operations transport data from the node point to the destination and go back, the *last mile* or *last kilometre* as the final leg of delivering connectivity from a communications provider to a user, the capacity to serve a *number of people* at a time, and the last the *coverage* of the infrastructure over the land-country. A qualitative evaluation in terms of high, medium and low amount of necessary resources and policy actions is given to these variables. The evaluation is independent from the question of who will support the required investment, such as government, commercial operator or end-users. It is evaluated in terms of the action required to extend or upgrade the network for the types of technology involved. At the current stage, it is relevant to note that SatCom with the European satellite capacity already in orbit can easily provide the *basic broadband* where no alternative network exists and where terrestrial networks are not economically affordable.

Here, two matrixes are proposed, one for the *basic broadband* by 2013 and another one for the advanced broadband as *fast* and *ultra-fast broadband* by 2020. In particular, the two tables can help to take the decision related with the present digital divide implying lack of infrastructures due to geographical and demographic reasons where terrestrial network is not available and it shall not be economically sustainable.

Technological Action	Variable		Fixed	Terrestrial Wireless	SatCom
Extending Network for ***basic broadband*** **by 2013**	**Investment**		High	Medium	Low
	Network system requirements	**Backhaul**	High	High	Low
		Last - Km	High	Medium	Low
		Number of People served	High	Medium	Low
		Land Coverage	High	High	Low

It is evident the prompt and efficient role of SatCom in comparison with the other terrestrial technologies for delivering the *basic broadband* in Europe in time by 2013 as the Digital Agenda has established.

[1] EC, Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, A Digital Agenda for Europe, Brussels, 19.05.2010, COM (2010) 245.

Technological Action	Variable		Fixed	Terrestrial Wireless	SatCom
Upgrading Network - Higher Capacity - for *fast* and *ultra-fast broadband* by 2020	**Investment**		High	Medium	High
	Network system requirements	**Backhaul**	High	High	Low
		Last - Km	High	Medium	Low
		Number of People served	High	Medium	Low
		Land Coverage	High	Medium	Low

As shown above, the main challenge of SatCom is in the upgrading action because its capacity is fixed from the beginning of its development. The development of a SatCom system does not have any exit-strategy; the initial choice to start a SatCom mission has to be thoroughly evaluated to avoid wasting resources and effort. This is one of the reasonable motivations to have a specific European space policy line for SatCom. In addition, the choice for broadband has to be sustainable for Europe, where the dimensions of the metropolitan areas with already terrestrial infrastructures for broadband are changing year by year due to population growth. If the advanced broadband is delivered only by terrestrial technologies even a continuous extension of the network has to be deployed.

The third cluster, concerning the *industrial policy*, where three actors, the EU, ESA and Member States, are involved. The EU and Member States use two fields of competence: telecommunications and space. The EU mainly uses the Framework Programme (FP) structure, currently FP7, and focuses on R&D for SatCom. The overall FP7 is managed according to areas, including ICT and Space. If SatCom is an element of the space sector, it must be used for international cooperation, such as new emerging markets and notably in Africa. If SatCom is an element of the ICT strategy it has the task of implementing international cooperation with aim of seeking strategic partnerships to tackle some of the future grand challenges in ICT R&D such as the Future Internet. Till now, SatCom has been an element of projects funded by FP7 ICT and not by FP7 Space. This has been unexpected because of 30% of projects, funded by previous FP6, were from budget allocated for FP6 Aerospace. The roles of ESA and the national space programmes have been mainly directed at developing the space component of the system. The main technological challenges have been in terms of multi-spot beams, data compression algorithms and ground equipments in order to more efficiently use the spectrum and to increase the data per second capacity in order to reduce the delay in transmissions. This is to help address the problem of *connectivity* with mobile users in that SatCom terminal devices have tended to be bulky, giving only a signal for connectivity but without user-friendly applications in comparison with the current smart-phones. For this purpose, ESA has established the Integrated Applications Programme (IAP) that is user driven. In addition to these issues, in 2010 the EC established an *integrated industrial policy* for Europe[2]. The challenge is to establish an industrial policy with an integrated perspective in order to reduce inefficiencies and to increase synergies between different industrial sectors, thus minimising costs and the burden for Europeans. The Communication pointed out that industry is still the foundation of the European economy and emphasised the fact that it makes a significant contribution to the external competitiveness of the EU. SatCom is explicitly mentioned as a key space sector from the economic and technological point of view and I can also enhance the space sector of space aiming at competitiveness and sustainability. It is defined as crucial for delivering the *Digital Agenda* closing the broadband gap for Europe. In line with this target, even an adequate spectrum policy should be preserved for SatCom to have communications free of interferences. The implementation of this industrial policy must follow three imperatives: to be *societal*, because of benefits for all Europeans; to be *economic,* in terms of space as a generator of knowledge that

[2] EC, Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, An Integrated Industrial Policy for the Globalization Era Putting Competitiveness and Sustainability at Centre Stage - {SEC(2010) 1272} {SEC(2010) 1276}.

drives innovation; and to be *strategic*, as space is a policy tool that contributes to the role of Europe as a global actor.

The last cluster includes *international relations*, because SatCom can be an element of the Common Foreign Security Policy (CFSP), the European External Action Service (EEAS), the European Security and Defence Policy (ESDP) and Space Policy as discussed above. Its contribution is in terms of communication services provisions for defence purposes, trans-national borders communication and disaster management issues. In addition, underlining the strategic role of SatCom for the Digital Agenda, SatCom can be the right enabler to deliver millennium goals also to European neighbours, such as Africa and the Middle East in a very cost-effective way because the services are provided with the same investment that is required for EU Broadband. In addition, the EU should be autonomous, not a stand-alone actor, but with others depending on it. For this purpose SatCom enables this strategic role and it can be a "traded-good" in relations with other countries, such as Russia, USA, and Asia. In addition, the EU has the duty to enhance its own growth and competitiveness also in view of the fact that foreign satellite operators can also serve European consumers; thus an opportune preventative action is required.

The study also considers the issues related with space law and international telecommunication law because, by definition, SatCom is an asset located in outer space that provides communication over a large coverage area from a transmitting point to another such point, thus easily crossing national borders. The main principle of international space law is the free use of outer space without any State sovereignty and carrying out activities for the benefit of all countries. Consequently there should be no military or aggressive use of outer space. SatCom is receiving particular attention with regard to making satellite communications available on a worldwide and non-discriminatory basis. The importance of SatCom as an element of international telecommunication law is addressed by the role of ITU that has the duty to assure an equitable, economic, efficient and free-of-interferences use of the spectrum. Thus, the regulation of orbital position, frequency allocation and coordination with terrestrial technologies is done at international level with continuous adaptation to emerging realities. The current issue concerns the exploitation of the Ka-Band for SatCom to meet the needs of the mass-market as required for the implementation of the Digital Agenda for Europe.

In the European context, SatCom can be considered as an element of space policy as per Art. 4 para 3 of the TFEU[3], with a *sui generis* shared competence, and/or an element of the trans-European network under Art. 4 para 2 TFEU, with a shared competence. From the regulatory point of view, the EU Telecom-Package regulates European electronic communications. The two most controversial aspects of the recently updated EU electronic communications policy for SatCom satellite services are the European spectrum allocation process, and its technology and service neutrality approach to spectrum access and usages. The first was designed to implement the common market, and the second aims to make spectrum bands available to all users irrespective of the technology used and the services provided. The concepts of technology neutrality, service neutrality, and flexible spectrum management can affect each technology in a different way, even if the overall principle is intended to foster competition and efficient allocation of resources. In the case of SatCom, the neutral allocation and assignment of frequencies is unfair as satellites are more suited to specific frequency bands. Since these bands are finite, with every frequency allocation lost to terrestrial services, a progressively less suitable spectrum is available for future satellite deployment. Moreover, the coexistence of terrestrial, especially mobile terrestrial communications and SatCom is very difficult in some frequency bands. Service neutrality is seen by device manufacturers and operators as a barrier to investing in the development of new technologies if spectrum availability for them is uncertain. The negative aspects of both service and technology neutrality are smaller economies of scale for device manufacturers, and loss of international harmonization, making interworking and roaming difficult if not impossible. These factors are also seen as contributing to higher end user prices. Other considerations concern the opportunity to create the best value for the spectrum in an environment free of administrative costs and barriers. These issues are not addressed here. In this regard, SatCom must satisfy the international filings and coordination through the ITU. It is an additional obligation –burden- on the development of the sector that operators with terrestrial technologies do not have.

All these issues lead to a set of policy recommendations to the EU institutional actors, ESA and Member States.

[3] Treaty on the Functioning of the European Union

Action by	Policy Recommendations
EU Council	• Establish a Space Policy which uses SatCom as a cross-sectional technology satisfying the needs of different policies (e.g. defence, energy, disaster management, maritime, air transport, etc) in order to reduce the inefficiency and to maximize the benefit that can be shared in the implementation of the EU 2020 policies • Establish a Space Policy with a coherent vision of International relations, such as with Africa, to provide services supporting the delivery of the Millennium Development Goals, share technological achievements with Japan and USA and coordinate market position with neighbour Russia • Address the dual-use of SatCom including by sharing participation between the EU and national defence SatCom programmes • Address the model of Private-Public-Partnership (PPP) in order to save costs and effort in achieving the same goals and creating opportunities for tax revenue
EU Commission	• Establish a monitoring platform to understand the conflicts and complementarities between terrestrial and SatCom technologies in terms of economic, societal and strategic outcomes; • Establish a mutual learning platform in order to implement SatCom as a cross-sectional technology satisfying the needs of different fields, e.g. defence, energy, disaster management, maritime, air transport, etc • Coordinate the vision of FP7 ICT and FP7 Space and the next FP8 in order to gain economies of scale and of scope of all SatCom systems • Evaluate as a positive discrimination the vertical model of SatCom industry mainly between satellite operators and service providers and not just between SatCom manufactures and service providers in order to spread profit along the entire supply chain • Establish a common indicator at EU level to sense actual current and future needs of broadband services and assess the capacity of SatCom to respond to EU Digital Agenda on a level playing field with other technologies
EU Parliament	• Revisit the principle of technology and services neutrality in a way which takes into consideration the particularity of SatCom technologies in the field of ICT • Revisit the principle of efficient use and equitable access to the spectrum for SatCom considering its advantages in reaching remote areas with low demographic density • Establish the right of e-citizenship with the concept of the technological environment guaranteeing full interactivity between citizens and government (public administrations)
ESA	• Enhance the “integrated industrial policy” approach for EU Competitiveness not only for the EU but also in terms of better coordination between the ESA, EU and national initiatives; • Establish coordination measures between EU FP7 programme and ESA (ARTES 20) Integrated Applications • Enhance the concept of Integrated Applications for exploiting user needs in the field of SatCom • Coordinate with EC and Member States a SatCom system providing advanced value-added services to achieve *convergence* needs • Enhance R&D efforts for a winning technology of Ka-band SatCom in terms of satellite payloads and terminal devices
Member States	• Evaluate a position, harmonized in European sense, towards CEPT and ITU for the orbital positions and an environment free of interference • Propose a platform in order to implement coordinated national space initiatives as much as possible with ESA programmes also with an integrated vision using FP7, for instance national initiatives such as contributory elements of ESA programmes in line with the strategic mission of FP7 • Create, or make more consistent use of, fiscal and financial mechanisms (e.g. Structural funds) for encouraging the use of SatCom for citizens located in disadvantaged areas in order to achieve the EU Digital Agenda objectives • Support the implementation of PPP in order to coordinate private investment and public expenditure

The initiative to implement these messages could be taken by any one actor although this might affect other actors thus requiring integrated coordination of the measures.

Action by	Interaction with **ESA**	Interaction with **Member States**
EU Council	• Establish a Space Policy which uses SatCom as a cross-sectional technology satisfying the needs of different policies (e.g. defence, energy, disaster management, maritime, air transport, etc) in order to reduce the inefficiency and to maximize the benefit that can be shared in the implementation of the EU 2020 policies • Establish a Space Policy with a coherent vision of International relations, such as with Africa, to provide services supporting the delivery of the Millennium Development Goals, share technological achievements with Japan and USA and coordinate market position with neighbour Russia	• Address the dual-use of SatCom including by sharing participation between the EU and national defence SatCom programmes • Address the model of Private-Public-Partnership (PPP) in order to save costs and effort in achieving the same goals and creating opportunities for tax revenue • Establish a Space Policy with a coherent vision of International relations, such as with Africa, to provide services supporting the delivery of the Millennium Development Goals, share technological achievements with Japan and USA and coordinate market position with neighbour Russia
EU Commission	• Enhance the "integrated industrial policy" approach for EU Competitiveness not only for the EU but also in terms of better coordination between the ESA, EU and national initiatives; • Establish coordination measures between EU FP7 programme and ESA (ARTES 20) Integrated Applications • Enhance the concept of Integrated Applications for exploiting user needs in the field of SatCom • Coordinate with EC and Member States a SatCom system providing advanced value-added services to achieve convergence needs • Enhance R&D efforts for a winning technology of Ka-band SatCom in terms of satellite payloads and terminal devices	• Establish a monitoring platform to understand the conflicts and complementarities between terrestrial and SatCom technologies in terms of economic, societal and strategic outcomes; • Establish a mutual learning platform in order to implement SatCom as a cross-sectional technology satisfying the needs of different fields, e.g. defence, energy, disaster management, maritime, air transport, etc • Coordinate the vision of FP7 ICT and FP7 Space and the next FP8 in order to gain economies of scale and of scope of all SatCom systems • Coordinate with Member States a SatCom system providing advanced value-added services to achieve convergence needs • Evaluate as a positive discrimination the vertical model of SatCom industry mainly between satellite operators and service providers and not just between SatCom manufactures and service providers in order to spread profit along the entire supply chain • Establish a common indicator at EU level to sense actual current and future needs of broadband services and assess the capacity of SatCom to respond to EU Digital Agenda on a level playing field with other technologies

Action by	Interaction with **ESA**	Interaction with **Member States**
EU Parliament	• Establish the right of e-citizenship through the concept of the *technological environment* guaranteeing the full interactivity between citizens and government (public administrations). *ESA should provide the most feasible technology for this purpose,*	• Revisit the principle of technology and services neutrality in a way which takes into consideration the particularity of SatCom technologies in the field of ICT • Revisit the principle of efficient use and equitable access to the spectrum for SatCom considering its advantages in reaching remote areas with low demographic density • Establish the right of e-citizenship with the concept of the technological environment guaranteeing full interactivity between citizens and government (public administrations)

1. Introduction

During the last decade, the field of communication has seen many changes in terms of user needs and related technologies. The entire phenomenon is named *convergence* and it can be classified into four categories: *convergence of services*, *convergence of transmission lines*, *convergence of terminals* and *convergence of providers*. The driver of this phenomenon is user mobility and the desire to know increasingly about where the user is, where other users are and what is available in the vicinity. This situation implies a continuous "local awareness" of people who travel and move very often. The condition of mobility implies, on its side, having a comfortable and convenient technology in terms of fast connectivity, deployment and hand-usage. Thus great efforts have been made in the development of broadband and large-capacity info-communications network technology and the improvement of mobile communications technology resulting in the explosive growth of the Internet in terms of "infrastructure" and the number of users. Accordingly, prompt action to formulate and implement policies that can deal with these realities is an urgent matter in order to increase the growth and the competitiveness of EU.

SatCom, as satellite communications, can provide communication (point-to-point) and broadcasting (point-to-multi-points) services. The sector plays a significant role in TV broadcasting due to its ability to transmit content from a single point to many users, localized in a huge area, in a very cost-effective way. This has been the pot of gold for TV broadcasting services for 30 years that has enabled the enhancement of the market power of satellite operators in economic and financial terms. The economic and social importance of this sector has induced many governments to reduce State regulation and intervention and to leave the floor to market competition forces. Nowadays, with the greater *convergence* between the two fields mentioned above, SatCom is at a relative disadvantage for the mass market when compared with traditional communication that receives higher policy attention. This has created a gap in attention to some relevant elements of user rights in the sense of the exercise of citizenship. This issue is going to be increasingly important with the advent of e-government, i.e. digital interaction between citizens and public institutions. Users/citizens, located in remote locations where terrestrial infrastructures are unaffordable to provide digital communication, cannot easily interact with government with respect to e-government services (requests for transcripts, certifications, enrolment procedures, tax payment system, e-justice, e-wealth, e-learning and so on). This development creates an exclusion of certain parts of society and consequently creates inefficiency and barriers to the inclusive growth of Europe.

In order to fill this gap in a strategic way, the EC has adopted a policy initiative, *Europe 2020*, establishing three imperatives for the concept of European growth: *smart*, *sustainable* and *inclusive*. The ambition is to include every European citizen in the growth of Europe and this must be achieved with the minimum level of inefficiency and with no harmful inflationary impact. This target is becoming increasingly problematic due to the continuing demand side effects of the 2008-2009 financial crisis on the market confidence of consumers. This issue has been addressed in another EU policy initiative, the *European Economic Recovery Plan*, which is an anti-cyclical measure to offset the financial crunch by providing a demand *stimulus* through four initiatives including *High Speed – Internet for Everyone,* for which purposes SatCom is potentially a highly contributive element. SatCom can also be appreciated as providing a cost-effective solution to the implementation of the EU Digital Agenda with the ambition of making *every European digital*.

The social inclusion dimension is also enhanced by other EU policy initiatives that are part of the strategic plan of *Europe 2020*, such as *New Skills & Jobs*, *Fighting Poverty* and *Youth on the Move*. For these purposes, SatCom can play a significant role providing connectivity infrastructures and services as well as requiring a high level of qualified job-skills and relevant job-mobility for employees throughout European countries. SatCom industrial capacity is not uniformly distributed among European countries; some Member States have a developed space industry and others do not. Thus a degree of transfer of knowledge and expertise is required. Moreover, in emerging European space States

there is a clear trend towards the establishment of new companies belonging to the main holding groups. For instance, the establishment of corporate entities of EADS, Finmeccanica, Thales is common in the new Eastern European countries, above all when they became ESA Member States acquiring the right of *juste retour* on investments made for ESA programmes.

Continuing with the political target of European growth, SatCom can also be an element of two other essential attributes - *smart* and *sustainable* - mainly through the policy initiatives of *Innovation Policy* and *Resource Efficiency & Energy*. SatCom can also contribute to the aim for a better life in providing near-real time communication and alert messaging systems for air and maritime safety, military communications, disaster management procedures and monitoring energy infrastructures with their high degree of criticality. In addition, SatCom is a front-runner technology in terms of performance and it can inter-play actions between the public and private actors to enhance the benefits of the investments.

All these issues indicate the magnitude of the potential contribution of SatCom to European growth as a means of advanced digital communications. In addition, as an asset located in outer space it falls within the common policy field of European Space Policy (ESP), which has been addressed through seven space councils from 2004 to 2010. In this context, a *paradox* exists because it does not have any specific policy line. The main attention of ESP focuses on the delivery of the two flagship programmes, Galileo and GMES, losing, at the same time, the necessary interaction with SatCom. SatCom will play a key role in Galileo-derived applications and services and in maximizing the value of GMES data. There is an ESA programme (ARTES 7) for a European Data Relay Satellite that could improve the data delivery system to the ground of the Sentinels, which are the EU space components of GMES. While SatCom is part of this link, any specific *ad hoc* policy for SatCom is not easy to find in the ESP. Moreover, this linkage in itself is insufficient to complete the strategic vision of the ESP because the absence of efforts to develop SatCom means, in a certain way, reducing the autonomy of Europe. SatCom provides the largest number of launches thus enhancing the performance of the European launcher – Arianne-; it permits Europe to fill the orbital positions achieved after the extensive process of coordination and notification to ITU that would otherwise be lost, it sustains European know-how in digital communication in terms of patents and international relationships from the scientific, military and commercial points of view. All these achievements of European industrial policy should take the opportunity of delivering the EU Digital Agenda.

In light of these considerations, this study provides a contextual setting, in terms of international law, including space law and telecommunication law, and European telecommunication law, for analyzing the main issues emerging from the European Telecom Package. Then, the report focuses on two policy priorities: industrial policy for SatCom, and broadband development and deployment for delivering the Digital Agenda. These policy priorities are seen as timely opportunities for enhancing the sector in a more competitive way. The analysis of these two fields shows the main critical issues to be solved. This will lead to conclusions and policy recommendations, addressed to specific actors – the EU Council, EC, EU Parliament, ESA and Member States – for individual or interactive consideration and implementation.

2. The Setting

2.1 SatCom as a Technological Tool and its Legal Context

The deployment of global satellite systems raises technical and regulatory, as well as economic and political issues, the full dimensions of which can only be addressed through a systematic and comprehensive vision encompassing technological, industrial, market and regulatory dimensions. SatCom is the outgrowth of developments in two main areas - space technology and communications technology. Thus, this field is involved in the current phenomenon of *convergence*[4] of communication needs and related technologies. The borders between telephone, internet, television broadcast and mobile phone services are becoming blurred, even irrelevant. Convergence and the demand for new applications are associated with being "bandwidth hungry", which implies new frameworks of spectrum uses, technological challenges and business models. SatCom is deeply involved in this development. Thus there are several different new trends in terms of satellites with multi-spot beam antennas working in the Ka-band and the reduced size of terminals for communication-on-the-move (COTM) and communication-on-the-pause (COTP) with integrated applications (*e. g.* navigation, timing, positioning, geo-reference information, data and video transfers). The issue of convergence involves also the borders between communication (communication as one-to-one) and broadcasting (communication as one – to – many) with the adoption of IP multicast technology that transmits the same data by designating multiple destinations thus facilitating the delivery of large-volume data such as broadcast-type voice and video. In light of this consideration, this study will consider SatCom in its broadest sense without a strict division between communication and broadcasting. This choice follows the approach of the EU with its unified regulatory framework of electronic communications networks and services. This approach is the most focused one[5] in the world in dealing with the convergence issue.

SatCom comes from SATellite COMmunication and it refers to the field of communications provided via satellites, based in Outer Space. SatCom acts as a relay station in space transmitting messages from one part of the world to another. In this study report, it is assumed that a SatCom system consists of a *space component* (satellite) and *ground infrastructures* (e. g. control centre, network centre, end user devices). Thus, three segments can be considered:

- *Space asset*: satellite working in outer space;
- *Ground and Network*: control centre, the type of network required per type of application (e. g. simplex transmissions, point-to-point/duplex transmission, point-to-multipoint transmission, mobile antenna, star network and mesh network etc);
- *Value Added - Services* (VAS): terminal equipments and several applications (e. g. broadcasting transmissions, maritime services, IP transport, news gathering, telephony, corporate networks, backhauling etc).

Applicable law and policy principles therefore relate to areas such as: space international communication; principles concerning human rights and freedom of information; legality of transmitted or broadcast programmes and content with regards to copyright and neighbouring rights; right of privacy, defamation, regulated marketplaces for systems and services, governance models for policy provisions, etc.

2.1.1 SatCom and International Space Law

Space law is a body of international legal norms that has been developed since the beginning of the 1960's primarily under the auspice of the United Nations General Assembly and its Committee on the Peaceful

[4] Jenkins, H. 2006. Convergence Culture: Where Old and New Media Collide, New York University Press.

[5] T. Shinohara – Y. Okano, Worldwide progress in the convergence of telecommunications, information technology and broadcasting: the tasks facing Japan, NRI Papers N. 41, 2002.

Uses of Outer Space[6]. Today, there is a *corpus* of five international treaties[7] of space law that constitutes a framework[8] for the international regulation of all space activities and that is therefore valid also for SatCom. The formulation of legislative provisions for space has been approached intellectually in a fashion very different from traditional notions of international law. The basic approach, as expressed in the Preamble of Art. 1 of the Outer Space Treaty, is the common interest of mankind in outer space. This principle is explicitly and implicitly brought to the fore in a number of provisions such as that the exploration and use of outer space shall be carried out for the benefit of all countries. The international law of outer space is also expressed in the general principle that international law, including the Charter of the United Nations, applies to space activities. This principle is complemented by a number of provisions that are particular to space law: the principle of free use of outer space by all States, without discrimination which should be seen in conjunction with the principle that outer space is not subject to national appropriation in any form; particular stress is also laid on the principle of cooperation, mutual assistance and mutuality of interests as applicable to all space activities.

The principle of State sovereignty and equality of States is complemented by the notion that States bear the international liability for space activities whether they are carried out by the States themselves, by international organizations or by non-governmental entities. This implies that no outer space activity can be conducted without the consent of the liable government. This principle has also been incorporated into national space laws mainly for the regulation of private sector space activity such as private companies operating satellites in orbits and providing satellite services. It is important to underline that private actors are not directly relevant inside international community.

There is also another international principle of space law that has relevance for SatCom; it is the non-military use of outer space. Military SatCom is one of the most common space applications and there has been a huge debate concerning the non-military use of space. A part of juridical doctrine interprets this principle in a strict and absolute way concluding with the prohibition of any military *status* in space activities. This view is no longer current and the more accepted sense of "non-military" is that it means no aggressive behaviour in space activities. Even so, there are some doubts as to whether a distinction should be made between active and passive behaviour in the face of aggressive conduct - active conduct being in response to an aggression, passive conduct being "preventive" conduct in response to potential further aggression. While this issue is again on the table, there is nonetheless a kind of customary law that accepts and permits military SatCom applications in the context of the peaceful use of space for the benefit of all mankind.

The subject of SatCom has been specifically mentioned in a number of resolutions[9]adopted by the General Assembly. All stress the principle of international cooperation, particularly with regard to making satellite communications available on a worldwide and non-discriminatory basis. Satellite broadcasting has attracted particular attention. Following the work of the Working Group on Direct Broadcast Satellites set up in 1969, the 25th General Assembly unanimously adopted a resolution (2733 (XXV)) on this subject-matter. Apart from recognizing the potential benefits of satellite-borne television particularly for developing countries and the importance of large-scale international cooperation, the Assembly recommends "that the Member States, regional and international

[6] Following various basic resolutions (1972 (XVI) and 1802 (XVII)), the General Assembly, in 1963, adopted a "Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space".

[7] The Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (the "Outer Space Treaty"), adopted by the General Assembly in its resolution 2222 (XXI), opened for signature on 27 January 1967, entered into force on 10 October 1967; The Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space (the "Rescue Agreement"), adopted by the General Assembly in its resolution 2345 (XXII), opened for signature on 22 April 1968, entered into force on 3 December 1968; The Convention on International Liability for Damage Caused by Space Objects (the "Liability Convention"), adopted by the General Assembly in its resolution 2777 (XXVI), opened for signature on 29 March 1972, entered into force on 1 September 1972; The Convention on Registration of Objects Launched into Outer Space (the "Registration Convention"), adopted by the General Assembly in its resolution 3235 (XXIX), opened for signature on 14 January 1975, entered into force on 15 September 1976; The Agreement Governing the Activities of States on the Moon and Other Celestial Bodies (the "Moon Agreement"), adopted by the General Assembly in its resolution 34/68, opened for signature on 18 December 1979, entered into force on 11 July 1984.

[8] Most of these principles were thereafter incorporated in the Outer Space Treaty of 1967, which has been complemented by special instruments on particular subjects (rescue of astronauts, liability, etc.). The principles are embodied in the Declaration and the Treaty.

[9] Inter alia see: UN, Resolution adopted by the General assembly n. 1721 (XVI) International co-operation in the peaceful uses of outer space, 1085th plenary meeting, 20 December 1961; Resolution n. 2776 (XXVI) International co-operation in the peaceful uses of outer space, 1998th plenary meeting, 29 November 1971.

organizations, including broadcasting associations, should promote and encourage international cooperation on regional and other levels in order, *inter alia*, to allow all participating States to share in the establishment and operation of regional satellite broadcasting services and/or in programme planning and production". It is obvious that in new, constantly evolving fields such as space law, there would be a difference of opinion as regards the interpretation of the principles adopted, particularly since these principles represent a new dimension in international law. There are also other principles of international space law that are relevant for these purposes, such as:

- The identification of the launching State[10];
- International State liability for outer space activities.

These matters are common to all space-based activities, thus they are not investigated in this context.

While this is general agreement on the applicability of the United Nations Charter, the Outer Space Treaty and relevant provisions of the International Telecommunication Convention and the Radio Regulation to satellite communication and broadcasting, opinions differ as to whether and to what extent the content of satellite broadcasts should be regulated by further legal rules. Some countries favour new sets of general principles or even detailed rules while others consider that no rules be established and still others would prefer regional and international cooperative arrangements. The difficulties are obvious in view of the differences in the roles, status and structures of broadcasting in the world and in the interpretation given to concepts such as freedom of speech, censorship and control of media. At the basis of *international telecommunication law* is the principle of State sovereignty expressed in terms of the fully recognized sovereign right for each State to regulate its own telecommunications, including SatCom. However, international cooperation is necessary to establish telecommunication links between countries and for the use of radio waves, the behaviour of which varies with frequency and which are propagated without regard for man-made frontiers. Thus, preventing harmful interference to the delivery of costly communications, the international allocation of frequencies, government licensing of all kinds of radio stations and international notification and registration of frequency use are the main activities regulated by international telecommunication law. At the international level a significant problem posed by the transmission or broadcast of programmes via satellites lies with the need to strike a balance between two legitimate and sometimes contradictory considerations: on the one hand the desire and need to increase the free flow and wide dissemination of information and of educational and cultural materials and, on the other, the desire to protect the holders of rights covered by the various international conventions. In these respects, there is a need to reach globally acceptable international arrangements taking into account the interests of all countries, particularly the needs of developing countries.

2.1.2 SatCom and International Telecommunication Law

Telecommunications poses extra-national issues. Thus, coordination among different States is required. There exists an International Organization under the UN, the International Telecommunication Union (ITU), with the task of assuring an operational environment for communication that is free of interference so orbital location and radio spectrum are regulated by two types of actions:

- Allocations: this is the process by which the ITU identifies particular ranges of radio frequencies as appropriate for particular services. Allocations are decided in the Table of Frequency Allocations set out in the Radio Regulations as an international treaty. Once adopted as part of the Radio Regulations, the frequency allocations are binding upon ITU members;
- Allotments: this solves the problem of interference. It is a bilateral agreement between two interested States.

This framework is established by ITU Regulation. The aim of the Radio Regulations is to ensure rational, equitable, efficient and economical use of the spectrum/orbit resources by all radio services, terrestrial and space services. In so doing, the sovereign right of each country to regulate its telecommunications must be preserved. As a starting point, the applicable legal instruments are the International Telecommunication Convention and the Radio Regulations, which both have treaty force. These instruments differ from most other international treaties in the way they are prepared and adopted by the Plenipotentiary and Administrative Conferences, in their contexts and in the manner in which they are applied and administrated. Consequently, the ITU performs a number of functions related to management of the RF spectrum. It establishes technical standards to

[10] Ex art. 1 Convention on International Liability for Damage Caused by Space Objects, 1971.

govern the power, modulation techniques, and other properties of radio emissions; it allocates frequencies to particular services; it makes allotments of frequencies among nations; and it defines conditions under which users of spectrum have the right to operate free of interference. Thus the ITU is organised under three sections[11]: Radio communication (ITU-R); Telecommunication Standardization (ITU–T) and Telecommunication Development (ITU-D).

ITU-R focuses on terrestrial and space-based wireless services, and develops operational procedures. The world for ITU purposes has been divided into three regions: Region 1 comprises Europe and Africa, Region 2 is the Americas and Region 3 is Oceania and Asia. Each area has proper frequency allocation plans[12] with *planned* sections following a command & control model, where frequencies are allocated by type of uses and each State has its proper spectrum quota; and *unplanned* sections having a common model where the rule of "first-come, first served" applies. Within the ITU-R overall mission, one of its main strategic objectives is to maintain and enhance the relevance of the sector in the efficient management of the radio frequency spectrum – and orbital locations, which are increasingly in demand from a large number of services and/or Administrations. In addition, it provides a forum for technical studies, which serve as a basis for the regulatory decisions made at World Radio Communications Conferences (WRC)[13]. In order to harmonize the position of States in a coherent way, the pre-workload to each WRC is managed through regional organizations[14].

The WRCs are officially part of the ITU. They provide a unique global forum in which governments and regulators, service providers and manufacturers, and other spectrum users can share knowledge and improve settlements.

The issue of political versus technical interests becomes more crucial with the growth of regional activities for coordination and the economic value of the spectrum. In addition, industry has international – rather than merely national – representation, affecting the technical study process. In turn, the WRC process' impacts on industry are significant: resulting in delays, uncertainties and political compromises can affect viability. At national level each country has an internal regulator organization in charge of national positions for the WRC as well as for national frequency management, authorization and licensing. Each country has the right to regulate telecommunications in its territory. A member country cannot change the service allocations, but it can apply them to particular services or operators. SatCom can result in interferences with the ground antenna and other terrestrial technologies. Thus, to have a free-from-interferences operational status, spectrum and orbit[15] and coordination with terrestrial technologies, as picture 1 shows, have to be determined[16].

The table 1 shows three mechanisms to regulate and manage spectrum, which have been proposed in specialized literature.

[11] Each works through world conferences or assembles and meetings, where members negotiate agreements that serve as the basis for the operation of global telecommunication services.

[12] As regards spectrum regulation, it is necessary to take account of the fact that the spectrum is a natural resource that is infinite by definition but not all the spectrum has the same peculiarities in terms of related wavelength, thus it has limitations in terms of sharing and related uses.

[13] Changes to the Radio Regulations can only be made by the WRC, meeting every three years. Each WRC defines the agenda for the next WRC. The WRC agenda contains the regulatory matters which will be under discussion. The WRCs are prepared in the specific subject Working Groups at national, regional and world levels during the three year interval.

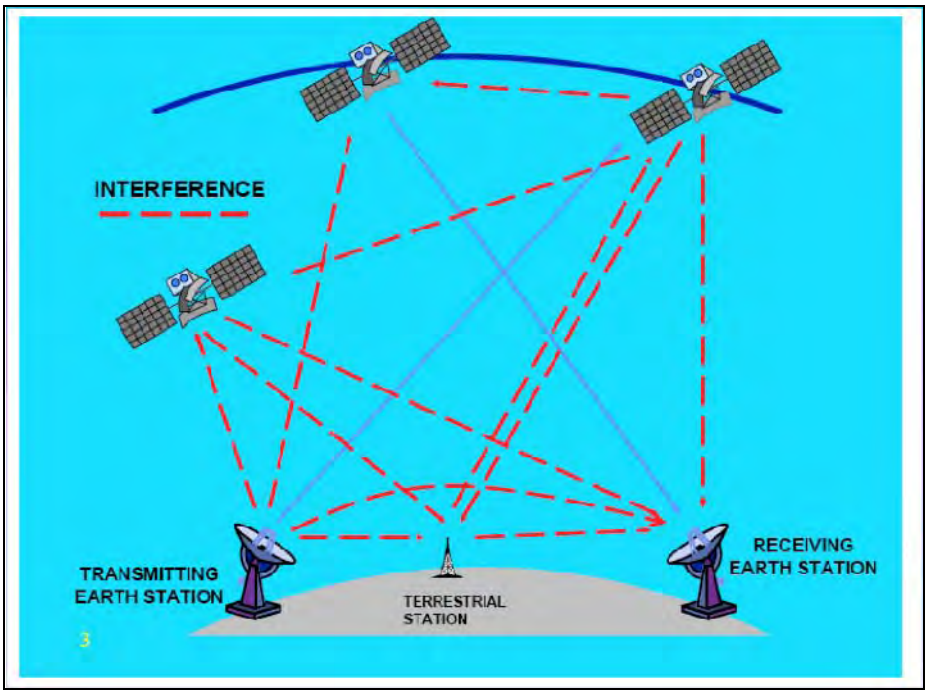
[14] Regional organizations are responsible for preparation of the regional common positions about each item to be discussed in WRC as well as standardization activities, etc, they include:

- Inter-American Telecommunication Commission (CITEL) for American countries;
- European Conference of Postal and Telecommunications Administrations (CEPT) for European countries;
- Asia-Pacific Tele-community (APT) for Asian and Pacific countries;
- African Telecommunication Union (ATU) for African Countries and
- League of Arab States (LAS) for Arabic Bloc.

[15] The geostationary position is also a scarce resource since the number of orbital positions is limited and it is necessary to have a minimum separation between adjacent satellites to avoid interference.

[16] Before bringing into service a new assignment, the user has to follow the procedures included in the RR. There are two main mechanisms to share the orbit/spectrum:

- National allotment in a Plan for accessing BSS and FSS planned bands, and
- Coordination to access unplanned band ex Art. 9 ITU RR.



Picture 1: Cases of Interferences concerning SatCom (Source: ITU, 2010)

Mechanism	PROs & CONs	ITU Regime	Note
Command & Control	**PROs**: It clearly determines how the spectrum must be used in terms of technologies and services. It solves all the interference issues. **CONs**: It is a restrictive use as it does not give incentives for efficient or further uses.	It is adopted per the planned Frequencies Bands.	It is considered to give equitable access to spectrum usages to all countries (developed and developing).
Commons Model	**PROs**: It is a flexible mechanism and easily adaptable to new demand in terms of technologies and services. **CONs**: It is difficult to implement with several actors and technologies.	It is adopted for the unplanned frequencies bands but requires mandatory coordination and uses the principle of *first come first served*.	It is suitable for new technologies permitting more efficient use of the spectrum but it creates some inequity for developing countries with fewer capabilities.
Market Mechanism	**PROs**: It is a flexible mechanism and easily adaptable to new demand in terms of technologies and services. It is able to create a *value* for the spectrum. **CONs**: It can generate *rents seekers* and consequently abuse of dominant position. It creates lack of concern for services that may not be economically sustainable.	---	There are at least four types of approaches: - *First come & first served*; - *Lottery* - Beauty Contest - Auctions.

Table 1: Spectrum Regulatory Model and ITU Approaches

This ITU practice can generate some inefficient uses of the spectrum, particularly for countries that are not ready to use advanced technologies, because of the way that SatCom systems can easily cover more than one national area. Thus ITU could promote a mechanism of "share technologies" between developed and developing countries with

respect to the financial risks and the national sovereign right of each country to access and use the spectrum. The mechanism of *first come first served* has been mitigated by the establishment of a monetary fee during the process of notification with the aim of reducing cases of "paper satellites" that produces a wasteful workload for the ITU. In particular, this bad attitude bypasses the co-operative spirit of the ITU RR, reduces the efficiency of the ITU system, and increases congestion in the skies and leads to business uncertainty and regulatory risk. There is little incentive for national administrations to stop this practice. First, over-filing increases the chances of getting a good orbit or frequency assignment. Second, the ITU has no enforcement mechanism; it relies instead on members' goodwill and cooperation. Third, goodwill can give way to commercial interests when large sums of money are at stake. Fourth, the ITU process only works correctly if the spirit of the RR is universally respected. In light of these issues, the next WRC 2012 already has a detailed agenda[17] and the main points for SatCom are the following:

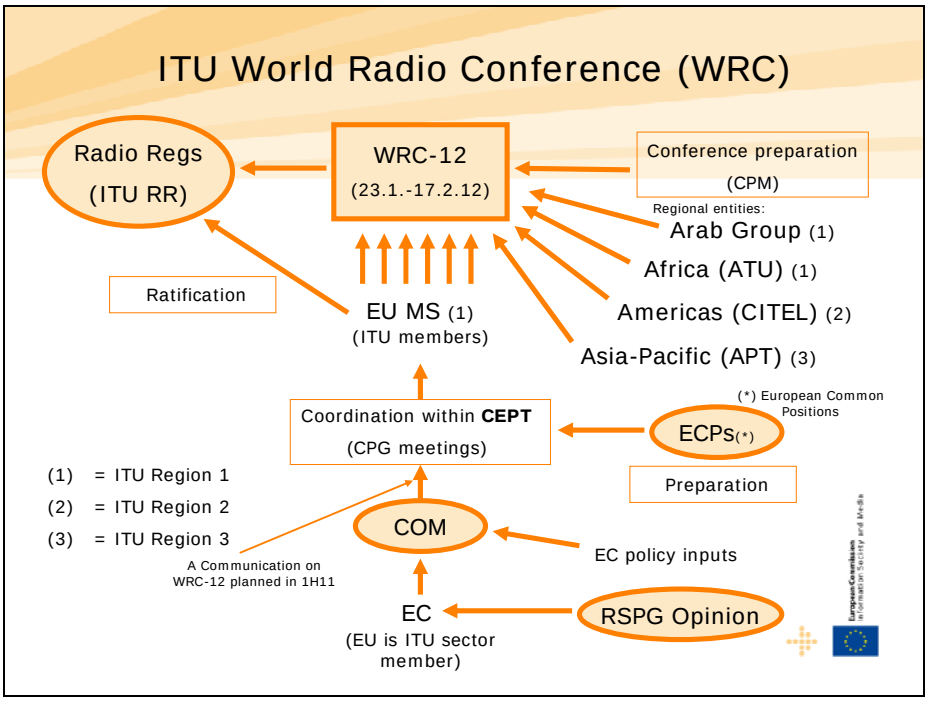
- Reconsidering mechanisms to reduce paper satellites that restrict access options[18];
- Preventing the situation of satellites that maybe already in orbit before completion of filling procedures and coordination[19];
- Reconsidering the timeframe may often be insufficient for developing countries to be able to complete the regulatory requirements as well as the design, construction and launch of satellite systems[20];
- Increasing awareness concerning the lack of provisions for international monitoring to confirm the bringing into use of satellite networks (assignments and orbits)[21];
- Increasing coordination of new satellite systems with systems providing aeronautical and maritime radio-communications and preventing harmful interference;
- Consideration of a CEPT Proposal for Europe requiring review of ka-band frequencies and related usage for deployment of broadband[22].

2.1.3 SatCom and European Telecommunication Law

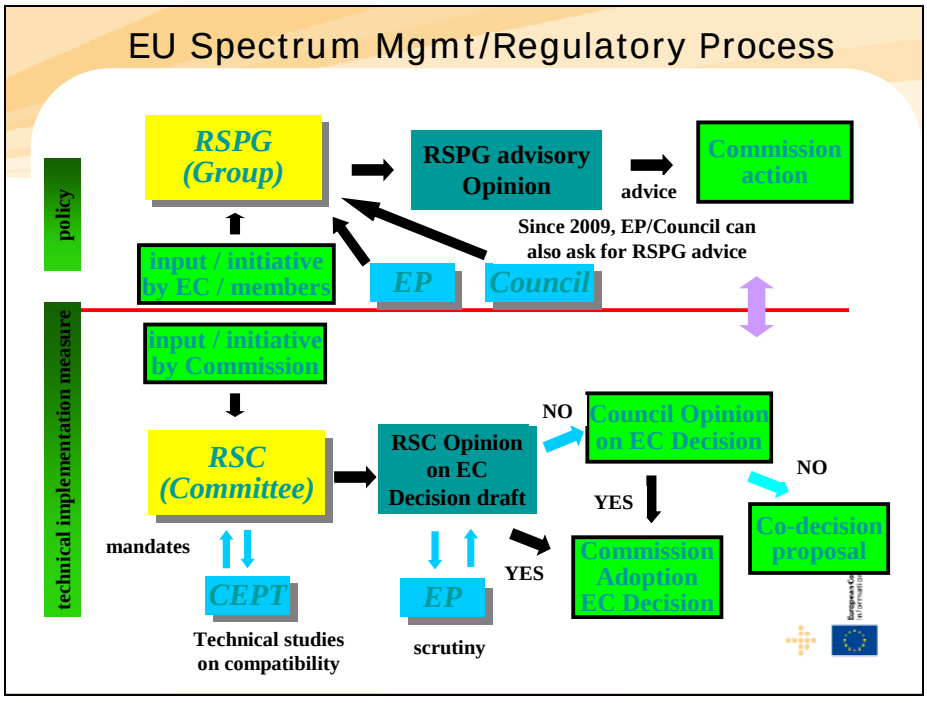
The role of the EU in this context is undertaken by different actors, involving a high degree of coordination of technical and policy issues. The main active players remain the EC and the Member States because the spectrum is still an issue of national sovereignty particularly affecting matters of security, defence, safety and emergency. The EU as an observer member is involved in ITU activities, but it does not have voting or other rights. There is a current debate about whether the EU should be recognized a full-member of ITU and its relevance. The issue is not easy; if the EU were a full individual member of the ITU, European Member States would lose their votes and for the EU overall it would not be an advantage. On the other side it is true that EU would increase its weight under the CEPT towards other CEPT members. The diagram in picture 2 shows the coordination mechanisms of EU with respect to the ITU.

There are different players that are classified by competence in terms of policy, technical and areas of services. The two dimensions of this categorisation – technical and policy – necessitates having separate entities. On the technical side there is the *Radio Spectrum Committee* (RSC)[23]. It assists the EC in the development and adoption of technical implementing measures aimed at ensuring harmonized conditions for the availability and efficient use of the radio spectrum. The European Telecommunications Standards Institute (ETSI) produces globally-applicable standards for Information and Communications Technologies (ICT), including fixed, mobile, radio, converged, broadcast and internet technologies; it is officially recognized by the EU as a European Standards Organization. The diagram in the picture 3 shows the relationships in the EU framework for spectrum management.

[17] ITU, 2012 World Radio Communication Conference - Agenda and References (Resolutions and Recommendations), 2010.
[18] Under Resolution 86, Agenda Item 7 to the Agenda of the WRC 2012, several proposals are considered to improve the procedures of Advance Publication-Coordination-Notification and Recording of frequency assignments associated to satellite networks.
[19] ITU, id., pp. 42.
[20] ITU, id., pp. 42.
[21] ITU, id., pp. 43.
[22] The position of CEPT can be seen on ECC Report 152 (publication: Sept. 2010) that provides details on those issues and studies to be carried out by CEPT (FM44/SE40 – www.ero.dk).
[23] It was established under the Radio Spectrum Decision 676/2002/EC as part of the new regulatory framework for electronic communications since 2002.



Picture 2: Coordination of EU toward ITU (Source: EC DG INFSO, 2010)



Picture 3: EU Spectrum Management and Regulatory Framework (Source: EC DG INFSO, 2010)

On the policy side, the role of Radio Spectrum Policy Group (RSPG)[24] is relevant for the spectrum management among European Member States. The remit of the RSPG has been extended as a result of the adoption of the new telecom regulatory framework in 2009[25]. According to the new remit, the RSPG can now also be requested by the European Parliament and/or the Council, in addition to the Commission, to issue an opinion or produce a report on specific radio spectrum policy issues relating to electronic communica-

[24] The RSPG is established under Commission Decision 2002/622/EC, which was one of the Commission initiatives following the adoption of the Radio Spectrum Decision 676/2002/EC and it adopts opinions, position papers and reports, as well as issuing statements, which are aimed at assisting and advising the Commission at strategic level on radio spectrum policy issues.

[25] EC Decision 2009/978/EU of 16 December 2009 amending the Decision establishing the RSPG.

tions. Those opinions and reports shall be transmitted by the Commission to the institution which so requests. Where appropriate, they may be in the form of oral presentation to the European Parliament and/or the Council by the chairman of the Group or a member nominated by the Group.

Recognizing the risks to international satellite operators, the EU's 2002 Spectrum Decision established a Community legal framework to ensure that national spectrum allocation policies are coordinated[26], and where necessary, harmonized[27]. Although the Spectrum Decision was a significant step for satellite operators, the jury is still out on the success of the pan-European spectrum allocation process. The system, as picture 3 presents, was designed to remove regulatory risks; the selected entities often require an additional license from individual States, which is unnecessary under a national allocation process. A pan-European selection and authorization process can be time consuming to establish and run, and is open to legal challenges if a well-balanced process is not in place. The harmonization approach permits saving time and money.

The management of the spectrum, whether by command and control or by market forces, serves broader policy goals, primarily the delivery of the information society and through that the Lisbon agenda of jobs and growth. The primary framework for this is the creation of the *single market*, supported by policies for competition, spectrum allocation and research and development. These issues have particular relevance in the establishment of the internal market for electronic communications, including SatCom**.** The EU Telecom Package[28] comprises five Directives in table 2, namely:

- Directive on regulatory framework [29],
- Directive on the authorization[30] of electronic communications networks and services (the "Authorization Directive");
- Directive on access[31] to, and interconnection of, electronic communications networks and associated facilities (the "Access Directive");
- Directive on the universal service[32] (the "Universal Service Directive");
- Directive on the processing of personal data[33] (the "Privacy and Electronic Communications Directive").

This *legal corpus* is currently on the process of national transpositions. The set of regulatory policies has seminally ambitious goals of creating an environment with the following aims: *better regulation for competitive electronic communications[34], completing the single market in electronic communications[35], and increasing the level of consumer protection and facilitating access to and use of communications[36].*

[26] Decision No. 676/2002/EC of the European Parliament and of the Council of 7 March 2002 on a regulatory framework for radio spectrum policy in the European Community (Radio Spectrum Decision), [2002-OJ L 108 of 24.4.2002].
[27] Commission Decision 2007/98/EC of 14 February 2007 on the harmonized use of radio spectrum in the 2 GHz frequency bands for the implementation of systems providing mobile satellite services [2007 OJ L43 of 15.2.2007] further acknowledged the specific characteristics of satellite services in relation to terrestrial providers, thus paving the way for the first competitive pan-European spectrum allocation process.
[28] EU Directive 2009/140/EC of the European Parliament and of the Council of 25 November 2009 amending Directives 2002/21/EC on a common regulatory framework for electronic communications networks and services, 2002/19/EC on access to, and interconnection of, electronic communications networks and associated facilities, and 2002/20/EC on the authorization of electronic communications networks and services. Added to this list, there is also the Decision on a regulatory framework for radio spectrum policy (the "Radio Spectrum Decision"). The "Telecoms Package" was amended in December 2009 by the two Directives "Better law-making" and the "Citizens' rights" , as well as by a body of European regulators for electronic communications.
[29] EU Directive 2002/21/EC on a common regulatory framework for electronic communications networks and services.
[30] EU Directive 2002/20/EC on the authorization of electronic communications networks and services.
[31] EU Directives 2002/19/EC on access to, and interconnection of, electronic communications networks and associated facilities.
[32] EU Directive 2002/22/EC of the European Parliament and of the Council of 7 March 2002 on universal service and users' rights relating to electronic communications networks and services (Universal Service Directive).
[33] EU Directive 2002/58/EC of the European Parliament and of the Council of 12 July 2002 concerning the processing of personal data and the protection of privacy in the electronic communications sector (Directive on privacy and electronic communications).
[34] The EC proposes improving the existing regulatory framework by maintaining ex-ante regulation, subject to market trends. It also proposes simplifying access to the radio spectrum in order to encourage investment in new structures and release the economic potential of the spectrum.
[35] The single market for electronic communications is still currently segmented and suffering from a complete absence of coherence. The EC recommends establishing an independent "European Electronic Communications Market Authority" which will build on the increased independence of NRAs and improve existing coordination mechanisms.
[36] It includes disabled users. The proposals aim in particular to strengthen security and privacy and to promote a high quality of service and unobstructed access to digital content. The EC wishes to ensure the independence of regulatory authorities, whose links with traditional operators are often overly close, so as to ensure competition and consumer rights.

Directive	Aims	Remarks
Regulatory Framework	It establishes a harmonized regulatory framework for all electronic communications networks and services across the EU.	It sets out management of scarce resources such as radio spectra
Authorization	It aims to implement harmonization and simplification of authorization rules and conditions in order to facilitate their provision throughout the EU.	It considers a "general authorization" that should limit administrative barriers to entry into the market to a minimum.
Access	Technological neutrality for product or service markets in particular geographical areas, to address identified market problems between access and interconnection.	It provides legal certainty for market players by establishing clear criteria on their rights and obligations and on regulatory intervention.
Universal Service	It aims to ensure universal service provision for public telephony services in an environment of greater overall competitiveness,	It aims to ensure the interoperability of digital consumer television equipment and the provision of certain mandatory services.
Privacy and Electronic Communications	It harmonizes the provisions of the Member States required to ensure an equivalent level of protection of fundamental rights and freedoms,	It basically translates the Privacy Directive into the case of electronic communications.

Table 2: EU Telecom Package

The two most controversial aspects of the recently updated EU electronic communications policy for communications satellite services are the pan-European spectrum allocation process, and its technology and service neutrality approach to spectrum access. The first was designed to implement the common market, and the second aims to make spectrum bands available to all users irrespective of the technology used and the services provided. The concepts of technology neutrality, service neutrality, and flexible spectrum management are poorly defined and open to varying policy-driven interpretations. While the satellite industry favours technology and service neutrality in principle, it considers the neutral allocation and assignment of frequencies unfair as specific satellites are more suited to specific frequency bands. These bands are finite, and with every frequency allocation lost to terrestrial services, increasingly less suitable spectrum is available for future satellite deployment. Moreover, it has been proven regarding C-band that the coexistence of terrestrial, especially mobile terrestrial, and satellite services in some frequency bands is very difficult, if not impossible[37]. Introducing flexibility into the management of certain core satellite frequency bands therefore jeopardizes the existing spectrum rights of satellite operators. In addition, the neutrality approach was introduced when technological solutions were already on the market with the aim of not disadvantaging anyone. Harmonization contributes to the single market in terms of greater economies of scale, more competition, less cross-border interference, more pan-European networks and more roaming. On the other side, a low degree of harmonization creates less flexibility to fit local markets, instances of both under and over utilization of the spectrum at the same time, additional costs and unequal benefits.

According to the EU set of rules, the spectrum must be managed in a transparent, non-discriminatory, objective way with equitable access to the spectrum, pursing the principle of neutrality in terms of technology and service. The effects of service neutrality and technology neutrality were other issues that were under consideration. Service neutrality was seen to maximize the economic value of the spectrum, in that the services creating the highest revenue would be implemented. This was also seen as a negative issue, as public services such as public broadcasters would likely be replaced by more profitable services. Also, device manufacturers and operators were seen as more unlikely to invest in the development of new technologies if spectrum availability for them was uncertain. A possible negative effect that respondents named was spectrum hoarding, that is, the possibility of acquiring frequencies for speculative purposes or to lock-out

[37] Earth station receive antennae are very sensitive and therefore susceptible to harmful interference generated by co-frequency transmissions and out of band transmissions from terrestrial services operating in adjacent bands.

competition. Technology neutrality without service neutrality was seen in a more positive light. It would enable technology upgrade paths for operators using existing spectrum leading to faster time-to-market for new technologies[38]. Easier migration paths were also seen to lead to increased competition between technologies. The negative aspects of both service and technology neutrality were identified as smaller economies of scale for device manufacturers and loss of international harmonization, making interworking and roaming difficult if not impossible. These factors were also both seen to contribute to higher end user prices. There are also considerations concerning the opportunity to create the best value for spectrum with an environment free of administrative costs and barriers that, here, are not addressed[39]. There is also another way to achieve effective and efficient use of the spectrum by cognitive radio devices. This requires that devices are able to switch operations into "white areas" of the spectrum where performances are better. This technology should be useful also for SatCom due to interference created with terrestrial technologies in down-link operations.

The areas for EU regulation must take into account the legal personality of the EU vis-à-vis its Member States and other international organizations, for instance the ITU and ESA. It is not easy to see where the right location for SatCom is. If SatCom is an element of Space Policy, it could be addressed by the Treaty on the Functioning of the European Union (TFEU) in accordance with Art. 4 para. 3, which expressly established a *sui generis* shared competence between the EU and the Member States in the area of space. In the areas of research, technological development and space, the EU shall have competence to carry out activities, in particular to define and implement programmes. However, the exercise of that competence shall not result in Member States being prevented from exercising theirs. Space is mentioned in Art. 179 (TFEU) in the *"objective of strengthening its scientific and technological bases by achieving a European research area in which researchers, scientific knowledge and technology circulate freely, and encouraging it to become more competitive, including in its industry*". Art. 189 TFEU mentions space as leverage "*to promote scientific and technical progress, industrial competitiveness*" and it charges the EU to develop a Space Policy. It continues in the following paragraph establishing that *the European Parliament and the Council, acting in accordance with the ordinary legislative procedure, shall establish the necessary measures, which may take the form of a European space programme, excluding any harmonization of the laws and regulations of the Member States.*

On the other hand, if SatCom is considered a component of a *Trans-European Network*, EU competence is expressed in Art. 4 *para* 2(h) as a *shared competence* between EU and Member-States: *Shared competence between the Union and the Member States applies in the following principal areas: (…) (h) trans-European networks; (…)*. It is suggested that this second possibility would establish a more harmonized and systematic policy with a higher degree of coherence and with a fair degree of efficiency for all European citizens. In addition, the behaviour of the EC in its mandate for telecommunication regulatory policy has been peculiar since the beginning. The EC has been by far the most active of the European institutions in telecommunications matters. In 1987 the EC published the *Green Paper on Telecommunications*[40]. This document went one step further by acknowledging the need for increased competition in telecommunications as a way of providing consumers with "a greater variety of telecommunications services, of better quality and at

[38] South Korea should be mentioned as an encouraging example: South Korean operators migrated to 3G technologies in existing frequencies as early as 2000, and today 3G users make account for 75% of subscribers, contributing to a 12 – 18% increase in revenues due to add-on services (CDG 2004).

[39] This means that the system of spectrum regulation should be workable, administrative outlay should remain within reasonable bounds, and transaction costs should be kept as low as possible. In addition, institutional barriers to spectrum trading should be kept as low as possible.
The set of regulations establishing this framework has the duty to assure best use of the spectrum. In economic terms it means that frequencies have to be assigned to those who can use them most efficiently. This can be for those who have a higher willingness to pay but at the same time this does not assure the best benefits for the effective use of the spectrum. Otherwise, it creates positions of speculation and abuse. It implies that the charge for using the spectrum should never be higher than the corresponding opportunity cost, which is equal to the market price. It is required, then, to create incentives for investment in new technologies that are able to contribute in a positive way to the effective use of the spectrum. It implies that users have to able to use the spectrum for a period that is sufficient to amortize the investment occurs and on the other hand, care also needs to be taken to ensure that spectrum regulation does not have a negative impact on the returns that can be achieved in certain sectors. Some theorists envisage creating a framework for a simulated market contest.

[40] The Green paper was a clear declaration of principles on the part of the EC. Far from deferring to national governments, the EC announced that it would act aggressively to open the telecommunications sector to competition as soon as feasible. The EC was certainly aware that it would encounter strong resistance from State Members' intent to preserve telecommunication monopolies.

lower cost". The EC took a bold step: the regulations that implemented its telecommunication policy were adopted under Art. 90[41] of the Treaty Establishing the European Economic Community (EEC Treaty), which arguably permitted the EC to bypass other European Community institutions in promulgating laws. The directives were addressed to Member States and had to be implemented through national legislation. They could be issued by the EC or by the Council. Member States opposed this aspect of EC regulation and submitted a case to the Court of Justice. The Court of Justice dismissed this as under Art. 90 (1) which directs Member States to "neither enact nor maintain" rules that permit monopoly holders to engage in anticompetitive behaviour to preserve their market power. In addition the Court drew a distinction between general decision-making powers regarding establishment of the Common Market, which it deemed to be subject to Art. 100 A, and specific enforcement powers in competition matters placed under EC jurisdiction by Art. 90 of the EEC Treaty. This decision was a victory for the EC and bestowed upon it new levels of authority. Then the Court went further by affirming the principles of a well-known competition case, making it applicable to telecommunication equipment, and leaving the door open to its application to services. In the case *Procurer du Roi vs. Dawsonville*[42], it was firmly established that "all trading rules enacted by Member States which are capable of hindering directly or indirectly, actually or potentially intra-Community trade" are illegal under Art. 30 of the EEC Treaty[43].

2.2 SatCom in the European Policies

SatCom is addressed by different European policies due to its place as a means of communication, critical infrastructure and its strategic value for Europe. This paragraph shows the enabling role of SatCom for each identified European policy, such as the Lisbon Strategy and, more broadly, space policy, international relations and industrial policy. The table 3 gives an overview. The context of industrial policy and broadband development and deployment will be considered in the next chapter as "the policy priorities".

Policy Field	Current Policy Initiatives
Space Policy	• 1st - 7th Space Councils

Lisbon Strategy	• European Economic Recovery Plan
	• Europe 2020:
	  • Digital Agenda
	  • Innovation Policy
	  • New Skills & Jobs
	  • Fighting Poverty
	  • Youth on the Move
	  • Resource Efficiency & Energy

International Relations	• Common Foreign Security Policy • European External Action Service • European Security & Defence Policy
Industrial Policy	• Integrated Industrial Policy • FP7:Space and ICT

Table 3: SatCom is an element in EU Policy Initiatives

[41] Art. 90 of the EEC TREATY imposes upon Member States the obligation to neither enact nor maintain measures contrary to the treaty in their relationship with state enterprises (as undertakings) and with enterprises which have been granted exclusive rights of the same kind. Art. 90 (3) contains a special enforcement procedure permitting the EC to address directives to the Member States directly without first submitting them to the Council and the Parliament.

[42] Procureur du Roi v. Dassonville (Case 8/74): This was one of many court cases that helped to precisely define the European Economic Community's internal free trade policy. Belgium had imposed a law that firms importing Scotch whisky had to provide certificates of authentication from the government of the United Kingdom. When several importers began bringing in Scotch from France, the Belgian government sued them. The European Court of Justice found that the Belgian law was in violation of Art. 28 EC (Art. 30 of the original EC Treaty), which states: "Quantitative restrictions on imports and all measures having equivalent effect shall be prohibited between Member States." The court ruled that "all trading rules enacted by Member States which are capable of hindering, directly or indirectly, actually or potentially, intra-Community trade are to be considered as measures having an effect equivalent to quantitative restrictions." In essence, the case established that EC Member States could not show favouritism, in any way, shape, or form, toward other Member States in their trade policy.

[43] See for a comprehensive survey on these topics: EC, Guide to the Case Law of the Court of the Justice of the European Union in the field of Telecommunications, 2010, [http://ec.europa.eu/information_society/policy/ecomm/doc/implementation_enforcement/infringements/guidetocaselaw2010en.pdf - available at Nov. 2010]

2.2.1 SatCom as Element of Space Policy

The starting point for *Space Policy* is an analysis of Space Council Documentation, form the first one in 2004 to the most recent one - draft proposal - in 2010. The first Space Council[44] focused on four pillar points; scope and content of European Space Policy (ESP), governance, industrial policy and funding ESP. It did not give any specific address line for SatCom, even if an elaborate interpretation in favour of SatCom can be made using points establishing rules of "making best use of existing capacities and strengths and avoiding duplication of tasks" and recognising the "strategic importance for their contribution to the implementation of a wide range of European Policies". A specific policy on the role of SatCom was expected because the assets were already in orbit and they could be enablers for a wide range of European policies.

The second Space Council[45] recognized the strategic value of the space sector for Europe. It identified a role for the EU as a pro-active actor with the duty of identifying and bringing together user needs and political will in support of ESP and wider policy objectives. On the other side, it established the role of ESA as developer of space technologies and systems, supporting innovation and global competitiveness. In addition, the priorities of ESP were identified in terms of the two European flagship programmes, Galileo and GMES, the competitive access to space through launchers and all elements of the value chains. The key principles of implementation were incorporated as part of the motivation to maintain and reinforce scientific and technological expertise and capacities, and to encourage the necessary investment to sustain know-how, independence and globally competitive of European space industry. While SatCom was again not specifically mentioned, its importance could be seen as part of the maintenance of achieved know-how of the European SatCom sector.

The third Space Council[46] took account of the role of international cooperation in the European strategy for Space activities. International partners were classified into four categories: established space powers, emerging space powers, other powers and international organizations. The classification was made with the aim of increasing Europe's role in the world. It is also in this context that SatCom can play its role due its technological achievements and features but the sector is missed in a specific way.

The fourth Space Council[47] proposed a vision for Europe with a general strategy of viewing space as an element for enhancing European cohesion; established steps for programmes and their implementation rules, recognizing the strategic value of sustainability for implementation of space activities; considered the dual-value of space assets for civil and defence purposes; and emphasised the vital importance for Europe of maintaining independent, reliable and cost-effective access to space at affordable conditions. In addition, it emphasised the political and scientific importance of the ISS and space exploration. It stressed the role of science and technology to enhance the leading role of Europe. It proposed a coordination measure for the governance of space activities between ESA and the EU. In establishing industrial policy, it recognized the flexibility of ESA rules as an effective and cost-effective industrial tool. It also enhanced the role of international relations as tools for improving access to third markets for European industrial players and for cost-saving of space activities whose costs are so high for only a single space power. In addition it encouraged the implementation of Public-Private-Partnership (PPP) as a financing scheme for involving lead-market initiatives. In this contest the role of SatCom should be proposed as a component of European cohesion as it can provide the same services for huge areas at same time, it can have dual-use relevance for civil and military communications, it can be easy affordable for the PPP model and it can be an asset to strengthen the European role for sustainable development towards developing countries, *inter alia,* African States.

The fifth Space Council[48] recognised the need to develop and deploy space applications and services and related infrastructures to contribute to societal, cultural, economic and scientific achievements, develop industrial and scientific potentialities and assure political and technological autonomy in a reasoned, coherent and realistic manner. It recognised four priority areas, namely, the contribution of space to climate change, space as an enabler of the Lisbon strategy, the relationship between space and security as de-

[44] 1st SPACE COUNCIL, Orientations from the first Space Council on the preparation of the European Space Programme, Council of the European Union, 25 November 2004.
[45] 2nd SPACE COUNCIL - Orientations from the second Space Council, Council of the European Union, 7 June 2005.
[46] 3rd SPACE COUNCIL - Orientations from the third Space Council on Global Monitoring for Environment and Security (GMES), Council of the European Union, 28 November 2005.
[47] 4th SPACE COUNCIL - Resolution on the European Space Policy, Brussels, 22 May 2007.
[48] 5th SPACE COUNCIL, Council Resolution: Taking forward the European Space Policy, 26 September 2008.

fence and foreign policy highlighting coordination between civilian and defence space programmes in the long-term arrangements, and establishing mitigation strategies to ensure guaranteed European access and reduced European dependence. In addition, it also remarked on need to develop a common vision and long-term strategic planning for exploration.

The sixth Space Council[49] recognised the value of an established framework for a structured dialogue concerning the coordination of space and defence, and the potentiality of identifying critical space technologies for European non-dependence. It emphasized the contribution made by space activities to the targets of the European Economic Recovery Plan (EERP), recognising *inter alia* the existing innovation support mechanisms in Europe at all levels, the cross-fertilization of knowledge, innovation and ideas between space and non-space sectors and between space industry and the academic world. It is the first time that a specific role of SatCom was recognised for Europe. SatCom was seen as an enabler technology to fill the broadband in terms of the binding implementation of EERP. It was seen as an integrating technology in the future broadband for Europe respecting the principles of open competition, technology neutrality and open and neutral Internet architecture. In addition, there is the need to explore innovative approaches and architectures for the provision of global satellite communications services in response to institutional demand for wider European policies: transport, energy and security.

The seventh Space Council is fully aware that space is an enabler for the delivery of EU policies, specifically in contributing to Europe 2020´s growth aims. It promised the necessary actions to protect and sustain the availability of critical space technologies, launchers, satellite systems and know-how; to promote healthy industry for a sustainable Europe, to prevent harmful interferences of satellite signals and to take into account the needed frequencies for Europe. European industry has to be sustained in a competitive way on European and export marketplaces. Attention then focused on the seven pillars: strategy and investment; the implementation of the flagship programmes Galileo and GMES; the contribution of space to combating climate change and its effects; the role of space for security and the security of space; the vision of space exploration; the partnership on space with Africa; and the governance of space activities in Europe. Particular mention was made of the potential contribution of space activities, including SatCom, to the sustainable development of the African continent and achieving the Millennium Development Goals (MDGs). The expansion of broadband is a critical factor in development, and in meeting the MDGs. Broadband has value in delivering health services and education, as well as its role in cultural diversity, and the generation of economic activity and management of climate change, natural disasters and other global crises. Highlighting the need for governments to raise broadband to the top of the development agenda and speed up its rollout, the importance of providing affordable broadband in the least developed countries was recommended. The role of SatCom as the best tool in the provision of broadband services in rural and remote areas or in the case of natural disasters when land infrastructure is not available should be stressed. Satellite technology is rapidly deployable, highly reliable and capable of delivering the access speeds required by applications. Satellites represent instant infrastructure that is economically viable and efficient. The main challenge for SatCom, following the policy lines of this last space Council, is to establish a significant role in the partnership with Africa initiative. The message is different from previous Space Councils as the policy is *with* and not *for* Africa anymore. Thus it is opportune to identify synergies of Europe with African stakeholders. In a special way, strategic synergies with local satellite operators with planned and on-orbit satellites for providing services locally are envisaged.

The ESP is deeply focused on the successful delivery of GMES and Galileo. On the one hand, this seems to exclude the relevance of SatCom but there are tasks that can be delivered only if SatCom is considered. The full role of Galileo and GMES can be exploited only if communications are effective and uniform over the European continent. The real relevance of downstream services and the effective strategic value of the two programmes are evident in the context of disaster management and post-crisis events where land telecommunication infrastructures collapse or are damaged or even destroyed. The last two Space Councils remarked on the leadership role of the two programmes as drivers of all space value chain and applications, including SatCom that is a basic underlying layer. The ESA expressed some concerns about data delivery systems for Sentinels because they have less data storage capability on board than their data acquiring systems. This could be a bottle-neck to the timely delivery of data that are acquired

[49] 6th SPACE COUNCIL, Council Resolution: The Contribution of space to innovation and competitiveness in the context of the European Economic Recovery Plan, and further steps, 15 June 2009.

through the orbit routes of satellites. A technological tool can help to solve the problem - this is the interaction with a data-relay satellite based in a geostationary orbit. This system will be considered with some possibility of piggy-back payloads for SatCom. Every time European Space policy documents mention SatCom, it is just added as an ancillary component of the two flagship programmes. It is clear that SatCom has its peculiar features in terms of technology and value for European socio-economic growth. Thus, a limited role for SatCom is perceived because the involvement of specific transponders onboard a satellite and the related architecture of the SatCom system are not taken into full account. The EC has noted to Member States that: "Space policy is driven by three main imperatives: societal [...]; economic [...]; strategic [...]." Commercial SatCom is the only sub-sector of space services today capable of delivering these three imperatives. In addition, SatCom can play a crucial complementary role in delivering the two main flagship programmes. Galileo is a positioning system which, when complemented with communications, becomes a navigation system and as a result opens up a wealth of opportunities, of which the EC is well aware. It must also be recognized that the communication element cannot always be achieved terrestrially and therefore SatCom will play a key role in Galileo-derived applications and services and in maximizing the value of GMES data.

The last communication of EC, namely "Towards a space strategy for the European Union that benefits its citizens"[50], recognises to SatCom to be a "significant part" of the space market. SatCom is relevant not only for its generated turnover but also for its role as leverage for the independence of European space sector because of it can foster the innovation. SatCom is envisaged to have a clear role for the delivering the broadband connectivity in Europe as established by the Digital Agenda.

2.2.2 SatCom as an Element of the Lisbon Strategy

In order to take anti-cyclical measures against the economic-financial crisis, the Council of the EU adopted the *European Economic Recovery Plan*. It is an initiative with two main pillars:

- Anti-cyclical fiscal *stimulus* and
- Structural reform as an anti-cyclical measure.

The thrust of the EERP is to restore confidence of consumers and business. It is envisaged to provide a demand *stimulus* of € 200 billion, equivalent to 1.5 % of EU Gross Domestic Product (GDP), in addition to possible further monetary easing. It consists of four measures: monetary and credit policies[51], fiscal policy[52], Lisbon-type structural reform[53] and external co-operation[54].

[50] EC, Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions: Towards a space strategy for the European Union that benefits its citizens, SEC(2011) 381 final, SEC(2011) 380 final, Brussels, 4.4. 2011, COM (2011) 152 final.

[51] Monetary policy is decided independently by the ECB, but it is assumed that the Bank will continue to provide liquidity as necessary, and possibly lower the interest rate further. Concerning credit policies, it is suggested that Member States encourage a return to normal lending activities and ensure that ECB interest rate cuts are passed on to borrowers. The EIB Group has taken on to increase its yearly interventions in the EU by some € 15 billion in 2009/10, equivalent to 7,5 % of the total of € 200 billion (including loans, equity, guarantees and risk-sharing financing), while the EBRD is expected to increase present financing in the new Member States by some € 0.5 billion.

[52] Fiscal policy should provide a significant stimulus to the EU economy, without breaching the Stability and Growth Pact (SGP). This stimulus should amount to € 185 billion, equivalent to 1.4 % of Union GDP. Then, an amount of € 170 billion, equivalent to 85 % of the total, should be contributed by Member States, in addition to letting automatic stabilizers work. It is suggested that the share of each Member State be determined by macro-economic criteria, in particular its current budgetary, competitive and external position.

[53] Measures should be targeted towards employment, availability of credit and Lisbon-type structural reform, and combine revenue and expenditure instruments, with the latter also including guarantees and loan subsidies. In addition, it is suggested that structural reform address some of the underlying root causes of the present crisis, bring down prices in key markets, reinforce the link between wage setting mechanism and productivity developments, avoid temporary labour shedding through more flexible working time, and reduce the time to start up a business. The remaining 7,5 % would come from the EU budget, taking mostly the form of shifting spending appropriations (from areas with foreseeable under-spending) to infrastructure projects and of increasing pre-financing of projects. Action on Lisbon-type structural reform comprises 10 proposals, which the Commission will specify in mid-December at level of Member State. These proposals include launching a major European employment support initiative (partly subsidized by the EU Budget), reducing social security contributions on lower incomes, reducing VAT on labour-intensive services, facilitating public-private partnerships, accelerating investments in infrastructure, "greening" energy policies, investing in R&D, innovation and education as well as providing universal access to High-speed Internet.

[54] A greater engagement is envisaged in the context of addressing the current downturn, of renewing commitment to an open world trade (also including early agreement on the WTO Doha round), of a more effective regulatory co-operation with key industrialized countries, of tackling climate change, and of stepping up development support. References to macro-economic issues are limited to a call on the European Council to continue close co-operation with international partners with a view to implementing global solutions to strengthen global governance and promote the economic recovery.

In 2009, reduced access to capital, changing perceptions of risk and shifting definitions about what is economically viable in this climate – i.e. provides sufficient return on investment –reduced the number of areas where operators could venture due to lack of finance. These factors have also affected operators' ability to make financial commitments to upgrade existing networks. Funding is also required in light of the increased challenges associated with the rollout of broadband infrastructure. The EERP *stimulus* is distributed through [the following initiatives

1. Factories of the Future (FoF);
2. Energy – Efficient Buildings (EEB);
3. Green cars (GE) and;
4. High Speed –Internet for everyone (HIS).

The cases addressed to SatCom are FoF with a total budget of € 1.2 billion, and HIS. HIS is considered as an action on Lisbon-type structural reform for which the EU will propose an employment support initiative (partly subsidized by the EU Budget), reducing social security contributions on lower incomes, reducing Value Added Tax (VAT) on labour-intensive services, facilitating PPPs, accelerating investments in infrastructure, "greening" energy policies and investing in R&D, innovation and knowledge.

The *Lisbon Strategy* was an action and development plan for the economy of the EU between 2000 and 2010[55]. Its aim was to make the EU "the most competitive and dynamic knowledge-based economy in the world capable of sustainable economic growth with more and better jobs and greater social cohesion", by 2010. This target had three pillars[56]:

- *Economic pillar* preparing the ground for the transition to a competitive, dynamic, knowledge-based economy by better policies for the information society, strengthening the role of R&D and completing the internal market;
- *Social pillar* modernizing the European social model, investing in people and combating social exclusion;
- *Environmental pillar* sustaining the healthy economic outlook and favourable growth prospects by applying an appropriate macro-economic policy mix.

By 2010, it was alleged by some that most of Lisbon Strategy Agenda goals had not been achieved. Official appraisal of the Lisbon Strategy took place in March 2010 at a European Summit, where the new *Europe 2020* strategy was also launched. Europe 2020 is a 10-year strategy proposed by the EC on 3 March 2010 for reviving the economy of the EU. It aims at "smart, sustainable, inclusive growth" with greater coordination of national and European policy. It identifies five headline targets:

1. Employment: 75% of 20-64 year-olds to be employed;
2. R&D and Innovation: 3% of the EU's GDP to be invested in public and private R&D for innovation;
3. Climate Change & Energy: reducing greenhouse gas emissions 20% (or even 30%, if a satisfactory international agreement can be achieved to follow Kyoto) lower than in 1990, providing 20% of energy from renewable sources, saving of emissions through at least 20% increase in energy efficiency;
4. Education: Reducing school drop-out rates below 10% at least 40% of 30-34 year-olds completing third level education (or equivalent);
5. Poverty & Social Exclusion: at least 20 million fewer people in, or at risk of, poverty and social exclusion.

These targets will be implemented through national targets in each European country, reflecting different situations and circumstances. They are highlighted through 12 Flagship Initiatives which contain three segments of Growth: *smart, sustainable and inclusive*.

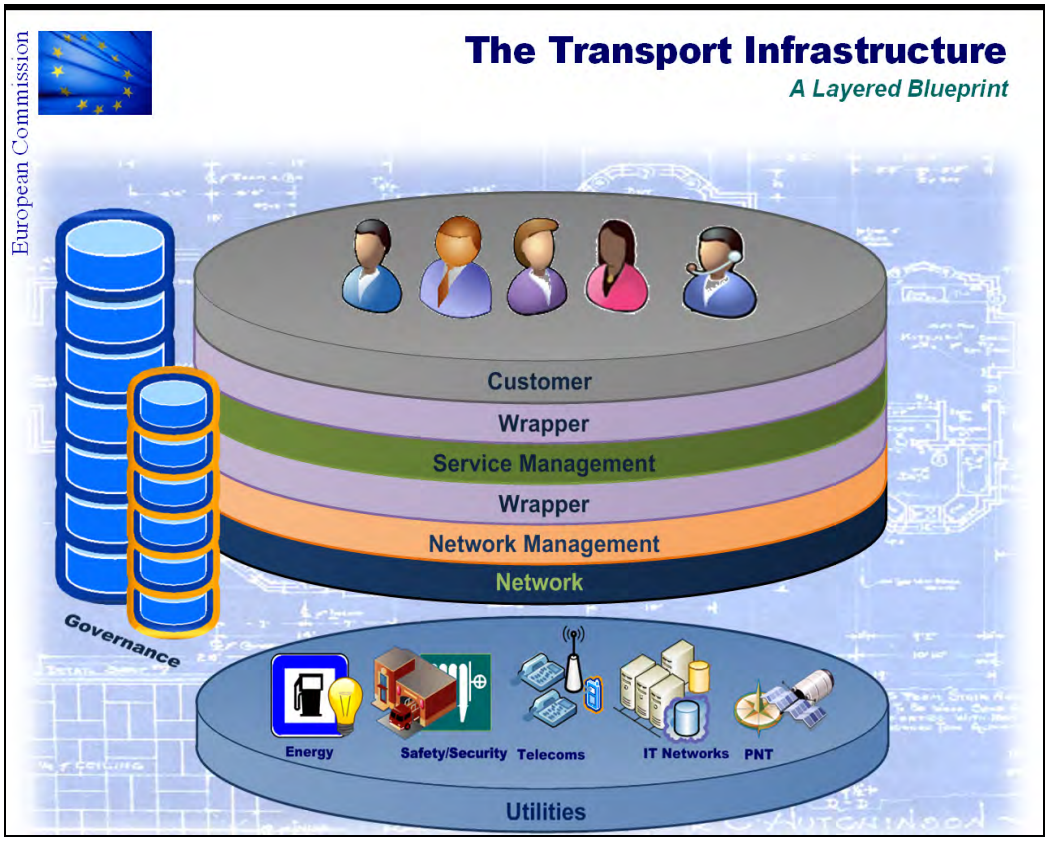
This high level strategic plan for the EU affects the SatCom sector insofar as this technology can play a crucial role in reaching the headline targets through different flagship initiatives, in a direct way:

- *Digital Agenda for Europe*: SatCom is one of the unique technologies that through its unique infrastructure permits closing the current broadband gap;

and in an indirect way:

[55] This was set out by the European Council in Lisbon in March 2000.

[56] The Lisbon Strategy focused attention on the concept of Innovation as the motor for economic change. Under the strategy, a stronger economy would create employment in the EU, alongside inclusive social and environmental policies, which would themselves drive economic growth even further.
An EU research group found in 2005 that current progress had been judged "unconvincing", so a reform process was introduced wherein all goals would be reviewed every three years, with assistance provided for failing items. Translation of the Lisbon Strategy goals into concrete measures led to the extension of the Framework Programs for Research and Technological Development (FP) and the Joint Technology Initiatives (JTI).



Picture 4: An integrated vision of the role and infrastructure of utilities, *inter alia* telecommunications (Source: EC DG MOVE, 2010)

- *Innovation*: SatCom requires a high level of innovation for its industrial development in order to sustain, protect and improve its "independent" European know-how;
- *Climate, Energy and Mobility*: SatCom applications – asset management solutions, and monitoring and alarming communication systems - can improve the efficiency of energy systems and networks in terms of energy saving and increased safety;
- *Competitiveness*: SatCom can help to increase the competitiveness of telecommunication solutions through different technological systems. Its deployment requires a global approach;
- *Employment and Skills*: The SatCom industry is characterized by a few big enterprises and several European SMEs; the former require the contributions of the latter; they are used to working together in special way for the deployment of ESA programmes that works under the system of *juste retour* under which members of programmes can expect to receive back in industrial contracts an amount roughly equivalent to their contributions, less overheads. This requires the mobility of the workers throughout Europe;
- *Fighting Poverty*: SatCom solutions can help to reduce the exclusion of people living in poor circumstances in remote and isolated locations.

The diagram in picture 4 depicts SatCom as a cross-sectional communication infrastructure in which SatCom is not only a "critical infrastructures" in itself but also supports other sectors including the industrial sector (energy, postal, and transport infrastructure, banks, financial entities) and social sectors (e-government, e-justice, e-health, e- learning).

One particularly relevant new initiative is *New Skills and New Jobs*[57], which is a joint policy

[57] This initiative enables EU Member States to learn from each other and share solutions by pooling their efforts at the European level, as well as cooperating with other international organizations on themes related to skills upgrading, matching and anticipation. New Skills for New Jobs draws on existing EU instruments such as the European Social Fund (ESF) to achieve its aims. It is an essential tool of the European Employment Strategy to expand and enhance investment in workers' skills, as part of its overall aim to create more and better jobs throughout the EU.
New Skills for New Jobs also contributes to the EU 2020 Strategy, the follow-up of the EU Lisbon Strategy for

initiative carried out in cooperation between the EC and the EU Member States. It aims to address some of these issues by developing more effective ways to analyse and predict which skills will be required in tomorrow's labour markets and, with this knowledge, to develop and adapt education and training so that workers gain the required skills. The SatCom sector represents a workforce of around 45.000 employees[58]. The European space industry is distributed across all ESA countries, resulting in significant fragmentation, particularly in the smallest contributors to the ESA. Yet, the 6 major ESA-Member contributors (France, Germany, Italy, United Kingdom, Spain and Belgium) account for about 90% of employment. European space industry employment is composed of a majority of males (77%), with an average age around 44. Female employees are slightly younger (42.5 average age). The proportion of employees above 50 is 32%, a figure which is slightly worrying as it suggests an ageing working population with potential replacement issues and know-how preservation problems in the next decade. Concerning employees' qualifications, European space industry employment is marked by a significantly higher than average proportion of university graduates/engineers (53% of the total)[59]. As a whole 77% of space industry employees are high level technicians, scientists and/or engineers. In addition, the workforce is highly concentrated in the "big companies" so policy intervention is easily addressable and implementable. The biggest company, EADS, comprises around 32% of the entire workforce. This implies also that the sector is worker-intensive so every new policy in favour of the workers will have direct effective results. There is a huge debate in the trade-off between SatCom and terrestrial technology because the latter has a higher number of employees. This point needs clarification because the development of a SatCom has a 10-year lead-time and the phases of mission design and manufacturing deployment need a huge number of employees[60]. In light of these facts, the sector is highly labour-intensive, with a high level of qualifications and innovation for development and deployment.

The aims of this policy initiative are mirrored in *Youth on the Move*, which is an initiative pursuant to Europe 2020. Its package proposes measures aimed at:

- Improving the job prospects of young people;
- Making education and training more relevant to their needs;
- Raising awareness of EU mobility grants to study, train or do voluntary service in another country - independent studies show this experience is highly rated by employers.

SatCom can contribute to reaching the desired targets because the sector employs young people and encourages mobility through Member States. This happens because the sector is dominated by big companies based in different States.

The aim of inclusive and sustainable growth is also addressed by the *Innovation Union*[61] that focuses on major areas of public concern such as climate change, energy efficiency and healthy living. It pursues a broad concept of innovation, not only technological, but also in business models, design, branding and services that add value for users. It includes public sector and social innovation as well as commercial innovation. It aims to involve all actors and all regions in the innovation cycle. The policies in the Innovation Union Plan aim to:

1. Make Europe into a world-class science performer;
2. Revolutionize the way public and private sectors work together, notably through Innovation Partnerships; and
3. Remove bottlenecks – like expensive patenting, market fragmentation, slow standard setting and skill shortages - that currently prevent ideas getting quickly to market.

SatCom can intuitively play a substantial role as it can create new job-opportunities[62] as well as life patterns and conditions through a

Growth and Jobs. Recommendations on how to advance the New Skills for New Jobs agenda as a part of EU 2020 were presented in the report of a group of independent high-level experts set up by the European Commission.

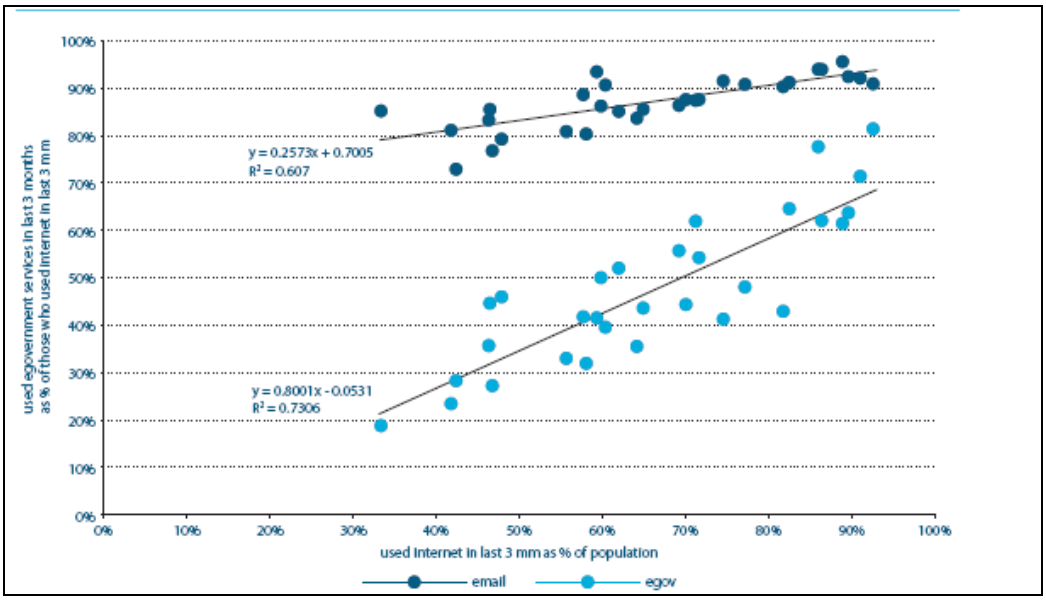
[58] ESOA, Communication of Association on European Space Programmes, 2010.

[59] Eurospace, The European Space Industry: Facts & Figures, 2010.

[60] ESOA, Communications Satellites & The EU Regulatory Framework, 2008 [http://www.esoa.net/upload/files/policy/ESOA_20080513_EUTelecoms.pdf available at Feb 2011]

[61] EC, Communication from the Commission to the European Parliament, the Council, The European Economic and Social Committee and the Committee of the Regions, Europe 2020 Flagship Initiative - Innovation Union, SEC (2010) 1161, Brussels, 6.10.2010, COM(2010) 546 final. The Innovation Union is a flagship of the EU 2020 Strategy. Like the Integrated Industrial Policy and other EU 2020 flagship programs, it must be smart, sustainable and inclusive. This policy proposes ten actions in order to boost the role of innovation, easily expressed by the EU target that 3% of GDP should be invested in R&D.

[62] There exist several studies and estimations describing and proving that satellite communication can boost job-growth in the economy. An exhaustive overview will be presented in Chapter 4 concerning broadband.



Picture 5: Use of Internet *versus* use of e-government services
(Source: Europe's Digital Competitiveness Report 2010)

unique and common satellite telecommunication system that can satisfy the needs of people living in a larger area. SatCom can also indirectly satisfy the target of "greener and better societies" because it has low environmental-impacts due to the fact that it is easily deployable and less land-invasive in terms of infrastructure, and its electromagnetic pollution is lower than terrestrial technologies. SatCom can also contribute to the aim of a better life as it can provide substantial assistance to: air and maritime safety, by guaranteeing near-real time communication and alert messaging systems; military communication; disaster management procedures and monitoring energy infrastructure with its high degree of criticality. In addition, SatCom is a front-runner technology in terms of performance; it can inter-play between public and private actors to enhance the benefits of investments.

Continuing with the aim of inclusive growth, the *European Platform Against Poverty And Social Exclusion*[63], as a flagship programme of Europe 2020, will encourage new ways of working and helping governments and other actors develop more effective and innovative methods to tackle poverty. Although fighting poverty is primarily the responsibility of individual member countries, EU-wide targets and approaches have helped make national policies in areas such as child poverty and homelessness more effective. The EC now wants to promote innovation in social policy, using small projects to evaluate potential new policies or reforms. The aim is for EU countries to learn from each other's experiences, and ultimately fine-tune their social policies so that they have a greater impact. The coming years - 2011-12 in particular - will see a range of initiatives, including coordination on voluntary policy and information sharing, new legislation and project funding. Specific actions will target those most at risk, including young people, people with disabilities and minority groups such as Roma. It has been already highlighted that SatCom in a one-stop action cover a large area and can contribute to inclusion policy mechanisms in a concrete and easy way. The EC Communication explicitly declares that poverty as social exclusion has different reasons also including the digital divide in terms of the unavailability not only of skills to be able to use digital tools but also in the availability of the infrastructure –signals and systems – to participate in society where a lot of services are electronic. Europe's Digital Competitiveness Report 2010[64] shows the increase in the dimension of e-government services for citizens including use of the Internet. The graph of picture 5 shows the relationship between general uses of the Internet in the last three month of 2010 and e-government uses.

It can be seen that e-government uses increase as general Internet use increases, thus e-government applications are used

[63] EC, Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, The European Platform against Poverty and Social Exclusion: An European framework for social and territorial cohesion - SEC(2010) 1564 final - Brussels, 16.12.2010, COM(2010) 758 final.

[64] http://ec.europa.eu/information_society/digital-agenda/documents/edcr.pdf [It is available at January 2011].

more widely where the digital society is better established. This implies unfair treatment of citizens who live in isolated areas where no use of e-government is made because of the lack of infrastructure. This directly impacts on the equal citizenship rights of Europeans who are excluded from these important services.

With respect to *sustainable* European growth, energy is a critical and strategic commodity for every State and group of States, including the EU. The EU is particularly concerned about energy provision and resources as it is a "big" energy consumer with limited energy resources and without a technological dominant position for energy exploitation and supply[65]. Thus, much of its international relations is related to the need to have secure energy supplies in the most effective and efficient way. Relations with Russia are critically impacted by reliance on gas supply. Relations with US are also affected by energy technology dependence for energy exploitation. The relationships with new emerging countries such as China and India also comprise energy issues and are mainly impacted by international law regarding global warming and the need to reduce CO2 emissions, along with the question of technology transfer to emerging countries. Overall policy on energy security and efficiency is quite complex as there are several expressions of interest and communications by the EC, the Council and the Parliament. Here, the interest is in understanding the enabling value and contribution of SatCom in providing services for 24/7 remote control and monitoring systems for industrial processes including renewable energy plants, which are often located in remote areas. In addition to being feasible because of its instant connectivity to such sites, SatCom provides a green solution that does not emit CO2 while monitoring such plants. Furthermore an increasing number of oil & gas companies that have vessels and platforms in remote and hostile locations, such as off-shore, polar areas, and desert zones, are using corporate networks through VSAT technology. In these situations terrestrial telecommunication technologies are not easily affordable or not available at all. The value of establishing a network of communication for oil & gas companies includes greater efficiency for drilling operations, for safety and security issues and for reducing the impact of disasters.

[65] International Energy Agency, Statistic Yearbook, 2010.

2.2.3 SatCom as an Element of International Relations

SatCom can enhance the role of Europe in its international relations because it can be an element of the Common Foreign Security Policy (CFSP), the European External Action Service (EEAS), the European Security and Defence Policy (ESDP) and Space Policy as discussed above.

Specifically, with respect to CFSP, Member States have committed themselves to a Common Foreign Security Policy for the European Union with aims of strengthening the EU's external ability to act through the development of civilian and military capabilities in Conflict Prevention and Crisis Management. Foreign and security policy is one area where essential authority remains with EU governments, although the EC and, to a lesser extent the European Parliament, are associated with the process. Key decisions are taken by unanimous vote. Aware of this constraint, the EU has introduced more flexible voting procedures on CFSP decisions by allowing individual governments to abstain, or by using majority voting, or by allowing a majority of countries to act on their own; but unanimity is still required on decisions with military and/or defence implications. Each European State has its own telecommunication systems for military purposes, even if dual-use and/or vocation of SatCom is being increasingly adopted. SatCom is clearly relevant in this area but Europe does not have a coordinated approach that would surely result in cost-savings. It should be noted that currently the sales of the European industry can also be split between civil and military systems. Interestingly, the total value of military systems sold exceeds the value of sales to military entities. This is because military systems can be procured by some civil customers, as is the case of the private operator Paradigm that procured the military Skynet-5 systems, and also of some civil agencies such as CNES, DLR and ASI, that procure military systems for defence authorities[66].

With respect to EEAS[67], EU High Representative for Foreign Affairs and Security Policy has diverse responsibilities including:

1. Security & Defence;

[66] ESPI (S. Pagkratis), Space Policies, Issues and Trends in 2009/2010, 2010, pp. 98 – 101.

[67] To address these issues the EU maintains diplomatic relations with nearly all countries in the world. It has strategic partnerships with key international players, is deeply engaged with emerging powers around the globe, and has signed bilateral Association Agreements with a number of States in its vicinity. Abroad, the Union is represented by a network of 136 EU Delegations, which have similar functions to those of an embassy.

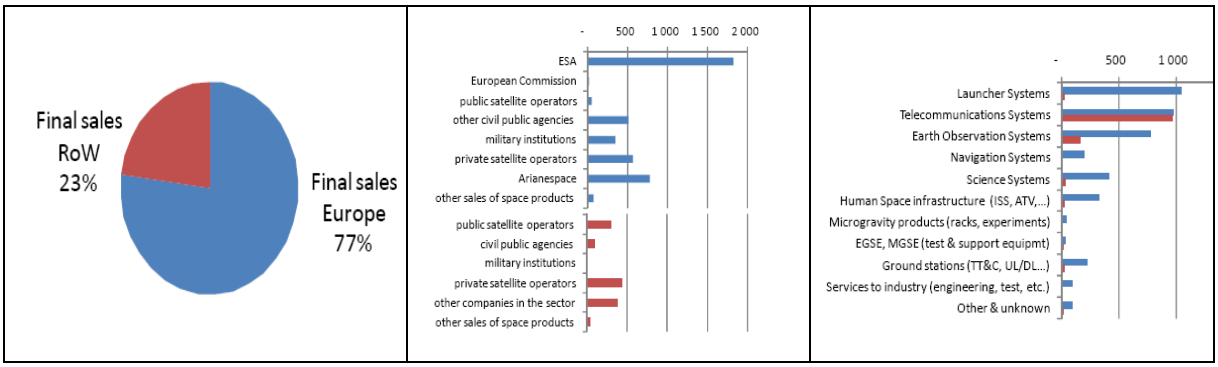


Table 4: European Sales & Export 2010 (Source: Eurospace, 2010)

2. Foreign Policy;
3. Global challenges;
4. Instrument for Stability;
5. Human Rights and
6. Regional policies.

Beside the issue of peace in the Middle East and promoting the cultural debate to enhance democracy and human rights in the world, there is also *the duty to act in foreign trade and support the principles of free and fair international trade*. Concerning European SatCom the almost perfect split between sales to European institutional customers (50.1%) and commercial and export sales (49.9%) confirms the important level of exposure of the European Space industry[68] to open markets. SatCom is one of the European industrial sectors with a significant amount of exports. Export sales (or sales to customers in the Rest of the World, € 1.2 billion are evenly split between three categories, public operators, private operators and sales to other companies in the sector. It is interesting to note in table 4 that exports are almost exclusively composed of telecommunications systems.

This policy action can also support the social and economic development of partners, and be ready to help when they are faced with disaster. Together, the EU and its Member States are the world's largest donors of development and humanitarian aid. Their contributions account for 60% of the world's official development assistance. As seen most recently in Haiti & Chile, established and sophisticated ground infrastructures can be damaged and rendered useless during disasters. SatCom infrastructures have almost complete immunity from catastrophic events such as hurricanes, floods, and earthquakes and are therefore deployed during most if not all disasters to enable immediate crucial communications for relief efforts, which otherwise would have taken much longer to set up. SatCom offer a range of solutions to meet the immediate needs of emergency response, help civil protection as well as the on-going needs of humanitarian aid. In addition, SatCom permits affirmation of this strategic role and it can be a "traded-good" with other countries such as Russia, USA, and Asian countries. Russia is one of the European neighbours and it is quite convenient to have a coordination action with it. Europe is energy dependent from Russia, thus SatCom can be one of commodities for a policy of market and trade reciprocity. USA is achieved an economy of scale for SatCom spacecrafts and even European satellite operators are buying USA satellites. In addition, USA with its global satellite operator, Intelsat, can also affect European marketplace for SatCom services. Thus, a coordinated vision will prevent a limited market performance of European players. The relations with Asian countries are more complex because China can be a good market for European industry due to its huge demand for SatCom services and Japan can be a good partner for provision of advanced digital communication components as shown in the follow section 3.1.3 concerning with the achievements of industrial policy.

The European Union's European Security and Defence Policy (ESDP) includes the gradual framing of a common defence policy which might in time lead to a common defence. The ESDP aims to allow the Union to develop its civilian and military capacities for crisis management and conflict prevention at international level, thus helping to maintain peace and international security, in accordance with the United Nations Charter. The ESDP, which does not involve the creation of a European army, is developing in a manner that is compatible and coordinated with NATO. Space capabilities that could be made available to NATO forces run the entire gamut of space products and services available. NATO has already made great strides in SatCom and missile warning and notable achievements in

[68] The positive trend in commercial and export sales observed since the recovery of the commercial market in 2003 is ongoing. With an overall turnover of € 2.5 billion made under unfavourable exchange rate conditions, the European Space industry demonstrates its competitiveness on the global market.

geographic imagery exploitation. SatCom are an area where NATO has long been successful in providing NATO commanders and forces with a vital military space capability. Since the launch of the first NATO communications system via satellite in 1970, NATO has united in providing common funding according to agreed cost-sharing formulas. Although that arrangement provided a vital capability in an area where resources were very scarce, the communications requirements in the information age have outstripped the capacity of the dedicated NATO satellites. In response, NATO changed the scheme in 2005 to an arrangement with the United Kingdom, Italy, and France to provide military communications to NATO from within their nationally owned systems. This provides NATO with more communications capacity and an increased robustness by virtue of the inherent diversity of the satellite design and command and control architecture. Designed to published NATO standards and guidance, the space-based systems and the ground-based equipment used within the NATO force structure and by NATO member nations are compatible. Of all of the areas of space force enhancement, communications alone is the one that is mature and robust, and can serve as the standard against which the other areas may be compared.

3. The Policy Priorities

SatCom is currently being asked to play crucial roles as an element of industrial policy and as an element of European initiatives for broadband connectivity. The first field is going to fit the right place in line with the developing new governance model between EU and ESA for space programmes. The second field is going to play a substantial role not only in implementing the technology but also in contributing to European growth according to the three ambitious attributes: smart, sustainable and inclusive.

3.1 SatCom Industrial Policy

To discuss the industrial policy of the EU is a complex matter with, at least, two levels of policy-making, drastic changes over time and the overall difficulty of where to draw the boundaries of EU industrial policy. In the EU, industrial policy is pursued by (at least) two levels of government: the EU and the Member States. These two 'European' features add to 'general' complications in analyzing industrial policy, such as the contrast between normative economics ('welfare') and positive analytical approaches to industrial policy, variations in classification of what industrial policy is, and the potentially vast range of tools, quasi-tools and soft forms of persuasion in this area[69]. These two levels of intervention require identifying the division of powers between them, and the complementarities between the Member States and EU level of government when it comes to industrial policy. Then, there is the classification that begins by distinguishing two sets of policy which influence industry, yet are not part of industrial policy, namely, 'policies not for industry which affect industry' for obvious reasons (such as macroeconomic stability with fiscal and monetary instruments; redistribution tools ; agricultural and services policies; tax policy; energy; land-use, and so on) and 'policies which directly help or constrain industry but are not meant (only) for industry' (such as price controls, buy-national campaigns, tied development aid or environmental policies addressing specific hazards such as poisonous chemicals or smog).

SatCom industrial policy has also these two levels of policies. EU policies affecting SatCom have been analysed above. Here, the policy context that directly addresses industry policy is addressed. In the case of SatCom there is also the interaction with another player, ESA, which addresses the space programmes. Thus, the picture is more complex than that previously described in general terms. The sector requires policy analysis in terms of the technological and industrial efforts of stakeholders from the two fields, space and communication. Historically, the field of communication was seen as a public good in terms of the natural monopoly of infrastructure and the positive externalities for users/customers and even citizens. Space was historically considered to be an area of research and development of technology and science and/or foreign affairs. Nowadays, the two fields are converging because of current trends of liberalization of the telecommunications sector and much reduced State intervention even on the infrastructure side, and the increasing interest in recognising the role of space infrastructure in providing utilities for the daily needs of citizens. This context assists in identifying three levels of players in SatCom industrial policy, namely:

- EU;
- ESA and
- Member States.

Within the category of Member States there are also other *players* such as Ministries of Defence procuring SatCom systems and services but here they will not be considered as playing a direct and active role as policy makers but as procurement actors. SatCom systems, as described above, can be viewed as three components that involve three industrial segments and related market players. Thus, industry policy is going to be analysed according to the scheme in table 5.

[69] The great significance of European integration in determining (changes in) structure and performance of industry in Europe is due to the deepening of economic integration since the 1970s, the widening of its scope and the enlargement of the club. Member States, drawing on the treaties but also on changing insights about the role and dynamics of markets, have agreed to bind themselves ever more by the pro-competitive logic of deepening market integration and to abide by the ever stricter constraints that this implies. In addition, they have not (or better, only marginally and selectively) shifted to the EU level the tools for interventionist policy-making Member States themselves used to employ in the past.

Component of System	Industrial Segment	EU Industrial policy	ESA Industrial Policy	National Industrial Policy
Space	**System Manufacturers**	✘	✓	✓
Network & Ground	**Satellite Operators**	✘	✓	✓
VAS & End-Users	**Services Providers**	✓	✓	✓
Key-Reading: ✓ as 'yes' - ✘ as 'no'.				

Table 5: SatCom Industrial Policymakers and Related Segments

3.1.1 SatCom Industrial Policy: EU

In 2010 the EC proposed an *integrated industrial policy* for Europe[70]. It is a challenge to establish an industrial policy with an integrated view[71] in order to reduce inefficiencies and to increase synergies among different industrial sectors, minimising costs and burdens for Europeans. The communication on industrial policy is a central element of the EU 2020 Strategy which targets sustainable, inclusive and smart growth. It meets the wish expressed by a majority of Member States for the implementation of a truly European industrial policy. The Communication pointed out that industry is still the foundation of the European economy. It also emphasised the fact that it makes a significant contribution to the external competitiveness of the EU. Three major items have renewed the policy's approach:

1. The linking of a horizontal (transversal) dimension and of a sector-based approach;
2. The inclusion of complete value chains;
3. The publication on a regular basis of status reports on industrial policies and Member State competitiveness including the tracking of legislation implemented to promote entrepreneurship.

The Communication has several chapters dedicated to access to financing, the links between industrial policy and the Single Market Act, the development of infrastructure and product standardisation. The document also has several chapters on innovation and on the adaptation of skills to changing industries, and an explicit paragraph[72] on Space. With this perspective, industrial policy has to be addressed with the aims of competitiveness and sustainability. In this context SatCom is explicitly mentioned as a *key space sector* from the economic and technological point of view. It is defined as crucial for delivering the Digital Agenda closing the broadband gap for Europe. In line with this target, the EC has the duty to establish an adequate spectrum policy. The implementation of this industrial policy must pursue three imperatives: *societal* because of benefits for all Europeans; *economic* in terms of space as a generator of knowledge that drives innovation and, *strategic* as space has to act as a policy tool contributing to the role of Europe as a global actor.

This new policy approach permits reviewing the implementation of current policy tools. EU Industry Policy has leverage on at least three areas:

- Competitiveness and Innovation Framework Programme (CIP);
- Framework Programme (FP currently FP7) and
- Structural Funds.

The first supports innovation activities (including eco-innovation), provides better access to finance and delivers business support services in the regions. The CIP is divided into three operational programmes[73]. Each programme has its specific objectives, aimed at contributing to the competitiveness of enterprises and their innovative capacity in their own areas, such as ICT or sustainable energy. The CIP runs from 2007 to 2013 with an overall budget of *€ 3.621 million*. Of particular relevance for SatCom purposes is *The Information Communication Technologies Policy Support Programme* (ICT-PSP) that funds mainly pilot actions, involving both public and private organisations, for validat-

[70] EC, Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, An Integrated Industrial Policy for the Globalization Era Putting Competitiveness and Sustainability at Centre Stage - {SEC(2010) 1272} {SEC(2010) 1276}.

[71] The EU started to have an integrated vision of policy implementation in 2006 with the Integrated Product Policy for Environmental concerns. It continued in 2007 with EC, An Integrated Maritime Policy for the European Union - COM(2007) 575 final 10 Oct 2007 and in 2008 with Integrated Policy for Climate Change and Energy Policy.

[72] EC, Int. Ind. Policy, para 8.1 Space. A driver for innovation and competitiveness at citizens' service, 2010.

[73] They are the Entrepreneurship and Innovation Programme (EIP),the Information Communication Technologies Policy Support Programme (ICT-PSP) and the Intelligent Energy Europe Programme (IEE).

ing in real settings, innovative and interoperable ICT based services in areas such as:

- ICT for health, ageing and inclusion;
- Digital Libraries;
- ICT for improved public services;
- ICT for energy efficiency and smart mobility;
- Multilingual web and Internet evolution;
- Networking actions for sharing experiences and preparing the deployment of innovative ICT based solutions in such areas are also supported, as well as the monitoring of the Information Society through benchmarking, analyses and awareness raising actions.

FP bundles all research-related EU initiatives together under a common roof playing a crucial role in reaching the goals of growth, competitiveness and employment; along with a new CIP, Education and Training programmes, and Structural and Cohesion Funds for regional convergence and competitiveness. The broad objectives of FP7 have been grouped into four categories: *Cooperation*, *Ideas*, *People* and *Capacities*. For each type of objective, there is a specific programme corresponding to the main areas of EU research policy. All specific programmes work together to promote and encourage the creation of European poles of scientific excellence. It is managed by thematic areas that, for present purposes, can be achieved in *Industry and Industrial Technology* and *Information and Communication Technology*.

The Structural Funds and the Cohesion Fund, with the European Regional Development Fund (ERDF) for large infrastructures and the European Social Fund (ESF) for job-integrations, are the financial instruments of EU regional policy, which is intended to narrow the development disparities among regions and Member States. The Funds participate fully, therefore, in pursuing the goal of economic, social and territorial cohesion. For the period 2007-2013, the budget allocated to regional policy amounts to around € 348 billion, comprising € 278 billion for the Structural Funds and € 70 billion for the Cohesion Fund. This represents 35% of the Community budget and is the second largest budget item.

These Funds[74] will be used to finance regional policy between 2007 and 2013 in the framework of the three new objectives, namely:

- The "*convergence*" objective to accelerate the convergence of the least developed EU Member States and regions by improving growth and employment conditions. This objective is financed by the ERDF, the ESF and the Cohesion Fund. It represents 81.5% of the total resources allocated. The co-financing ceilings for public expenditure amount to 75% for the ERDF and the ESF and 85% for the Cohesion Fund;
- The "*regional competitiveness and employment*" objective to anticipate economic and social change, promote innovation, entrepreneurship, environmental protection and the development of labour markets which include regions not covered by the Convergence objective. It is financed by the ERDF and the ESF and accounts for 16% of the total allocated resources. Measures under this objective can receive co-financing of up to 50% of public expenditure;
- The "*European territorial cooperation*" objective to strengthen cooperation at cross-border, transnational and interregional levels in the fields of urban, rural and coastal development, and foster the development of economic relations and networking between small and medium-sized enterprises (SMEs). This objective is financed by the ERDF and represents 2.5% of the total allocated resources. Measures under the Territorial Cooperation objective can receive co-financing of up to 75% of public expenditure.

With the exception of grants coming from the FP, these funds have not been directly involved in the development and/or deployment of SatCom. At present, FP7 is running and has a specific involvement in SatCom as an element of the ICT Sector and Space. It is considered to be a component of the ICT programme for enhancing the role of the EU but there is no specific mention as Space of FP7 programmes. It is clear that SatCom is considered as an enabler technology for the ICT sector and not of the space industry. Thus the focus is more on network and connectivity provision than space service in itself. Consequently there is no identified specific strategic value for the EU in its foreign relations but for Europe towards its citizens. This is in line with the EU i2010 and Digital Agenda initiatives. In addition, these initiatives have to fulfil the aims of Europe 2020. The R&D for ICT has a precise strategic purpose as *A Strategy for ICT R&D and Innovation in Europe: Raising the Game*[75], where the priorities are different from those for Space sectors. In particular there is a divergence of vision for international cooperation. If Sat-

[74] Structural Fund and Cohesion Fund support for the three objectives always involves co-financing. The rates of co-financing may be reduced in accordance with the "polluter pays" principle or where a project generates income. All projects must of course comply with EU legislation, particularly with regard to competition, the environment and public procurement.

Com is an element of the space sector it must be part of international cooperation notably for Africa. If SatCom is an element of the ICT strategy it has the task of implementing international cooperation with the aim of seeking strategic partnerships *to tackle some of the future grand challenges in ICT R&D such as the Future Internet*.

The table 6 is a non-exhaustive overview of the main current EU projects concerning SatCom under FP7 – ICT, indicating the total cost of the project in terms of million of Euros (Cost) and the EU funds (EU Fund).

Project Name	Cost	EU Fund	Aims	Relevance of SatCom
20-20 3D Media: Spatial sound and vision Execution: 2008-12	15.21	9.84	Creation of new forms of stereoscopic and immersive networked media for the home and public spaces	Broadcasting
ACTION-GRID: International cooperative action on grid computing and biomedical informatics between the European Union, Latin America, the Western Balkans and North Africa Execution: 2008-09	1.12	0.99	Creation of a common health information infrastructure in Europe, and extending it to other regions	Tele-medicine
ASCENS: Autonomic Service-Component Ensembles Execution: 2010-14	7.21	5.3	Exploiting the future generation of software-intensive systems ensembles	Satellite network
CRISP: Cutting edge reconfigurable ICS for stream processing Execution: 2008-10	4.4	2.8	Optimal utilization, efficient programming and dependability of reconfigurable many-cores for streaming applications.	Downstream satellite Services related with IP-TV and broadcasting
FISI: Future Integral SatCom Initiative Execution: 2010-12	0.64	0.49	Definition of a strategic vision on R&D priorities for the European SatCom industry in the evolving ICT context	SatCom Policy
LOCON: Platform for an inter-working of embedded localization and communication systems Execution: 2008-10	4.4	2.8	Development of connectivity and inter-working of embedded localization and communication systems	Network platform with interaction of SatCom Assets
MEDNET: Latin American Health Care Network Execution: 2008-10	2.14	1.4	Development of a medical network that addresses the problems of providing health care from a distance in Latin America	Tele-medicine
MEMS-4-MMIC: Enabling MEMS-MMIC technology for cost-effective multifunctional RF-system integration Execution: 2008-10	2.9	2.9	Proof-of-concept of an RF-MEMS MMIC based antenna module	SatCom Antenna
MONET: Mechanisms for optimization of hybrid ad-hoc networks and satellite net-	3.6	2.43	Development of hybrid solution SatCom and terrestrial technology networks	SatCom Connectivity

[75] EC, A Strategy for ICT R&D and Innovation in Europe: Raising the Game, {SEC(2009) 289} - Brussels, 13.3.2009 COM(2009) 116 final.

Project Name	Cost	EU Fund	Aims	Relevance of SatCom
works Execution: 2010-12				
MUSCADE: Multimedia Scalable 3D for Europe Execution: 2010-12	11.7	7.45	Evolution from HDTV to 3DTV	Broadcasting
MYMEDIA: Dynamic personalization of Multimedia Execution: 2008-10	4.4	2.8	Integration of multiple, content catalogues and recommender algorithms in a single system.	Broadcasting
NETMAR: Open service network for marine environmental data Execution: 2010-13	3.8	2.9	Interoperability and connectivity between heterogeneous data systems to meet the demand for information from different user groups	SatCom Network
OPTIBAND: Optimization of Bandwidth for IPTV video streaming Execution: 2010-12	4.5	2.8	Demonstration of the video content data dropping algorithm	Broadcasting
PII: Pan-European laboratory infrastructure implementation Execution: 2008-10	8.3	5.7	Federated test bed for new communication services and applications across Europe	SatCom downstream services
SEACOOP: Further developing strategic RandD cooperation with Southeast Asia on ICT Execution: 2007-09	0.8	0.5	Interaction of South-Asian needs with European ones (user driver mechanisms)	SatCom Network
SFERA: Structural funds for European regional research advancement Execution: 2007-09	1.09	0.9	Evaluation architecture for network of the future	SatCom Network
SISI: Support action to the Integral SatCom Initiative (ISI) Execution: 2008-10	1.42	0.9	Support platform involving stakeholders for SatCom development	SatCom Policy
TELEIOS: Virtual Observatory Infrastructure for Earth Observation Data Execution: 2010-13	3.7	2.8	Implementing a SatCom network for EO data sharing	SatCom Network foe EO data dissemination
WHERE: Wireless hybrid enhanced mobile radio estimators Execution: 2008-10	5.5	4	Combination of wireless communications and navigation for the benefit of the ubiquitous access for a future mobile radio system	SatCom Connectivity
WHERE2: Wireless Hybrid Enhanced Mobile Radio Estimators - Phase 2 Execution: 2010-13	7.48	5.26	Integral research of cooperative positioning and communications	SatCom interaction with terrestrial technologies
Total [Million €]	**94.31**	**64.96**		

Table 6: Projects funded by FP7 - ICT with SatCom relevance

SatCom is also an element of the FP7work plan for Space. Under this framework space is going to serve policy priorities that are different from those under FP7 - ICT. In par-

ticular, FP7 is tasked with delivering the following EU policies:

- Sustainable Development including climate change;
- Common Foreign and Security Policy and
- Europe 2020.

Work plan 2011[76] of FP7 Space provides the overall political framework for the development of a viable and strong European space sector that will:

- Develop and exploit European space applications, such as Galileo, GMES and satellite communication applications to secure maximum political, economic and social return from investments in space technologies;
- Establish appropriate funding arrangements for the operational phase of GMES, in order to ensure the sustainability of the services for users;
- Improve coordination of and better exploit synergies between civilian and military programmes – to find ways and means to improve the coordination between civilian and defence space programmes in long-term arrangements. This will help to ensure that each sector can take maximum advantage of the investments of the other;
- Invest to maintain technological expertise as well as knowledge in space-based science and space exploration, for example by the extensive use of the International Space Station (ISS), as well as to maintain independent access to space;
- Develop a more coordinated and coherent approach to international relations in space;
- Create, for the first time, a common European Space Programme, serving as a basis for transparency of European and national space programmes.

Space is considered to have a role also in International Cooperation. SatCom is explicitly recognized as a central tool to support Africa in its sustainable economic and social development. Thus, under FP7 ICT, SatCom has a role in supporting the external, not internal, role for Europe, as above described. The real role of SatCom is seen as an element of integrated applications with navigation and remote sensing. The integration of SatCom and satellite navigation solutions with space-based observing systems fostering the convergence of these space-based capacities with an emphasis on prevention and management of emergencies is seen as a priority. There has not actually been any project for SatCom funded by FP7 Space. It is a sort a back-step from the previous FP6 where SatCom has been funded for projects through FP6 Infrastructures, FP6 Aerospace, FP6 Mobility and FP6 Information Society Technology. The table 7 presents the main projects for SatCom referring the project cost (Cost) and the project funding (Fun) in million of Euros.

PF6 Information Society Technology	Cost	Fun
Wireless infrastructure over satellite for emergency communications	2.53	1.28
IP-based Networks, services and terminals for convergence systems	17.38	9.6
Broadband to rural America over satellite integrated links	0.9	0.9
Satellite-based communications systems within IPv6 networks	7.17	4.25
Advancing interactive Broadband satellite access by optimal convergence of session based services over DVB-RCS	5.15	2.9
Qubit applications	12.79	9.9
Universal satellite home connection	6.26	3.55
Cooperation on digital broadcasting convergence with mobile communications between Europe and China	1.06	0.9
Satellite communications network of excellence - Phase II		7
Satellite access technologies: Leading improvements for Europe	8.43	4.5
Mobile applications and services based on satellite and terrestrial interworking	10.21	5.2
Satellite Communications Network of Excellence		4.4

[76] EC, C (2010) 4900 of 19 July 2010.

Advanced satellite mobile systems-task force specific support action	0.7	0.6
Communications from Aerial Platform Networks delivering Broadband Communications for All	5.65	3.1
Total [Million €]	**78.23**	**58.08**
FP6 Aerospace	**Cost**	**Fun**
Land and sea integrated monitoring for European security	21.2	11.93
Satcomms in support of transport on European roads	10.33	5.38
Airborne new and advanced satellite techniques and technologies in a system integrated approach	19.46	11.09
MObile Wideband Global Link sYstem	12.6	6.61
Telecommunications advanced networks for GMES operations	9.25	5.19
New technologies to avoid digital division in e-divided areas	3.07	1.9
RURAL WINGS	8.83	5.4
BASE2 - Broadband Access Satellite Enabled Education	2.15	1.34
African satellite communication and Galileo applications	0.3	0.3
Networking the Sky for Aeronautical Communications	3.59	2.13
Aeronautical surveillance and planning by advanced satellite-implemented applications	4.24	2.37
Study on High Altitude Aircrafts and Airships (HAAS), deployed for specific aeronautical and space applications	0.5	0.5
Improved material exploitation at safe design of composite airframe structures by accurate simulation of collapse	6.69	4
Improvement of Fan Broadband Noise Prediction: Experimental investigation and computational modelling	4.83	3
Total [Million €]	**107.04**	**61.14**
FP6 Infrastructures	**Cost**	**Fun**
Organising Caucasus and Central Asian services for Internet offerings to NRENs	0.8	0.8
Total [Million €]	**0.8**	**0.8**
FP6 Mobility	**Cost**	**Fun**
Multi-application advanced channel coding		0.15
Modelling and analysis of dielectric resonators for microwave applications	0.04	0.04
Total [Million €]	**0.04**	**0.19**
Total [Million €]	**186.11**	**120.21**

Table 7: Projects funded by FP67 with SatCom relevance

3.1.2 SatCom Industrial Policy: ESA and National Space Agencies

The main role of industrial policymaker is played by ESA in accordance with its Institutional Convention of 1975, Art. VII ESA Convention[77]. According to the ESA Convention and the framework agreement between ESA and EU[78], one of the major tasks of ESA procurements is to increase the competitiveness of European industry on the international market. The whole ESA procurement approach aims at developing the capacity of European industry to enable it to react to market demands in the most efficient and the most economical way. One of the Agency's essential industrial policy activities is to perform a number of co-ordination and harmonization tasks between European and national space activities.

The profile of Industry Policy for space activities is linked with the model of governance and coordination for a common view of Space Policy between ESA and the EU, which is still under construction[79]. This matter involves important issues with two dimensions:

- Geographical asymmetry of ESA and EU Member States;
- ESA principle of *juste retour* and EU principle of "fair competition in the internal market".

These issues are not here deeply considered. The Council resolution recognized that the EU, together with the ESA and the Member States, is a major player in space. The EU was charged in particular with strengthening the coordination of resources and programmes with ESA and the Member States and the development of EU instruments and funding schemes to allow for long term EU investment in space. There is a huge debate about the differences between the mandates of the EU and ESA and the difference between the internal market framework under the EU and the ESA framework with the principle of *juste retour* is going to receive much attention. While on the surface these principles seem to be contradictory, it should be noted that the overall context has worked very well for establishing a European space industry. The ESA principle encouraged States to join ESA while the European rules with respect to the establishment of the internal market helped the industrial players to easily establish themselves in new ESA Member States. This permitted a natural transfer of space technology, industrial capabilities and market dynamics. Thus, the fair competition context is not affected in a negative way but is, on the contrary, saved because the European economy did not suffer any loss of efficiency with negative effects for citizens and consumers. The table 8 shows how the EU has favoured the establishment of new industrial players even if they came from the same holding company and it also shows the industrial consolidation in Europe and its extent.

Here, a sort of positive "discrimination" by EU towards merger and antitrust operations in the field of SatCom is understandable. The rational is often envisaged in the positive value of the vertical model for SatCom in order to reduce inefficiency in developing new innovative customized services for "professional" consumers (military, governmental entities, oil & gas companies and corporations in general terms). It is also due to the absence of a huge mass market of satellite services with the direct involvement of citizens/users.

[77] The industrial policy which the Agency is to elaborate and apply by virtue of Art. II d. shall be designed in particular to:

- meet the requirements of the European space program and the co-ordinated national space programs in a cost effective manner;
- improve the world-wide competitiveness of European industry by maintaining and developing space technology and by encouraging the rationalization and development of an industrial structure appropriate to market requirements, making use in the first place of the existing industrial potential of all Member States;
- ensure that all Member States participate in an equitable manner, having regard to their financial contribution, in implementing the European space program and in the associated development of space technology; in particular the Agency shall for the execution of the programs grant preference to the fullest extent possible to industry in all Member States, which shall be given the maximum opportunity to participate in the work of technological interest undertaken for the Agency;
- exploit the advantages of free competitive bidding, except where this should be incompatible with other defined objectives of industrial policy.

[78] EU Council Decision on the signing of the Framework Agreement between the European Community and the European Space Agency, Brussels, 7 October 2003 (OR. en)- 12858/03, RECH152, OC 589.

[79] EU and ESA, Resolution on the European Space Policy, March 2007.

Policy Area	Parts	Time	Case Number	Remarks	Result
Merger	Nordic Satellite Distribution	1995	M. 490	Council Regulation 4064/89 Art: 8 (3)	×
Merger	Magneti Marelli - Telespazio	1998	M 1211	Concentration Council Regulation 4064/89 Art. 3 (1) (b) Art. 6 (1) (b)	✓
Antitrust	TPS + 7	1999	36237	Art. 85 (1) - (3) EC Treaty	✓
Antitrust	Eutelsat	2000	37562	Art. 81 (1) EC Treaty	✓
Merger	MMS - DASA - Astrium	2000	M 1636	Council Regulation 4064/89 Art. 8 (2)	✓
Antitrust	Intelsat	2001	37995	Cooperation Agreement	✓
Merger	Finmeccanica - Telespazio	2002	M 2949	Concentration Council Regulation 4064/89 Art. 6 (1) (b)	✓
Merger	EADS - Astrium	2002	M 2924	Council Regulation 4064/89 Art. 6 (1) (b)	✓
Merger	EADS - Astrium	2003	M 3156	Council Regulation 4064/89 Art. 6 (1) (b)	✓
State Aids	Lombardia - Trasport-Satellite Control	2005	XS139/2004	Direct Grant	✓
Merger	Alcatel - Finmeccanica - Alcatel Alenia Space - Telespazio	2005	M 3680	Concentration Council Regulation 139/2004 Art. 8 (1)	✓
Merger	Apax Partners - Telenor Satellite Services	2007	M. 4709	Concentration Regulation (EC) No 139/2004	✓
Merger	Thales - Finmeccanica - Alcatel Alenia Space - Telespazio	2007	M 4403	Council Regulation 139/2004 Art. 8 (1) (b)	✓
Merger	SES Astra - Eutelsat - *JV*	2007	M 4477	Council Regulation 139/2004 Art. 6 (1) (b)	✓
Merger	Serafina - Intelsat	2007	M 4804	Council Regulation 139/2004 Art. 6 (1) (b)	✓
Merger	Theodorus I - Theodorus II - EADS Astrium - Euro Heat Pipes	2008	M 5060	Council Regulation 139/2004 Art. 6 (1) (b)	✓
Merger	Abertis - SEPI - CDTI - INTA - Hispasat	2008	M 5105	Council Regulation 139/2004 Art. 6 (1) (b)	✓
Key-Reading: ✓ as 'Approved' - × as 'Rejected'.					

Table 8: EU Cases of Antitrust, Merger and State Aids in SatCom

ESA began developing communications satellites in 1968. Past relevant ESA SatCom Programmes are presented in the table 9:

SatCom Programmes	Description	Achievements
Orbital Test Satellite (OTS-1)	SatCom in C- and Ku-Bands	Lost at launch in 1977
Orbital Test Satellite (OTS-2)	SatCom with six Ku-band transponders and provided services for 7,200 telephone circuits.	ESA, Eutelsat and national telecom companies used OTS-2 for over 13 years. It demonstrated broadcasting to cable feeds and direct-to-home television. OTS-2 inspired subsequent satellites in Europe.
European Communications Satellites (ECS)	Each ECS allowed coverage of the whole European continent for cable television, telephone communications, specialized services and Eurovision transmissions	These satellites were used by Eutelsat.
MARECS	SatCom Development for communications with mobile stations, especially ships at sea	They were leased for operations to Inmarsat. Their L-band payloads, with global coverage, handle 50 telephone circuits.
Olympus	Its design incorporated technologies that were later incorporated in commercial satellites, including high-power transmitters, multi-spot beam Ka-band technology and on-board switching.	Its direct-to-home TV broadcasting payload allowed national network programme to be captured with dish antennas as small as 30 cm in diameter.
Artemis	A technological demonstration satellite that incorporates Data Relay Satellite at both optical frequencies and in the Ka-band, a navigation payload for EGNOS and a mobile services payload.	It is one of the European Experiments for a multi-task satellite.
Hylas - 1	The Highly Adaptable Satellite is an advanced satellite system focused on high-speed internet connectivity for Europe. Operating across Ku- and Ka-band frequencies with advanced communication technology, Hylas-1 can pipe broadband through the sky to hundreds of thousands of previously underserved users while simultaneously broadcasting multiple standard and high-definition TV channels.	It is ESA's first public–private partnership resulting in a full satellite system. The commercial operator, UK-based Avanti Communications, has contributed most of the mission budget and will use the satellite to deliver broadband services to customers. ESA's involvement focuses on Hylas-1's payload technology.

Table 9: Past ESA Programmes and Achievements

Industry policy for the development and/or deployment of SatCom has traditionally involved manufacturing players. Up to now, ESA and National Space Agencies have driven industry policy in these senses. ESA has created a programme line known as the *Advanced Research on Telecommunication Satellite Systems* (ARTES) programme. Currently, ESA has a long-term telecommunication plan in which the items in table 10 refer to SatCom from the point of view of satellite systems:

ARTES Programme	Description	Challenge
ARTES 7 – European Data Relay Satellite (EDRS)	DRS are satellites placed in geostationary orbit to relay information to-from non-geostationary satellites, spacecraft, other vehicles and fixed Earth stations, which otherwise are not able to permanently transmit-receive data.	To add to Europe's independence, the European Data Relay Satellite System will fill the gap of an independent European telecom network that is fast, reliable and seamless.
ARTES 8 Alphabus/Alphasat	This is the satellite that, in partnership with Inmarsat, will incorporate the first unit of the Alphabus Platform jointly developed by Astrium and Thales Alenia Space. Alphasat incorporates innovative on-board processing technology and user services.	The Inmarsat **extended L- band (XL)** payload will support advanced geomobile communications and augment Inmarsat's BGAN service with its coverage centred over Africa and providing additional coverage to Europe, the Middle-East and parts of Asia. The other technological tests are of: - Advanced Laser Communication Terminal to demonstrate GEO to LEO communication links at 1064nm; - **Q-V Band** communications experiment to assess the feasibility of these bands for future commercial applications; Advanced Star Tracker with active pixel detector; Monitor the GEO radiation environment and effects on electronic components.
ARTES 10 IRIS	Development of a new Air-Ground Communication system for Air Traffic Management. The satellite-based solution for the Single European Sky ATM Research (SESAR) programme.	By 2020 it will contribute to the modernization of air traffic management by providing digital data links to cockpit crews in continental and oceanic airspace.
ARTES 11 Small - GEO	Development and implementation of the **Small GEO System**. This is a satellite that, in partnership with Hispasat will fly the Luxor Platform developed by OHB and partners. This satellite will incorporate advanced payload technology: DVB-S2 Processor and active antennas.	The core team of companies that is jointly developing and will later commercialise the platform includes, besides OHB-System AG and its Luxembourgish subsidiary LuxSpace, Swedish Space Corporation, Carlo Gavazzi Space (Italy) and Oerlikon (Switzerland). The selection of Hispasat for the mission was made through an open Call for Interest (ESA, June 2007).

Table 10: ESA Programmes with SatCom System

The interest of ESA is to address front-runner SatCom systems in terms of:

- New concept of satellite systems (EDRS) with the aim of European Autonomy[80] of space assets;
- Exploration use of "new" bands as XL-Bands, where there are crowded uses, and Q/V Bands after the Ka-Band (Alphasat/Alphabus);
- Procuring of innovative systems for critical services in support of Air Traffic Management (IRIS);
- Development of affordable SatCom systems with aim of reducing barriers of

[80] European Autonomy is a concept stressed by ESPI. It is close to European Dependence and Independence of Space Policy.

satellite infrastructures to new-entry players in the market and to permit economies of scale in the supply of manufacturing chains (Small – GEO).

The strategy of ESA is characterised by the following points:

- Enhancing the role of SatCom also for space exploration needs as EDRS can provide communication for the deep space environment;
- Enhancing, again, the role of SatCom for institutional purposes such as air traffic management issues with IRIS;
- Affirming the relevance of SatCom technologies for provision of broadband services with the further aim of exploit bands in anticipation of a crowded environment for Ka-Band uses;
- Supporting the needs of new operators through the development of small-satellites in order to gain efficiency through a standardized supply chain.

From the network and platform point of view, ESA also includes items referring to SatCom in the current telecommunication long-term plan, such as in table 11:

Programme	Description	Challenge
ARTES 1 Preparatory	Dedicated to strategic analysis, market analysis, technology and system feasibility studies and to the support of satellite communication standards.	• Integration of Mobile Satellite Systems in terrestrial mobile networks • The role of satellites in converged mobile/fixed/broadcasting environments • Emerging system concepts for UAS command and control via satellite
ARTES 3 – 4 Products	Dedicated to the development, qualification, and demonstration of products such as a piece of equipment, either of the platform or payload of a satellite, a user terminal or a full telecom system integrating a network with its respective space segment.	• Integration and Trial of an Ad-hoc Terrestrial Component into Global Satellite Communications Systems • S-band Satellite Broadcasting Experimentation Campaign through NICT ETS-VIII satellite • Resource for Emergency Services to Access Command and control data using satellite and hybrid Technologies • Satellite Enhanced Network System for flexible bandwidth management
ARTES 5 Technology[81]	Focuses on research and development of new technologies and techniques in telecom satellites, ground and user equipment for future or evolving SatCom systems.	• Broadband Access over multi-spot beam Ka-band satellites • Satellite Interactive Multimedia Platform for Low-cost Earth stations

Table 11: ESA Programmes addressed to Networks and Platforms

[81] ARTES 5 is composed of two sets of activities:
- the "Competitive Work plan" activities or ARTES 5.1: activities are implemented on the basis of an annual work plan. This work plan is established based on the results of an annual Call for Ideas open to Participating States' satellite industries, satellite operators, service providers, universities and research centres, national space agencies and to ESA employees.
- "Non-Competitive Industry Initiated" activities or ARTES 5.2: supports, through co-funding, the development of new technologies, techniques and system concepts in the area of satellite communication. Activities are identified and proposed by Industry through an Always Open Calls for Proposals, a mechanism allowing Industry to submit one or several proposals at any time. A proposal shall include a plan for completing the ARTES 5.2 activity in a follow-on development of a product.

The ESA approach to the concept of a network starts from a feasibility study (ARTES 1) and its attention is towards the integration of SatCom and terrestrial technology. ESA then proposes a work plan in order to implement the network required for operational SatCom systems (ARTES 3 -4) and its current focus is on S-Band, emergency services and efficient use of the spectrum. The attention towards technology (ARTES 5) is not only about satellite components but also concerns access techniques to the network. Future global network infrastructure should support the following requirements:

- Data rates: Applications such as video streaming, media cast distributions, telemedicine, two-way telephonic education, require rates ranging from a few hundred megabits to several gigabits. Broadband systems have approximately 11-30 Mbps transmission speeds. The target speed for 4G cellular will be around 10-20 Mbps;
- Delay: Real-time applications require a maximum delay of 400 ms and packet transfer delays for other classes of service are even more stringent;
- Mobility: new systems will require at least 2 Mbps for moving vehicles;
- Wide Coverage: Next-generation systems must use GSO systems to provide wide coverage. Mobile satellite networks using NGSO cover roaming and handover to other systems;
- Quality of Service (QoS): Application QoS must be supported providing guaranteed bandwidth, delay, and meet a delay jitter, packet loss, and availability requirements;
- Scalability: Network scalability should support large numbers of users, e.g. a few million, and resources in proportion to the number of users, application scalability providing the necessary QoS levels without performance degradation, i.e. 100,000 users with multimedia service support and QoS level guarantees per system;
- Security: User authentication, privacy, encryption, and end-to-end security must be supported;
- Multicast: In addition to uni-cast, IP multicast service must be provided;
- Interoperability: Standard protocol interoperability must be provided at all levels with interface designs supporting homogeneity of terminals, networks, and user-to-user applications.

ESA also plays a role in value-added services of a SatCom system as shown in table 12. Its role is to deploy applications through two types of measures: industry driven (ARTES 3-4 and 5) and user driven (ARTES 20). The latter aims are to involve non-space sectors as users in order to increase the awareness of benefits coming from space-based technologies. The involved programmes are ARTE 3-4 and ARTES 5.

Programme	Description	Challenge
ARTES 3 – 4	It offers an opportunity for Small and Medium sized Enterprises entering into the field of satellite communications with the **Initiative for ESA Telecom Newcomers (IETN)** for the early stages of R&D services for the SatCom market.	The IETN aims to support SMEs in the development of services or applications emerging from the creative use of existing satellite technology such as multimedia, Internet, mobile applications, or systems or technologies to support new, or improve existing, services.
ARTES 5	It considers ground and user equipment for future or evolving SatCom systems.	The development of User Terminals has the aim of increasing bandwidth for DTH applications, cost reductions in user terminal antennas, and innovative mechanisms for rapidly deployable antennas.
ARTES 20	It is dedicated to the development and pilot operations of Integrated Applications that combine different types of satellites, considering Health, Safety, Development, Energy, Transport.	The goal is to provide innovative added value to services by combining different space assets, integrating with existing terrestrial assets.

Table 12: SatCom Value – Added Services - Industry Policy

At the level of national programmes, telecommunications are still an issue of national sovereignty particularly for military and defence purposes. In this sense, national space agencies have played a crucial role in support of military SatCom programmes. This matter presents some trend peculiarities, such as dual use –civil and military applications – and the cooperation of France and Italy. The dual use also comprises the dual procurement of the system with the consequent right of use by both of the entities. Some dual use concepts comprehend also the commercial uses of downstream services. In the table 13, the past and present programmes are presented per country. The main initiatives have been led by France, Italy, Germany and United Kingdom.

SatCom Programme	Description	Achievements	Present -Past
France			
SYRACUSE SYstème de Radio Communication Utilisant un SatelitE	There have been three generations of MilSatCom since 1980.	It also provides services for UK Army, NATO Forces and Italy Army.	Present -Past
Athena Fidus	It is a dual use system for civil and military requirements. It will work inside EHF- and Ka-Band and transmission technologies on standard DVB-RCS e DVB-S2.	It comprises cooperation with Italy also with a dual use profile.	Present
Italy			
SIRIO 1 and 2	SIRIO was a spin stabilized geostationary experimental communications satellite with a nominal life of two years.	It was a cooperation of ESA programme as MARECS.	Past
ITALSAT 1 and 2	It was a body stabilized experimental geostationary satellite which provided pre-operational domestic Italian telecommunications services in the 20/30 GHz bands.	ITALSAT 2 also hosted ESA's first European Mobile Services payload.	Past
SIGMa	GEO Satellite with transponders in Ku- and Ka-Bands. It will also provide a complementary service to Athena Fidus.	It aims to fill the broadband gap for Italy.	Present
Athena Fidus	*See above*	*See above*	Present
United Kingdom			
SkyNet 1-5	Skynet is a family of military satellites, now operated by Paradigm Secure Communications on behalf of the UK Ministry of Defence, which provide strategic communication services to the three branches of the British Armed Forces and to NATO forces engaged on coalition tasks.	It is a model of Private Financial Initiatives (PFI) with commercial purposes.	Present -Past

SatCom Programme	Description	Achievements	Present -Past
Germany			
SATCOMBw	The programme presents two military communications satellites for the German Bundeswehr.	It is a dual use system with commercial orientation.	Present
Heinrich Hertz	It is a Small-GEO satellite to include advanced Ka-band broadcast technologies as part of a partnership with a commercial satellite operator.	It intends to maintain a national capability in the sector and to help German industry maintain its telecommunications competitiveness	Present

Table 13: National SatCom Programmes – Present and Past

In the table 14 it is clear the main strategic guidelines in the development of these systems have been defence and security. They have been national initiatives in order to have independent space capacity and capability for national purposes. The case of cooperation between France and Italy for Athena Fidus is exceptional. In terms of national initiatives there are several projects enhancing broadcasting services, establishing TV-platforms, developing techniques and algorithms for IP-TV, etc. Following, are some examples from France and Italy.

Programme	Description	Challenge
FRANCE		
Cospas-Sarsat	Initiated in 1982, it is an international search-and-rescue programme for mobiles at sea, in the air and on land anywhere on the globe.	The system comprises a satellite constellation, orbiting the Earth continuously with the task of listening for signals emitted by distress beacons.
Telehealth	Modern space technologies—satellite communications, Earth imaging and satellite positioning systems—enable us to better measure, compare and understand health-related parameters.	Its applications cover four key areas: provision of care in remote regions, epidemic monitoring (environment, climate and health), crisis management, and education and training.
ITALY		
EMERSAT	The project foresees as its primary objective, the development, integration and testing of satellite solutions for applications and communications services to national institutional agencies dedicated to security and emergency management.	Its aim is the enhancement of the satellite's role: interoperability between different networks, strength and "survival", security of communications and access, back up and complementariness of solutions that optimizes the use of satellite technology.
TELESAL	It proposes a technological architecture for operating and managing a broad-band satellite communications system integrated and interoperable with ground communications networks.	Its success can ensure the forecast institutional services of Telemedicine, especially in the two specific sectors of operations for emergencies and home care assistance.

Table 14 National SatCom Programmes – Value Added Services

3.1.3 SatCom Industrial Policy: Achievements

These types of mechanisms from ESA, EU and Member States, have created a SatCom Industry with the current market players per segment in table 15.

Component of System	Industrial Segment	Players (European Presence)	Typical EBIT Margin [%]
Space	**System Manufacturers**	• EADS Astrium (FR, ES, DE, CZ, PL) • SSTL (UK) [EADS company] • Thales Alenia Space (IT, FR) • OHB (DE, IT) • INDRA (ES)	2 – 8 %
Network & Ground *Transponder leasing*	**Satellite Operators**	• Eutelsat (FR) • SES – ASTRA (LX) • Hispasat (ES) • Hisdesat (ES) • Hellasat (HE) • Paradigm (UK, DE) • Inmarsat (UK)	30 – 40 %
↑↓	**Terminal Equipment Manufacturer**	• Thrane & Thrane (DK) • CMS Electronics (AT) • Cobham (UK)	5 – 10%
VAS & End-Users	**Services Providers**	• Astrium Services (FR, ES, DE) • Telespazio (IT, FR, DE) • ND Satcom (DE) [SES Company] • Deimos Space (ES) • *Several SMEs for peculiar SatCom Applications*	minus – 15%

Table 15: SatCom Industry Players in Europe

In particular, there are two satellite operators, Eutelsat and SES, with global relevance as they have big fleets of satellites and they compete directly with the other global satellite operator, Intelsat. Eutelsat has 25 satellites in orbit and plans 5 more satellites. SES has a fleet of 44 satellites on orbit and a plan for 10 new satellites. The picture presents some criticalities in the sector of "service providers". The established business model considers the sale relationship between satellite operators, selling space transponder usages, and service providers selling VAS for end-users, which requires customized solutions with consequently low economies of scale. Thus the market risk is often transferred to service providers. Then, there are not numerous terminal manufactures in Europe with a leading technology and related market power thus the price is not affordable for the mass market. On the other side it is an element affecting the performance of services providers building the turn-key solutions with outsourcing of satellite capacity and terminal equipments.

In order to understand the "value-added" produced by this framework of industry policy, it is envisaged to use as a measure the Intellectual Property Rights (IPRs) by Europe from 1988 to 2009. The form of IPRs considered here is the Patent Label. It is a reasonable "proxy" because its requirements are *Industrial Applicability*[82], *Novelty*[83] , and a *Patentable subject matter*[84]. The table 16 shows the number of Patent labels obtained per segment by European stakeholders.

[82] The invention must be of practical use, or capable of some kind of industrial application.
[83] It must show some new characteristic that is not known in the body of existing knowledge (referred to as prior art) in its technical field. Inventive step (non-obviousness) must show an inventive step that could not be deduced by a person with average knowledge of the technical field.
[84] The invention must fall within the scope of patentable subject matter as defined by national law. This varies from one country to another. Many countries exclude from patentability such subject matter as scientific theories, mathematical methods, plant or animal varieties, discoveries of natural substances, methods for medical treatment (as opposed to medical products), and any invention where prevention of its commercial exploitation is necessary to protect public order, good morals or public health.

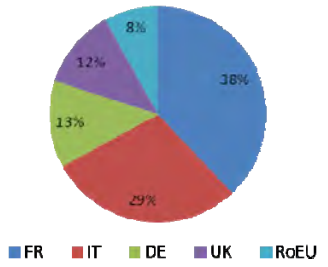
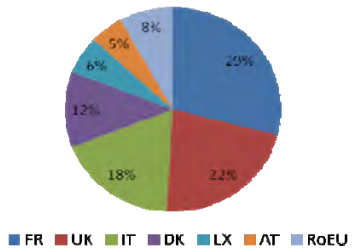
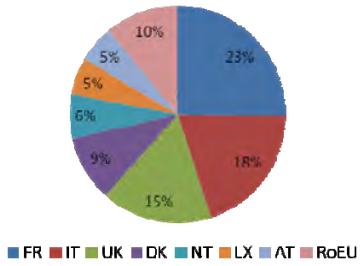
Components	European Geographical Distribution	Remarks
Space		The leading European Countries registered 2.856 patent labels in the sector from 1988 to 2009.
Network & Ground **Terminal Equipment**		The leading European countries, together with DK and AT, are those where firms for Terminal Equipment are based. They achieved 2.300 patent labels between1988 - 2009.
VAS & End-Users		The share of leading countries is lower than in other sectors. Here, also other European countries participate. 3.125 patent labels were reached in the sector in 1988 - 2009.

Table 16: SatCom Patent Labels in Europe per Industry Segment

In order to evaluate the significance of this number of patents, some proxy of comparative performance should be considered, such as the degree of European SatCom intensity compared to worldwide industry, export sales of the sectors, and technical comparison. Various aspects make patents particularly useful as a proxy for technology and technological developments. Patent statistics refer to the output of the research process undertaken by firms and sectors. They provide information on a large number of sectors and technologies and they permit good coverage of developments over time, which is particularly interesting. As these data are available for a large number of countries, they also enable calculation of the relative performance of the EU, or any other country or region with respect to the world. The index proposed is:

$$PAT\_\text{int}ensity = \frac{\frac{PAT_{i,EU}}{PAT_{Tot,EU}}}{\frac{PAT_{i,World}}{PAT_{Tot,World}}}$$

- where $PAT_{i,\ EU}$ is the number of patents of sector (i) in Europe;
- where $PAT_{Tot,\ EU}$ is the total number of patents in Europe;
- where $PAT_{i,\ World}$ is the number of patent of sector (i) in Europe;
- where $PAT_{Tot,\ World}$ is the total number of patents in the World.

Values greater than 1 indicate that the sector has a 'patent' specialization relative to the reference area, here the world.

Field of Technology	PAT_ intensity
I - Electrical engineering	
Electrical machinery, apparatus, energy	0.83
Audio-visual technology	0.60
Telecommunications	0.67
Digital communication	1.01
Basic communication processes	0.83
Computer technology	0.63
IT methods for management	0.48
Semiconductors	0.46
II - Instruments	
Optics	0.43
Measurement	1.15
Analysis of biological materials	1.28
Control	1.00
Medical technology	1.09
III - Chemistry	
Organic fine chemistry	1.67
Biotechnology	1.19
Pharmaceuticals	1.33
Macromolecular chemistry, polymers	1.10
Food chemistry	0.93
Basic materials chemistry	1.21
Materials, metallurgy	0.94
Surface technology, coating	0.87
Micro-structural and nanotechnology	0.93
Chemical engineering	1.32
Environmental technology	1.04
IV - Mechanical engineering	
Handling	1.38
Machine tools	1.21
Engines, pumps, turbines	1.34
Textile and paper machines	1.03
Other special machines	1.20
Thermal processes and apparatus	0.94
Mechanical elements	1.48
Transport	1.46
V - Other fields	
Furniture, games	0.83
Other consumer goods	1.06
Civil engineering	1.22

Table 17: European Patent Intensity per Sector

The red character in the table 17 indicates that the sector is global in terms of patents. The telecommunication field is not EU-specific; the only sector dominated by the EU is digital communication. SatCom is partially included in the category of digital communications in terms of modulars, transmitters, power amplifiers. Some years ago there was a huge international debate concerning SatCom development and the contextual policy environment[85]. There have been several studies comparing SatCom technologies from the EU, USA and Japan in order to understand the impact of the policy context on technological performance. These studies compare European, US American and Japanese satellites in terms of implemented technology. The table 18 presents an overview with the main technical "proxies" of satellites. Each proxy has been evaluated with a value of 1 as "the best in class", "2" as medium level and "3" as low level.

It is evident that EU SatCom performance is not low even if it never achieves a "1" as the best in class. This "middle-position" allows the EU SatCom industry to reach, as already indicated, a significant level of exports in terms of SatCom services and SatCom systems and turn-key solutions form spacecraft to network architecture, including satellite operations and transponder leasing. Concerning with the index of PAT_intensity, SatCom is more patent intensive in Europe than in the other regions, USA and Japan. The European PAT_intensity index is higher for the spacecraft and its components and lower for ground elements and terminal devices. The European leadership, related with patent intensity, is achieved but from performance point of view it is not really recognised by the technical literature.

When considering exports and domestic markets, it is interesting to note that the exports are almost solely composed of telecommunications systems sales. All other systems produced by European industry are sold only in Europe. Only half of telecommunications systems produced by European industry are exported, the rest are sold on the European market[86]. The size of exports is around 23% of the current revenues coming from SatCom sales. With an overall turnover of € 2.5 billion made under unfavourable exchange rate con-

[85] Burton I. Edelson, Joseph N. Pelton, Satellite communications systems and technology--Europe, Japan, Russia, ndc, 1995; Gérard Maral, Michel Bousquet, Zhili Sun, Satellite Communications Systems: Systems, Techniques and Technology, 2002; Takashi Iida, Joseph N. Pelton, Edward Ashford, Satellite communications in the 21st century: trends and technologies, American Institute of Aeronautics and Astronautics, 2003, and http://www.wtec.org/loyola/satcom/toc.htm

[86] Idem, p. 8

Technical proxy	EU Satellite	USA Satellite	Japan Satellite
Spacecraft Antenna	2	3	1
Ground Antenna	3	2	1
Antenna Positioning	2	3	1
VSAT	3	2	1
Large Scale Antenna	2	3	1
Ultra Small Aperture Terminal /Personal Communication	3	2	1
On Board Processing	2	3	1
Inter-satellite Link	2	3	1
Power System	2	3	1
Optical Link	2	3	1
Ion Thrusters	2	3	1
Solid State Power Amplifiers (SSPAs)	2	3	1
Travelling Wave Tube	2	3	1
High Data Rate Communication	2	1	3
High Electron Mobility Transistor Technology	2	3	1
Device for SSPAs	3	2	1
Advanced system concept	2	3	1
Total Average life	2	3	1
PAT_ intensity	**EU Satellite**	**USA Satellite**	**Japan Satellite**
Spacecraft Antenna	1.21	1.08	0.61
Ground Antenna	0.97	0.90	1.14
Antenna Positioning	1.27	1.08	0.32
VSAT	0.85	1.51	0.44
Large Scale Antenna	0.80	0.59	0.50
Ultra Small Aperture Terminal /Personal Communication	0.70	1.23	1.14
On Board Processing	1.27	0.69	1.39
Inter-satellite Link	0.95	0.59	0.63
Power System	0.82	1.33	0.69
Optical Link	1.12	0.98	0.76
Ion Thrusters	0.80	0.72	0.88
Solid State Power Amplifiers (SSPAs)	0.57	0.54	0.63
Travelling Wave Tube	0.62	0.46	0.76
High Data Rate Communication	1.27	0.59	1.14
High Electron Mobility Transistor Technology	1.20	0.69	1.58
Device for SSPAs	0.95	0.54	0.57
Advanced system concept	1.52	0.51	0.69
Total Average life	1.35	0.74	0.95

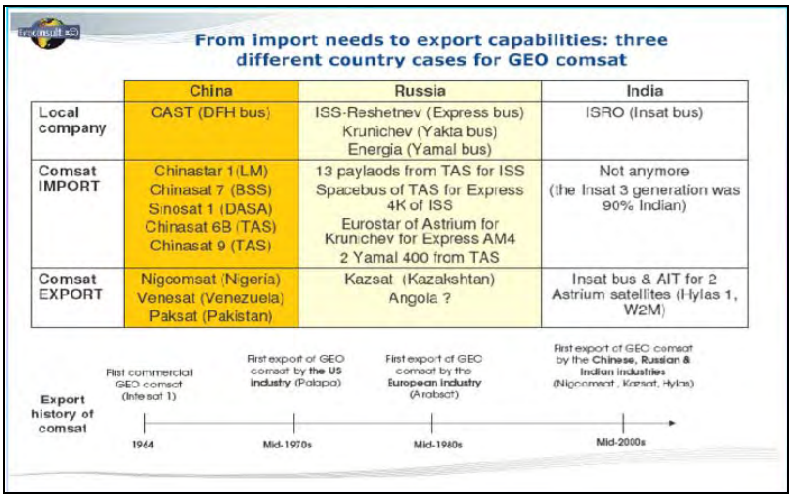
Table 18: Technical Comparison of a "typical regional satellite" and PAT_intensity per proxy. (Source, ITRI, 2007 ; WIPO, 2011; OECD, 2011)

ditions, the European Space industry demonstrates its competitiveness on the global market. The successful cases of Europe export are mentioned by Euroconsult[87] in the picture 6.

Exports are mainly to emerging countries; the import-export ratio with the USA is still dominated by import flow. The SatCom sector quota as a proportion of the overall telecommunication sector was, as picture 7 presents, around 13% in 2000, 15% in 2007 and 17, 4% in 2008[88].

[87] Euroconsult, Nurturing the development of space technology: an international comparison, Industry Symposium of the Scientific and Technical Subcommittee of the OOSA, February 8, 2010 - United Nations Office, Vienna. [http://www.unoosa.org/pdf/pres/stsc2010/symp-01.pdf - available at Nov. 2010 -].

[88] EUROSTAT, Note DS 0189- Statistics in Focus, 03/2009.



Picture 6: SatCom Cases of European Exports (Source: Euroconsult, 2010)

	EXPORTS						IMPORTS					
	2000	2007	2008	Average annual growth rate 2000-2008	Share in EU-27 telecom. equipment exports 2008	Share in total EU-27 exports to that country 2008	2000	2007	2008	Average annual growth rate 2000-2008	Share in EU-27 telecom. equipment imports 2008	Share in total EU-27 imports from that country 2008
EU-27	38 720	39 087	38 058	-0.2%	100.0%	2.9%	46 502	79 731	74 881	6.1%	100.0%	4.8%
China	3 730	1 835	1 473	-11.0%	3.9%	1.9%	6 853	33 205	32 306	21.4%	43.1%	13.0%
Republic of Korea	489	485	626	3.1%	1.6%	2.4%	3 159	10 813	10 337	16.0%	13.8%	26.2%
United States	5 471	3 861	3 852	-4.3%	10.1%	1.5%	12 807	8 997	6 644	-7.9%	8.9%	3.6%
Japan	1 274	462	459	-12.0%	1.2%	1.1%	8 586	6 293	5 838	-4.7%	7.8%	7.8%
Russia	985	4 653	5 134	22.9%	13.5%	4.9%	27	57	45	6.6%	0.1%	0.0%
Taiw an	1 234	213	246	-18.2%	0.6%	2.1%	1 746	5 123	4 402	12.2%	5.9%	18.3%
Malaysia	708	387	398	-6.9%	1.0%	3.4%	2 429	2 848	2 875	2.1%	3.8%	16.4%
Hong Kong	1 793	981	974	-7.3%	2.6%	4.6%	658	1 373	2 260	16.7%	3.0%	19.6%
Turkey	2 665	1 783	1 728	-5.3%	4.5%	3.2%	940	1 867	1 424	5.3%	1.9%	3.1%
Sw itzerland	2 068	1 909	2 102	0.2%	5.5%	2.1%	829	426	426	-8.0%	0.6%	0.5%

Picture 7: Extra EU-27 trade in telecommunication, sound and video equipment [€ Million] (Source: EUROSTAT, 2009)

3.2 The Case of Broadband: Development and Deployment in Europe

In 2010 the EC issued a Communication on the Digital Agenda[89]with the aim of providing broadband for all European citizens with the following specific targets:

- *Basic broadband* for all by 2013: basic broadband coverage for 100% of EU citizens;
- *Fast broadband* by 2020: broadband coverage at 30 Mbps or more for 100% of EU citizens;
- *Ultra-fast broadband* by 2020: 50% of European households should have subscriptions above 100Mbps.

The task of providing "connectivity" for all Europe is also an element of Europe 2020 and the European Economic Recovery Plan. Thus, it is one of the priorities for the growth of Europe.

3.2.1 Definition of Broadband and Technologies

As there is no clear definition of broadband, the meaning of the first target *basic broadband* is not clear. There exist different definitions of broadband in terms of capacity, number of Kbitps, as adopted by the U.S. - FCC[90], or in terms of the number of applications provided at the same time, as adopted by Canada[91], or a connectivity able to provide

[89] EC, Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, A Digital Agenda for Europe, Brussels, 19.05.2010, COM(2010) 245.

[90] FCC, Connecting America: National Broadband Plan, 2010.

[91] Canadian Ministry of Economics, Broadband Canada: connecting rural Canadians, 2009.

a downstream access at 256 Kbitps and an upstream at 128 Kbitps as the OECD[92] has proposed, or, even, as a capacity over the primary rate of ISDN that is over 1,5 Mbitps in the USA and over 2Mbit/s in Europe as proposed by the ITU[93]. In a commercial sense, broadband is connectivity at 256 Kbitps. There is also a complex definition of broadband as "a technological environment that is able to use high level of advanced digital communications and permitting a high degree of interactivity"[94]. In this definition the key word is the "interactivity" that requires a technology able to assure a high throughput of data in downlinks and in uplinks. This definition underlines the concept of "technological environment" thus the context is complex and it has policy relevance.

Different technologies to provide broadband exist. They can be classified as fixed broadband and as wireless. Each one requires a network infrastructure and related terminal equipment in the hands of users. Some work in the same range of the spectrum where, by EU law, the neutrality principle has been established in terms of technology and service.

Technology	Spectrum Usage	Shared Capacity	Capacity	Max Range	Advantage	Limitation
Fixed Line						
ADSL	Up to 1.1 MHz	No	12 Mbps @ 0.3 km 8.4 Mbps @ 2.7 km 6.3 Mbps @ 3.6 km 2 Mbps @ 4.8 km 1.5 Mbps @ 5.4 km	5.4 Km	Uses existing POTS	Limited bandwidth which is distance sensitive, asymmetric – order of magnitude lower upstream rate
Wireless						
3G WCDMA CDMA200 UMTS HSDPA HSUPA	1.92–1.98 GHz 2.11–2.17 GHz (licensed)	Yes	Up to 3 Mbps per mobile subscriber	Coverage area of host network	Mobile terminals Ride on existing cellular infrastructure	Costly Spectrum Limited Applications
WiFi	2.4–5.7 GHz	Yes	11.54 Mbps	Up to 100 m	Ethernet compliant Standardized 802.11 a/b/g Mass Consumption	For LAN Applications only Security issues Unlicensed ISM
WiMAX	3.5 GHz	Yes	2.8 to 11.3 Mbps DWLK per CPE 0.17 to 0.7 Mbps per UPLK per CPE	LOS 10-6 km NLOS 1-2 km Indoor self-install NLOS 0.3–0.5 km	NLOS	No large coverage of area Required ground infrastructures for deployment
Satellite	L, S, C, Ku, Ka - Bands 1.5 ~ 3.5 3.7 ~ 6.4 11.7 ~ 12.7 17.3 ~ 17.8 20 ~ 30 GHz	Yes	Up to 155 Mbps per downlink	Large coverage area of up to: 1.000 – 36.000 Km	Large coverage Multicast application Limited ground infrastructures Fast Deployment	Expensive to build Limited capacity per subscriber but suitable for remote locations with low number of users

Table 19: The Main Technologies for Broadband

[92] OECD, The Development of Broadband Access in OECD Countries, 2001.
[93] ITU, Communication from ITU-R and ITU-T: nr. 256-A1, 2003.
[94] Fondazione Ugo Bordoni, Le reti di telecomunicazioni in Italia, 2001.

For this reason, at present, there is not a dominant technology in the EU. Each Member State has its own particular historical reasons for why it chose one technology over another. The table 19 shows the main broadband technologies.

The technologies can be broadly classified into three categories, such as *wired* as in ADSL[95] with a cable support, *terrestrial wireless* as in 3G, WCDMA, CDMA 200, UMTS, HSDPA and HSUPA, and *SatCom*. Inside the set of wired technologies, ADSL is currently the most widely-used broadband access technology, used in a number of countries since 2002. Its limitations are beginning to be felt: the distance between the subscriber and the distribution frame is a problem, bitrates are asymmetrical and in some cases not high enough, particularly if more and more multimedia files are being sent over the network. In using this technology there is a new issue concerning the burden on users due to the new standards for Reach extended ADSL (ReADSL)[96]. It should be pointed out that the compatibility of existing equipment will help spur the implementation of the new standards. ReADSL, which was standardized in 2005, is a technology aimed at rollouts in rural zones as it is dedicated to use on long lines and can increase the signal transmission distance by 20% compared to ADSL. ReADSL operates on first generation ADSL but requires users to be equipped with a dedicated ReADSL modem. There are issues of bottlenecks in the last kilometre. They can limit the speeds and services available on networks even if the backhaul capacity is sufficient. Here, the crucial issue for the policy maker deciding to implement a full coverage is that the marginal cost of extending a backbone connection to an additional community could be much lower than the benefit it could potentially provide. In addition, the "benefit" has to be accurately evaluated not only in terms of economics but also according to the social dimension, for instance the size of inclusive growth that can be achieved as indicated by Europe 2020. Thus, governments must also take great care not to displace private investment and letting the market play its role as an efficient "allocator" of resources and an optimal consumer surplus.

There are several terrestrial wireless technologies, such as 3G[97], WCDMA[98], CDMA 200[99], UMTS[100], HSDPA[101], HSUPA[102] and Wi-Fi[103] and WiMAX[104], and then there are satellite[105] solutions that are wireless by definition.

[95] Asymmetric Digital Subscriber Line.

[96] In 2002, the ITU approved two new standards to remedy these problems: ADSL2 and ADSL2+, compatible with existing ADSL equipment. Based on higher frequencies than ADSL (1.1 MHz for ADSL2 and 2.2 MHz for ADSL2+), these standards enable much higher speeds: up to 10 Mbps for ADSL2 and up to 20 Mbps and even 25 Mbps for ADSL2+ provided the subscriber is less than 2.5 km from the exchange.

[97] International Mobile Telecommunications-2000 (IMT — 2000), better known as 3G or 3rd Generation, is a generation of standards for mobile phones and mobile telecommunications services fulfilling specifications by the International Telecommunication Union.

[98] Wideband Code Division Multiple Access (WCDMA).

[99] CDMA2000 (also known as IMT Multi-Carrier (IMT-MC)).

[100] Universal Mobile Telecommunications System (UMTS).

[101] HSDPA (High Speed Data Packet Access) technology employs more efficient coding than classic UMTS, and currently delivers commercial speeds of 3.6 Mbps (peak rate of 14 Mbps). Enjoying improved performance depends on the modulation and coding that adapts to the quality of the transmission and reduces lag (2 ms). Available with Release 5 from 3GPP, HSPA is fully compatible with WCDMA – so much so that the same wireless channel can support both types of user. This specification also brings an evolution to the core network: IMS (IP Multimedia Services). Release 5 offers an improvement only in downstream speeds, with upstream speeds getting a boost thanks to HSUPA (High-Speed Uplink Packet Access) which is available with Release 6 of the 3GPP specification.

[102] HSPA (High Speed Packet Access) is an evolution of WCDMA systems and is compatible with existing networks. It makes it possible to achieve speeds of 14 Mbps downstream over 5 MHz UMTS channels, with predictions of reaching 42 Mbps when using MIMO (Multiple- Input Multiple-Output), starting in 2008/2009.

[103] Wi-Fi is a trademark of the Wi-Fi Alliance. A Wi-Fi enabled device such as a personal computer, video game console, smart phone or digital audio player can connect to the Internet when within range of a wireless network connected to the Internet. The coverage of one or more (interconnected) access points — called hotspots — generally comprises an area the size of a few rooms but may be expanded to cover many square miles, depending on the number of access points with overlapping coverage.

[104] Some BWA (Broadband Wireless Access) systems are based on wireless local loop technologies that have been equipped with mobile capabilities. This category also includes proprietary technologies that have not received widespread industry support. Alternative broadband access technologies (fixed and mobile WiMAX, Flash-OFDM and Wi-Fi to a lesser extent) also provide a complement to cellular technologies, particularly since they make it possible to alter the width of the frequency band used, in addition to delivering high bitrates.
It is a WLAN, or wireless local access network, technology. In addition to the initial applications that can be based on Wi-Fi, such as wireless private networks and inter site connections, the technology can be employed for applications such as public hotspots and as a local loop access solution. Initiated by the WiMAX Forum in 2003, WiMAX, or Worldwide Interoperability for Microwave Access, is a wireless MAN (Metropolitan Area Network) technology. Like other broadband access technologies, both wire line and wireless, WiMAX can be used in different configurations, the main ones being providing internet access to businesses and residential users in outlying regions, and as a backhaul solution for Wi-Fi or even cellular networks.

[105] Satellite broadband solutions using Ka-band are starting to be deployed by providers, and the future is promising in terms of performance, as bit-rates between 10 and 20 Mbps are expected. Ka-band technology reduces the required dish size, resulting in a lower equipment cost to consumers. It employs "spot beams", rather than regional

Wireless networks are often relatively less expensive to install and even to deploy for the case of SatCom than wire-based networks and now offer speeds comparable to average wired-broadband connections. Wireless broadband will likely be the right choice in some rural and most remote areas where installing wired infrastructure is too difficult or too expensive. Wireless networks may allow for faster installation than wired infrastructure, assuming the rights for existing towers have been negotiated or new towers have been constructed and spectrum is available. Wireless connections may be attractive to end-users as well because the connections offer mobility which is not possible with a fixed broadband connection. However, wireless connections are often more expensive and may be subject to download constraints that are much lower than fixed networks. The key drawback with wireless investment is the limited capacity of wireless technologies. The speed of any wireless network technology is a function of the amount of spectrum available, the number of users sharing the bandwidth, and other physical characteristics such as interference. Presently, technological development and industrial policy focus on how to provide similar speeds of wireless technologies compared to the advanced wired networks. Wireless connections are also by their nature a shared technology. The capacity in a cell is shared among all users in a given area so the capacity of all users decreases when another user connects to the network in the same area. To be a shared technology is not a big issue for remote areas where demographic density is not high, it may affect metropolitan areas but there fixed broadband solutions are easily affordable. Wireless connections will still need good backhaul connections[106] in order to offer high broadband speeds to users. Public investment in backhaul networks reaching out into rural areas can provide the needed capacity to support new wireless broadband access networks.

Within wireless technologies, satellite connections will continue to play a key role in providing broadband to remote areas out of economic reach by traditional wired networks. Satellite also is among the most efficient methods for delivering high-definition linear television signals. Long-range terrestrial wireless connections will also continue to be an important backhaul technology for certain rural and remote areas. Considering this, policy makers should examine spectrum allocations to see if there are ways to open up certain frequency bands which have efficient signal propagation characteristics for broadband use. This implies an appropriate policy for spectrum management. There will be incremental advancements in the amount of data which can be transmitted over a finite amount of spectrum but new high-speed networks will need large amounts of spectrum in which to operate. Ka-Band uses for SatCom broadband are going to be established. The drawbacks of SatCom solutions consist of latency of the transmission, the shared technologies, limited bandwidth per users compared with fixed technologies and the requirement of a long development process without an exit strategy. This last point requires a strong *ex-ante* effort, such as a specific and consistent policy action, because it implies deciding on the SatCom capacity at mission design stage. Thus, policymakers should know if the system will be able to satisfy user requirements during the satellite life, around 15 years, avoiding being crowded out by other technologies.

3.2.2 Broadband Technologies Adopted in the EU

This section presents an overview of technologies that are in use in the EU in terms of three categories of technology and also the SatCom capacity in orbit or already planned to be launched. Knowledge of broadband availability is therefore a precondition in informing policies aimed at maximizing the availability of services and the opportunities they present for economic and social development. The ideal situation would be having full, 100%, residential and business broadband coverage, thus enabling each segment of society to profit from the possibility of broadband access. Thus, a map is essential to understand the current status of the EU and identify the dimension of the digital divide through lack of infrastructure. Comparing data on broadband coverage across countries still faces some challenges because of the use of different metrics. Coverage data are important to policy makers in that they indicate the extent to which businesses and residential customers have access to broadband, i.e. to what extent the population and businesses are able to subscribe to broadband if they wish, regardless of price, usage or speed constraints. It is important to recognise that the data show availability and/or coverage/physical coverage. It is desirable to

or hemispheric transponder coverage, allowing for a more efficient use of bandwidth.

[106] In a hierarchical telecommunication network the backhaul portion of the network comprises the intermediate links between the core network, or backbone, of the network and the small sub networks at the "edge" of the entire hierarchical network. For example, while cell phones communicating with a single cell tower constitute a local sub network, the connection between the cell tower and the rest of the world begins with a backhaul link to the core of the telephone company's network (via a point of presence).

have data showing presence of each technology in terms of density, such as availability per square-kilometre of territory. There is not a clear common view on the issue for several reasons. For instance, the data are provided by local operators who have no incentive to monitor the real situation. Common data are presented in terms of percentage of served population, or as the number of households or as the number of subscriptions. These methodologies require some caveats.

There is no uniform database for ADSL; its coverage might be measured in terms of household availability, population coverage, or by the percentage of telephone lines that may deliver services. Broadband coverage is, of course, not the only factor that needs to be considered in order to assess potential digital divides. It is, however, a necessary indicator in determining whether some segments of the population are unable to participate in economic and social activities that require high speed Internet access. Other indicators surrounding factors such as price, speed or usage are complementary in assessing the true availability of service. Availability of broadband clearly is a factor in the take-up of broadband services (number of subscribers), but not the only factor. The only factor that could bias the household indicator, in relation to the population indicator, is the fact that households might have, on average, a higher or lower people-to-household ratio, which would result in a different population proportion. This could well happen in underserved areas, which are quite likely to be rural, where demographic characteristics of a household might vary in relation to the average, urban, served household. In general, therefore, in urban areas the population and household indicator are likely to be more comparable than in rural areas. Then, the number of subscriptions can help to understand which technology has been more adopted but it is not useful in understanding the dimension of the digital divide, or where the technology is not available at all for lack of signal, or as a simple choice of users.

The table 20 presents the broadband presence in terms of the percentage of population per each Member State and the presence of the technology in terms of the number of subscriptions per 100 inhabitants.

Country	Broadband penetration*	ADSL*	3G*	Cable§	Fibre§	Satellite§	Terrestrial Wireless§
Austria	22.70%	94%	84%	6.9	0.1	0.01	17.6
Belgium	29.10%	100%	89.90%	13.2		0.01	75.6
Bulgaria	13.00%	85%	50.00%				
Cyprus	22.20%	96%	85.00%				
Czech Republic	19.10%	92%	89.90%	4.5	1.5	0.00	10.1
Croatia							
Denmark	37.80%	99%	97.00%	10	4.4		72.8
Estonia	24.80%	94%	62.00%				
Finland	29.40%	96%	80%	4.3	0.3		48.3
France	30.30%	99%	73%	1,6	0.2		47.3
Germany	30.40%	95%	80.00%	3.2	0.1	0.05	47.4
Greece	17.00%	91%	88%				
Hungary	18.70%	91%	56%	8.7	1.8		46.6
Iceland		93%	63%		2.8	0.02	44.4
Ireland	24.80%	90%	89%	3.9	0.1	0.01	43.2
Italy	20.60%	96%	92%		0.5	0.03	42.0
Latvia	19.30%	89%	48%				
Lithuania	18.90%	89%	59%				
Luxemburg	32.10%	100%	90%	5.8	0.2		34.3
Malta	26.80%	99%	100%				
Netherlands	37.70%	99%	90%	14.8	0.9		30.0
Norway	33.50%	90%	87%	9.2	4.8		30.0
Poland	13.50%	64%	19%	4.0	0.2		28.9
Portugal	18.60%	96%	60%	7.6	0.7		23.6
Romania	13.00%	74%	30%				

Country	Broad-band pene-tration*	ADSL*	3G*	Cable§	Fibre§	Satel-lite§	Terres-trial Wire-less§
Slovak Republic	14.80%	78%	62%	1.6	3.4	0.005	22.1
Slovenia	22.90%	93%					
Spain	21.50%	93%	80%	4.1	0.1	0.025	21.3
Sweden	31.50%	98%	94%	6.4	7.8		7.5
Switzerland		98%	91%	10.4	0.4	0.038	6.9
United Kingdom	29.80%	100%	90%	6.4	0.1		1.2
(*): % of population | (§): Number of subscriptions per 100 inhabitants							

Table 20: The presence of broadband in Europe (Source: EU DG INFSO, Europe's Digital Competitiveness Report 2010, 2010. – OECD, Broadband statistics, 2010)

This picture is going to change soon as many governments are considering infrastructure investments as a way to counter the cyclical nature of the current economic downturn. Broadband network investment, in particular, is a key component of many national plans. The table 21 shows the main national initiatives for deployment of broadband in various Member States.

Entity	Fund Dimension	Policy Initiative
EU	1.2 Billion €	Digital Agenda
Belgium		Super Fast Belgium
Bulgaria		National Program for Development of Broadband
Czech Republic		National Broadband Access Policy
Denmark		From hardware to content
Estonia		Estonian Electronic Communications Act
Finland	200 Million €	National Plan
France	> 2 Billion €	France Numérique 2012
Germany	> 2 Billion €	Breitbandstrategie der Bundesreigierung
Greece	2 Billion €	Greek Digital Strategy
Ireland	223 Million €	National Broadband Scheme
Italy	1.5 Billion €	e-Government 2012
Lithuania		Rural Area Information Network (RAIN)
Netherlands		Nederland BreedbandLand
Portugal	1.1 Billion	Next-generation broadband networks
Spain	110 Million €	Avanza Infraestructuras
Slovenia		Strategy for Development of Broadband Networks
UK	230 Million €	Digital Britain
Sweden	1 Billion €	National Plan

Table 21: The main national broadband policy initiatives in Europe

In order to better see the potential for coordination with space programmes, the next table shows policy initiatives in the fields of space and telecommunication. Some national programmes do not explicitly consider SatCom solutions while in others SatCom could be included to reach the ambitious target of 100% coverage for broadband provision. One of the major advantages of satellite over terrestrial technology, both wire line and wireless, is undoubtedly its coverage capabilities. Available across the globe, in some instances it is the only connectivity solution possible. It does, however, fall short of the most widely available solutions when it comes to connection speed.

State	EU Status	ESA Status	ESA Programmes	National Programmes	SatCom Player
Austria	✓	✓	4.4 M€ (10,8%)		
Belgium	✓	✓	6 M€ (4%)	SuperFast Belgium (TLC)	
Bulgaria	✓	×		National Programme for Development of Broadband (TLC)	
Cyprus	✓	✓			
Czech Republic	✓	✓	0.9 M€ (11,1%)	National Broadband Access Policy (TLC)	
Denmark	✓	✓	2 M€ (6,9%)	From hardware to content (TLC)	
Estonia	✓	~		Estonian Electronic Communications Act (TLC)	
Finland	✓	✓	2 M€ (8,3%)	National Plan (TLC)	
France	✓	✓	45 M€ (6,6%)	Athena Fidus (Defence) Syracuse (Defence) France numérique 2012 (TLC)	Eutelsat
Germany	✓	✓	51 M€ (8,6%)	Heinrich Hertz (Space) COMSATBw-2 (Defence) (Space) Breitbandstrategie der Bundesreigierung (TLC)	Satcom BW
Greece	✓	✓	0.1 M€ (1,3%)	Greek Digital Strategy (TLC)	Hellasat
Hungary	✓	~			
Ireland	✓	✓	0.7 M€ (5,1%)	National Broadband Scheme (TLC)	
Italy	✓	✓	13 M€ (3,2%)	SIGMa Athena Fidus (Defence) Syracuse (Defence) SICRAL (Defence) Piano e-Government 2012 (TLC)	Telespazio
Latvia	✓	~			
Lithuania	✓	~		Rural Area Information Technology - RAIN- (TLC)	
Luxembourg	✓	✓	15.4 M€ (54%)	Lux LAUNCH	SES Global
Malta	✓	×			
Netherland	✓	✓	3 M€ (2,6%)	Nederland BreedbandLand (TLC)	
Norway	×	✓	6 M€ (10,7%)		Telenor
Poland	✓	~			
Portugal	✓	✓	2.2 M€ (14%)	Next-generation broadband networks (TLC)	
Romania	✓	✓		National Space Programme	
Slovakia	✓	×			
Slovenia	✓	~		Strategy for Development of Broadband Networks (TLC)	
Spain	✓	✓	22 M€ (11,8%)	XTAR (Defence) Avanza Infraestructuras (TLC)	Hispasat, Hisdesat
Sweden	✓	✓	5 M€ (8,9%)	National Plan (TLC)	
Switzerland	×	✓	7 M€ (6,6%)		
United Kingdom	✓	✓	58 M€ (28%)	SkyNet 5 Digital Britain (TLC)	Inmarsat, Paradigm

Key-Reading: ✓ Member States; ~ Cooperating States; × No *Status* - TLC: Telecommunication Sector; (Percentage of national budget for ESA programmes for telecommunication)

Table 22: SatCom Initiatives in Europe

In addition to this, the contribution of SatCom that are already available or are in the early planning stages by satellite operators has to be considered. SatCom can provide connectivity over large areas, thus Europe can be served by operators located outside of Europe. That is the rational adopted for the table 23 including all SatCom in the Ka-band as the most promising band for SatCom technologies. The cells indicated in grey presents Ka-band without European coverage.

Operator	Location HQ	SatCom	Manufac-turer	Orbital Position	Fre-quency band	Coverage areas
Telesat	Canada	Anik F2	Boeing SS	111.1° W	Ka	North America
HNS	USA	SpaceWay 3	Boeing SS	95° W	Ka	North America
HNS	USA	Jupiter	SS Loral	TBD	Ka	North America
ViaSat	USA	WildBlue 1	SS Loral	109.2° W	Ka	North America
ViaSat	USA	ViaSat1	SS Loral	115° W	Ka	North America
Thaicom	Thailand	iPSTAR	SS Loral	119.5° E	Ku & Ka	Asia Oceania
Avanti	UK	Hylas 1	EADS	33.5° W	Ku & Ka	Europe
Avanti	UK	Hylas 2	OSC	TBD	Ka	EMENA South Africa
Eutelsat	France	KA-SAT	EADS	13° E	Ka	Europe
Eutelsat	France	Hotbird 6	TAS	26° E	Ka	EMENA
Eutelsat	France	W3A	EADS	7°E	Ka	EMEA
Al Yah SatCom	UAE	Yahsat 1B	EADS/TAS	52.5° E	Ka	MENA, Asia
SES	Luxembourg	AMC 16	LM	85° E	Ka	Americas
SES	Luxembourg	AMC 15	LM	105° W	Ka	Americas
SES	Luxembourg	Astra 1H	Boeing SS	19.2° E	Ka	Europe
SES	Luxembourg	Astra 1L	LM	19.2° E	Ka	Europe
SES	Luxembourg	NSS 6	LM	95° E	Ka	EMEA
Intelsat	USA	Galaxy 28	SS Loral	89° W	Ka	Americas
Venesat	Venezuela	Venesat 1	CGWIC	82.7° W	Ka	Latin America
Spacecom	Israel	AMOS 3	IAI	4° W	Ka	EMEA
Hispasat	Spain	Hispasat	SS Loral	30° W	Ka	EMEA
Arabsat	Saudi Arabia	BADR 5A	EADS/TAS	26°E	Ka	EMEA
Nilesat	Egypt	Nilesat 201	TAS	7° W	Ka	EMEA
Measat	Malaysia	Aricasat 1		46° E	Ka	EMEA
Nigcomsat	Nigeria	Nigcomsat 1	CGWIC	46° E	Ka	South Europe Africa
Antrix	India	GSAT 11	n. a.	n. a.	Ku & KA	India
JSat	Japan	Superbird B2	Boeing SS	162° W	Ka	Asia
KT Corp.	South Korea	Koreasat 3	LM	116° W	Ka	Asia
Kt Corp.	South Korea	Koreasat	TAS	113° W	Ka	Asia

Table 23: Planned Ka-Band SatCom Capacity by Satellite Operators

It is evident that the EMEA region is going to be a competitive environment, thus European operators are not alone in serving this market. In addition, Africa has not adopted standards for some terrestrial wireless technologies. Thus the market for SatCom is growing thanks to the lower competition of terrestrial wireless technologies.

3.2.3 Broadband Development: Evaluation Criteria

All policies for broadband development and deployment have the duty of making a substantial contribution to the growth of Member States and of the EU as a whole in terms of social inclusion, sustainable development and smart growth. Thus, it is necessary to choose the right technology to achieve these three principles. There has been a huge amount of scientific literature since the seminal work of Haavelmo that demonstrated that investment in infrastructure increases the level of GDP. There have also been several empirical studies demonstrating that investment in broadband also enhances the economy in terms of growth of GDP, increasing the rate of job growth and saving costs and inefficiency. Broadband networks are increasingly being recognised as fundamental for economic and social development. They serve as a communication and transaction platform for the entire economy and can improve productivity across all sectors. Advanced communication networks are a key component of innovative ecosystems and support economic growth. Broadband networks also increase the impact and efficiency of public and private investments that depend on high-speed communications. Broadband is needed as a complementary investment to other infrastructure such as buildings, roads, transportation systems, health and electricity grids, allowing them to be “smart” and save energy, assist the aging, improve safety and adapt to new ideas.

The following presents a method to help policymakers evaluate the best solution that can

implement and reach the targets of the EU Digital Agenda. This policy requires two types of intervention: *extending the current network* that is sufficient in terms of capacity for providing *basic broadband* by 2013 but not available in some areas and *upgrading the existing network* and/or implement a new one to reach the capacity targets level established by the Digital Agenda by 2020. Policy makers considering broadband investments need to balance any investment in last-kilometre networks with similar investment in backhaul networks[107] servicing targeted areas. In other countries and regions there is still a significant number of people who cannot subscribe to broadband. Investments targeting these areas will likely focus on extending backhaul connections closer to users and installing new last-kilometre networks. Last-kilometre upgrades in rural and remote areas are typically more expensive than similar upgrades in urban areas.

Here, two matrixes are proposed, one for the *basic broadband* by 2013 and another one for the advanced broadband as *fast* and *ultra-fast broadband* by 2020. In particular, the two tables can help to take the decision related with the present digital divide implying lack of infrastructures due to geographical and demographic reasons where terrestrial network is not available and it shall not be economically achievable and sustainable. Each matrix identifies the three groups of technologies, as fixed communication technologies including the wired ones, terrestrial wireless technologies and SatCom. Then the dimension of the *investment* in terms of necessary economic resources is considered in order to satisfy the system requirements like the *backhauling* as operations transport data from the node point to the destination and go back, the *last mile* or *last kilometre* as the final leg of delivering connectivity from a communications provider to a user, the capacity to serve a *number of people* at a time, and the last the *coverage* of the infrastructure over the land-country. A qualitative evaluation in terms of high, medium and low amount of necessary resources and policy actions is given to these variables. The evaluation is independent from the question of who will support the required investment, such as government, commercial operator or end-users. It is evaluated in terms of the action required to extend or upgrade the network for the types of technology involved. At the current stage, it is relevant to note that SatCom with the European satellite capacity already in orbit can easily provide the *basic broadband* where no alternative network exists and where terrestrial networks are not economically affordable. The table 24 presents the matrix for *basic broadband* by 2013.

Technological Action	Variable		Fixed	Terrestrial Wireless	SatCom
Extending Network for ***basic broadband*** **by 2013**	**Investment**		High	Medium	Low
	Network system requirements	**Backhaul**	High	High	Low
		Last - Km	High	Medium	Low
		Number of People served	High	Medium	Low
		Land Coverage	High	High	Low

Table 24: Matrix of Technology Actions and technologies for *basic broadband* by 2013

It is evident the prompt and efficient role of SatCom in comparison with the other terrestrial technologies for delivering the *basic broadband* in Europe in time by 2013 as the Digital Agenda has established.

[107] Backhauling is the transport of traffic from a cellular network to a core network where voice and data switching takes place. This transport of traffic can be over various transport mediums such as copper, fibre, microwave, or satellite.

Technological Action	Variable		Fixed	Terrestrial Wireless	SatCom
Upgrading Network - Higher Capacity - for *fast* and *ultra-fast broadband* by 2020	**Investment**		High	Medium	High
	Network system requirements	**Backhaul**	High	High	Low
		Last - Km	High	Medium	Low
		Number of People served	High	Medium	Low
		Land Coverage	High	Medium	Low

Table 25 Matrix of Technology Actions and technologies for advanced broadband by 2020

As shown in the table 25 the main challenge of SatCom is in the upgrading action because its capacity is fixed from the beginning of its development. The development of a SatCom system does not have any exit-strategy; the initial choice to start a SatCom mission has to be thoroughly evaluated to avoid wasting resources and effort. This is one of the reasonable motivations to have a specific European space policy line for SatCom. In addition, the choice for broadband has to be sustainable for Europe, where the dimensions of the metropolitan areas with already terrestrial infrastructures for broadband are changing year by year due to population growth. If the advanced broadband is delivered only by terrestrial technologies even a continuous extension of the network has to be deployed. Nevertheless the upgrading through other technologies also involves other issues such as the compatibility of the end-user equipment with the new system that eventually has new standards.

Currently, the fixed technology has been largely adopted so it does not exist mainly in remote locations thus the extension of the network is high costly. The cost should be lower with terrestrial wireless; however, it requires some ground infrastructure, such as radio bridges. This often includes a satellite backhaul connection through Very Small Aperture Terminals, usually coupled with wireless technologies such as Wi-Fi. This combination allows access to telecommunication and data services even to more remote areas, albeit with limited and expensive bandwidth. The backhauling action by satellite is affordable with low effort as the footprint is usually bigger than a country's territory. This peculiarity permits extending the network in a better cost-effective way. On the other side, the drawbacks of transmission delay, and to be a shared technology can be improved by new R&D effort. It is important to note that there is extensive debate in the sector about whether wireless connections should be considered substitutes for wired broadband in the longer term. Clearly, wireless connections can provide basic broadband connectivity capable of supporting most of the current available applications over wired connections.

Government investment in broadband networks will likely include a mixture of extending access to un-served/underserved areas and upgrading infrastructure in areas which already have connectivity. There are a number of technological choices which each have benefits and drawbacks for government investment. When policy makers focus on connectivity there are different variables to take into account such as the number of impacted users, the marginal improvements users will receive, the capacity of the network, longevity and upgradability of the system and the strategic value of the projects under consideration.

Different network investments affect different numbers of end users. Governments should consider the number of users who will benefit from any network investment in order to perform a valid cost/benefit analysis. In the case of the Digital Agenda, the aim of social inclusion is to not exclude anyone. Delivering low-speed broadband to an area previously without connectivity will likely have a different impact than upgrading network capacity for existing users at 10 Mbitps to 100 Mbitps. The impacts of network investment on productivity in the economy will be tied to the practical lifespan of the constructed networks. Investments in networks with long predicted life spans will produce higher aggregate impacts on GDP and growth than investment in networks which may need to be upgraded or rebuilt after only a few years. At some point all networks need to be upgraded to allow for higher capacity transmissions. SatCom as a physical network offers a

nearly limitless upgrade path while others may not be able to accommodate higher speeds without new, significant investment in the network infrastructure itself. On the other hand, it permits having a uniform quality of services over the covered area and it also enables last countries to be on-line in this context**.** Policy makers should also consider non-budgetary measures that foster the use of SatCom and improve economic efficiency.

SatCom for broadband can be the right enabler to deliver millennium goals also to European neighbours, such as Africa and the Middle East in a very cost-effective way because the services are provided with the same investment required for EU Broadband. In addition, the EU should be autonomous not as a stand-alone actor but with other States depending on it.

4. Conclusions

SatCom is one of the technologies that deliver telecommunication. Its particular strength in cost-effectively providing communication over large areas of coverage and its easy deployment for end user solutions make the sector of special interest in the present era of globalization feeding the phenomenon of *convergence*. This external factor is a challenge for the success of SatCom in Europe and from Europe to the rest of the world.

Europe has made significant achievements in the sector in terms of technology, regulatory frameworks and market share. At the same time, new efforts are required to enhance these achievements and to address new challenges in a strategic way. The main challenge comes the Millennium Development Goals, coming from the UN Summit on the Millennium Development Goals concluded in September 2010 with the adoption of a global action plan to achieve the 8 anti-poverty goals by their 2015 target date, and the announcement of major new commitments for women's and children's health and other initiatives against poverty, hunger and disease. Europe has already started dialogues on the eight goals that, in a broader sense, establish the concept of *smart, sustainable* and *inclusive* growth. Of particular relevance is goal number 8 - *Develop a global partnership for development* and sub-target *8F* that suggests establishing partnerships making *available the benefits of new technologies, especially information and communications*. Here, the role of the EU should be to provide broadband in a sustainable way for and with Africa. It means sustaining partnerships with local actors and stakeholders using existing capacities and transferring the necessary competences that are lacking locally.

To achieve this “goal” it is opportune to note the contribution that SatCom can make to the EU Digital Agenda for the EU itself and, using the same effort in terms of infrastructure, for EU goals for its neighbours, Africa and the Middle East. This involves a set of considerations from the industrial and regulatory points of view. It is crucial to enhance the synergies, at least, between the traditional or, better, terrestrial telecommunication sector and SatCom through an integrated industrial policy as proposed by the EC in 2010. The integrated approach permits reducing inefficiency and consequently inflationary pressures are partially avoided. Implementing the dialogue in an integrated way also helps in reducing the time and costs required for adoption of policy initiatives. The integration is also envisaged between the EU and ESA whose geo-asymmetry permits including more States than if they work as stand-alone actors.

The importance of the Digital Agenda is a challenging opportunity to start new dialogues among European stakeholders, as both public and private players. This process will bring benefits in several areas, such as a more equitable international and European communication regulatory framework, an industrial policy that enhances the competitiveness of the EU, a market more satisfying for consumers, a space policy more integrated to deliver economic, societal and strategic aims. All these issues need of a set of policy recommendations that are considered in the following section.

In conclusion, the objective for the EU should be an *integrated* vision for SatCom that would deliver the Digital Agenda as a key-space component with an appropriate space policy that, on its side, feeds the concept of European growth and competitiveness in order to enhance the European role of global actor. A coherent and appropriate SatCom system for broadband, delivering services as one of the Millennium Goals for the EU and for Africa, is an opportunity to give substance to the fundamental principle of international space law that *the exploration and use of outer space shall be carried out for the benefit of all countries*. It is a reason to revisit the seminal idea of the Wideband European Satellite Telecommunications (WEST) programme [108] that offered an interactive wideband communications network that would have been initially used by one or more Ka-band geostationary satellites that cover Europe and neighbouring regions.

[108] ESA; Annual Report, 1998; UNOOSA General Assembly, A/AC.105/729/Add.1, 8 January 2000.

5. Policy Recommendations

The EU has the duty to pursue the Lisbon Strategy, reviewed by Europe 2020, establishing smart, sustainable and inclusive growth. There is a set of policy initiatives in this context, and one of them is the Digital Agenda. Accordingly, the policy recommendations are addressed in the table 26 to EU institutions such as the Council, Commission and Parliament, ESA and Member States.

Action by	Policy Recommendations
EU Council	• Establish a Space Policy which uses SatCom as a cross-sectional technology satisfying the needs of different policies (e.g. defence, energy, disaster management, maritime, air transport, etc) in order to reduce the inefficiency and to maximize the benefit that can be shared in the implementation of the EU 2020 policies • Establish a Space Policy with a coherent vision of International relations, such as with Africa, to provide services supporting the delivery of the Millennium Development Goals, share technological achievements with Japan and USA and coordinate market position with neighbour Russia • Address the dual-use of SatCom including by sharing participation between the EU and national defence SatCom programmes • Address the model of Private-Public-Partnership (PPP) in order to save costs and effort in achieving the same goals and creating opportunities for tax revenue
EU Commission	• Establish a monitoring platform to understand the conflicts and complementarities between terrestrial and SatCom technologies in terms of economic, societal and strategic outcomes; • Establish a mutual learning platform in order to implement SatCom as a cross-sectional technology satisfying the needs of different fields, e.g. defence, energy, disaster management, maritime, air transport, etc • Coordinate the vision of FP7 ICT and FP7 Space and the next FP8 in order to gain economies of scale and of scope of all SatCom systems • Evaluate as a positive discrimination the vertical model of SatCom industry mainly between satellite operators and service providers and not just between SatCom manufactures and service providers in order to spread profit along the entire supply chain • Establish a common indicator at EU level to sense actual current and future needs of broadband services and assess the capacity of SatCom to respond to EU Digital Agenda on a level playing field with other technologies
EU Parliament	• Revisit the principle of technology and services neutrality in a way which takes into consideration the particularity of SatCom technologies in the field of ICT • Revisit the principle of efficient use and equitable access to the spectrum for SatCom considering its advantages in reaching remote areas with low demographic density • Establish the right of e-citizenship with the concept of the technological environment guaranteeing full interactivity between citizens and government (public administrations)

Action by	Policy Recommendations
ESA	• Enhance the "integrated industrial policy" approach for EU Competitiveness not only for the EU but also in terms of better coordination between the ESA, EU and national initiatives; • Establish coordination measures between EU FP7 programmes and ESA (ARTES 20) Integrated Applications • Enhance the concept of Integrated Applications for exploiting user needs in the field of SatCom • Coordinate with EC and Member States a SatCom system providing advanced value-added services to achieve *convergence* needs • Enhance R&D efforts for a winning technology of Ka-band SatCom in terms of satellite payloads and terminal devices
Member States	• Evaluate a position, harmonized in European sense, towards CEPT and ITU for the orbital positions and an environment free of interference • Propose a platform in order to implement coordinated national space initiatives as much as possible with ESA programmes also with an integrated vision using FP7, for instance national initiatives such as contributory elements of ESA programmes in line with the strategic mission of FP7 • Create, or make more consistent use of, fiscal and financial mechanisms (e.g. Structural funds) for encouraging the use of SatCom for citizens located in disadvantaged areas in order to achieve the EU Digital Agenda objectives • Support the implementation of PPP in order to coordinate private investment and public expenditure

Table 26: Policy recommendations by policymaker

These recommendations are directed towards individual actors: the EU Council, EC, EU Parliament, ESA and Member States but can also be seen in terms of relationships among them as in the table 27. There are some policies that affect ESA and/or Member States or vice versa. The weight of the interaction is evaluated in an *ex facto* not *de jure* way as the current legal framework of Lisbon Treaty establishes.

Action by	Interaction with ESA	Interaction with Member States
EU Council	• Establish a Space Policy which uses SatCom as a cross-sectional technology satisfying the needs of different policies (e.g. defence, energy, disaster management, maritime, air transport, etc) in order to reduce the inefficiency and to maximize the benefit that can be shared in the implementation of the EU 2020 policies • Establish a Space Policy with a coherent vision of International relations, such as with Africa, to provide services supporting the delivery of the Millennium Development Goals, share technological achievements with Japan and USA and coordinate market position with neighbour Russia	• Address the dual-use of SatCom including by sharing participation between the EU and national defence SatCom programmes • Address the model of Private-Public-Partnership (PPP) in order to save costs and effort in achieving the same goals and creating opportunities for tax revenue • Establish a Space Policy with a coherent vision of International relations, such as with Africa, to provide services supporting the delivery of the Millennium Development Goals, share technological achievements with Japan and USA and coordinate market position with neighbour Russia

Action by	Interaction with ESA	Interaction with Member States
EU Commission	• Enhance the "integrated industrial policy" approach for EU Competitiveness not only for the EU but also in terms of better coordination between the ESA, EU and national initiatives; • Establish coordination measures between EU FP7programme and ESA (ARTES 20) Integrated Applications • Enhance the concept of Integrated Applications for exploiting user needs in the field of SatCom • Coordinate with EC and Member States a SatCom system providing advanced value-added services to achieve convergence needs • Enhance R&D efforts for a winning technology of Ka-band SatCom in terms of satellite payloads and terminal devices	• Establish a monitoring platform to understand the conflicts and complementarities between terrestrial and SatCom technologies in terms of economic, societal and strategic outcomes; • Establish a mutual learning platform in order to implement SatCom as a cross-sectional technology satisfying the needs of different fields, e.g. defence, energy, disaster management, maritime, air transport, etc • Coordinate the vision of FP7 ICT and FP7 Space and the next FP8 in order to gain economies of scale and of scope of all SatCom systems • Coordinate with Member States a SatCom system providing advanced value-added services to achieve convergence needs • Evaluate as a positive discrimination the vertical model of SatCom industry mainly between satellite operators and service providers and not just between SatCom manufactures and service providers in order to spread profit along the entire supply chain • Establish a common indicator at EU level to sense actual current and future needs of broadband services and assess the capacity of SatCom to respond to EU Digital Agenda on a level playing field with other technologies
EU Parliament	• Establish the right of e-citizenship through the concept of the technological environment guaranteeing the full interactivity between citizens and government (public administrations). ESA should provide the most feasible technology for this purpose,	• Revisit the principle of technology and services neutrality in a way which takes into consideration the particularity of SatCom technologies in the field of ICT • Revisit the principle of efficient use and equitable access to the spectrum for SatCom considering its advantages in reaching remote areas with low demographic density • Establish the right of e-citizenship with the concept of the technological environment guaranteeing full interactivity between citizens and government (public administrations)

Table 27: Policy recommendations by EU policymaker in relationship with ESA and Member States

List of Acronyms

Acronym	Explanation
ADSL	Asymmetric Digital Subscriber Line
APT	Asia Pacific Telecommunity
ARTES	Advanced Research in TElecommunications Systems
AT	Austria
ATU	Africa Telecommunications Union
Art.	Article
BSS	Broadcasting Satellite Services
BWA	Broadband Wireless Access
CDMA	Code Division Multiple Access
CEPT	European Conference of Postal and Telecommunications
CFSP	Common Foreign Security Policy
CIP	Competitiveness and Innovation framework Programme
CITEL	Inter-American Telecommunication Commission
COTM	Communication-On-The-Move
COTP	Communication-On-The-Pause
CZ	Czech Republic
DE	Germany
DK	Denmark
EBRD	European Bank for Reconstruction and Development
ECB	European Central Bank
EEAS	European External Action Service
EEB	Energy – Efficient Buildings
EEC	European Economic Community
EERP	European Economic Recovery Plan
EC	European Commission
EC DG MOVE	European Commission Directorate General Mobility and Transport
EC DG INFSO	European Commission Directorate General Information Society
EDRS	European Data Relay Satellite
EIB	European Investment Bank
EIP	Entrepreneurship and Innovation Programme
EMEA	Europe Middle East Africa
EMENA	Europe Middle East North Africa
ERDF	European Regional Development Fund
ES	Spain

Acronym	Explanation
ESA	European Space Agency
ESDP	European Security and Defence Policy
ESF	European Social Fund
ESOA	European Satellite Operators Association
ESP	European Space Policy
ESPI	European Space Policy Institute
ETSI	European Telecommunications Standards Institute
EU	European Union
FCC	Federal Communications Commission
FP	Framework Programme
FoF	Factories of the Future
FR	France
FSS	Fixed Satellite Services
GDP	Gross Domestic Product
GE	Green Energy cars
GMES	Global Monitoring for Environment and Security
GSO	GeoSynchronous Orbit
HE	Greece
HIS	High Speed – Internet for everyone
HSDPA	High Speed Downlink Packet Access
HSUPA	High-Speed Uplink Packet Access
ICT	Information and Communication Technology
ICT - PSP	Information Communication Technologies Policy Support Programme
IEE	Intelligent Energy Europe programme
IEEE	Institute of Electrical and Electronic Engineers
IMS	Internet protocol Multimedia Service
IP – TV	Internet Protocol - Television
ISDN	Integrated Services Digital Network
IT	Italy
ITRI	Industrial Technology Research Institute
ITU	International Telecommunication Union
ITU-R	International Telecommunication Union – Radio communication
ITU-T	International Telecommunication Union – Telecommunication Standardization
ITU-D	International Telecommunication Union - Telecommunication Development
ITU – RR	International Telecommunication Union – Radio Regulations
JTI	Joint Technologies Initiatives
LAS	League of Arab States
LOS	Line-of-sight
LX	Luxembourg
MAN	Metropolitan Access Network

Acronym	Explanation
Mbps	Megabit per second
MDG	Millennium Development Goal
MIMO	Multiple Input Multiple Output
NATO	North Atlantic Treaty Organization
NGSO	Non GeoSynchronous Orbit
NLOS	Non-line-of-sight
OECD	Organisation for Economic Co-operation and Development
OFDM	Orthogonal Frequency-Division Multiplexing
OTS	Orbital Test Satellite
Para.	Paragraph
PL	Poland
POTS	Plain Old Telephone Service
PPP	Public-Private-Partnership
QoS	Quality of Service
R&D	Research and Development
RAIN	Rural Area Information Network
RF	Radio Frequency
RSC	Radio Spectrum Committee
RSPG	Radio Spectrum Policy Group
SatCom	Satellite Communications
SSPA	Solid State Power Amplifier
TFEU	Treaty on the Functioning of the European Union
TLC	Telecommunication
TV	Television
UK	United Kingdom
UMTS	Universal Mobile Telecommunications System
USA	United States of America
VAS	Value Added Service
VAT	Value Added Tax
VSAT	Very Small Aperture Terminal
WCDMA	Wideband Code Division Multiple Access
WEST	Wideband European Satellite Telecommunications
Wi-MAX	Worldwide Interoperability for Microwave Access
WIPO	World Intellectual Property Organization
WRC	World Radiocommunication Conferences
WTO	World Trade Organization

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