The Telecommunications Long-Term Plan: 2006-2010

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The Telecommunications Long-Term Plan

– Executive Summary

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The Programme Content

Satellite Telecommunications is the most mature and economically most important of all space applications. It constitutes the core industrial activity for Europe's satellite manufacturers. Consequently, the health of the satellite telecommunications market determines to a great extent the sustainability and therefore the continuity of the European Space Industry.

The annual revenue accrued from the lease of the approximately 7500 FSS and DBS (36 MHz equivalent) in-orbit transponders is more than 6.6 billion US$, i.e. around 5 billion Euro. The revenue produced by MSS systems exceeds 800 million Euro. This means that 50-60 % of the turnover of European Industry (5 billion Euro) is generated by manufacturing and launching communications satellites.

Of the 155 satellites successfully launched by Ariane-4 in the course of its lifetime, 139 are telecommunications satellites, as are 26 of the 39 satellites launched by Ariane-5. The average number of telecommunications satellites launched each year in the course of the 1990s was 23, and the estimate for 2001-2010 is between 15 and 20 per year. This figure is directly reflected in the turnovers of both the satellite manufacturers and the launch providers.

While the telecommunications ground-segment industry offers a turnover of 17.8 billion US$, the revenue produced downstream in satellite-driven services exceeds 50 billion US$.

The role of the European Space Agency in Telecommunications is to maintain the competitiveness of European and Canadian Industry in this most important segment of space applications by promoting innovation in technology, systems and services.

The ESA effort covers all elements in the value chain associated with the provision of the various telecommunication services by the different types of satellite systems. The activities range from market analysis to applications, and include system and subsystem design, interface definition, standardisation, equipment definition and specific component and technology developments. The resulting developments may be subject to qualification and they are followed, whenever appropriate, by the necessary deployment and experimentation, and pilot operations, both for the space and ground systems.

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The Market Situation

In broad terms, the satellite telecommunications market can be perceived as being made up of two mature sectors (Fixed Satellite Services and Mobile Satellite Services), two emerging sectors (Broadband Services and Broadcast to Mobiles), and a strategic component associated with institutional and security-related services.

Fixed Satellite Services

Fixed Satellite Services (FSS) are the most mature sector of the satellite telecommunications industry. Currently there is an excess of capacity resulting from over-provisioning by the Satellite Operators following the boom in digital television. Figure 1 shows the demand for FSS services, which is expected to show moderated growth in the next few years. However, it is unlikely that this demand will be reflected in the same proportion in new orders to the Industry. In the medium term, the demand cycle will resume and new satellites will be ordered.

It is fundamental to maintain the competitiveness of European Industry in this sector by guaranteeing its technological excellence: improved performance, higher reliability, and especially more flexible C- and Ku-band payloads will be necessary. Larger platforms will also be needed.

The industrial process associated with the production of telecommunications satellites should be upgraded, looking for greater flexibility, reliability and cost efficiency, and shorter delivery times.

Broadband Services

Broadband satellites are starting to become a reality after many years of unfulfilled promise. Today Broadband Services in general, and broadband access to the Internet for domestic customers in particular, constitute the most promising

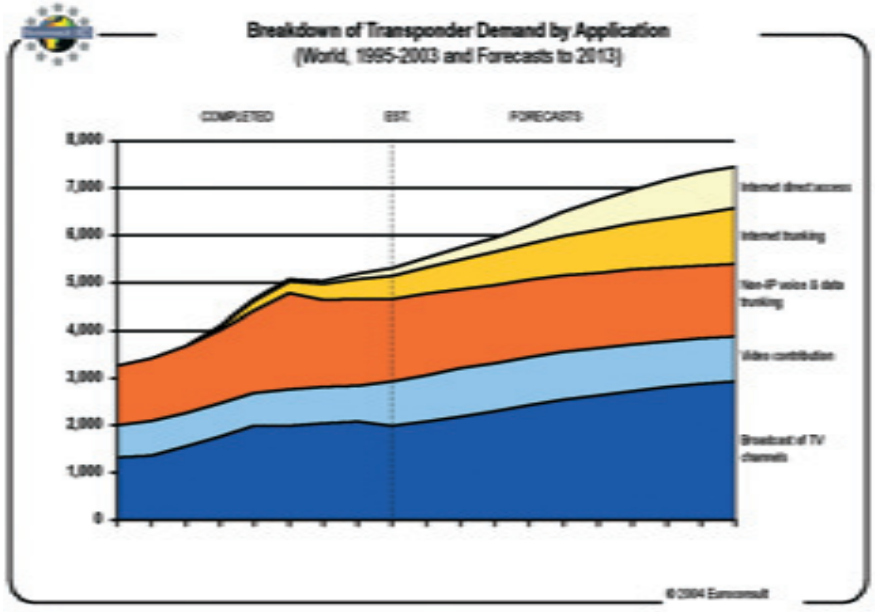

Figure 1. Projection of the demand for Fixed Satellite Services

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opportunity for reinvigorating the satellite telecommunications sector.

The evolution in demand for broadband access is expected to reach 327 million homes by 2008 (present penetration is around 100 million homes). There is an important challenge to ensure that satellite-based solutions take a significant proportion of this market, and at the same time meet the social needs, i.e. the provision of broadband Internet access for rural communities in a sustainable manner. To achieve this objective, all the components of the service cost must be substantially reduced, i.e. terminals, hubs, installation, customer support, and especially the space segment. For this reason, ESA will continue to encourage an open-standard approach based on the DVB-family.

Given the general economic outlook, public intervention – possibly in partnership with private actors – may be required to facilitate the deployment of such multispot-beam Ka-band systems.

Mobile Satellite Services

Mobile Satellite Services have moved from the hype and then the crisis created by the fiasco subsequent to the deployment of the low-Earth-orbit (LEO) constellations (Iridium, Globalstar) to an epoch of realism, which is not inconsistent with the introduction of new services with better performance. In this context, MSS is a mature market segment enjoying healthy growth and with excellent prospects following the introduction of the latest generation of mobile satellites and services, such as Inmarsat-IV.

The revenue of the whole MSS sector is close to 700 M$ per annum, i.e. approximately one tenth of the revenue produced by the FSS market. Of this, 75% is accrued by Inmarsat (504 million in 2003), and the rest by regional systems like ACES and Thuraya, and what remains of the LEO constellations.

Mobile systems are generally much more demanding in terms of technological innovation than other services. ESA must therefore reinforce its strategic support to Industry in all areas of the business: space segment, ground segment, operations and applications. This commitment should be mainly reflected through the continuation of key technological developments in space: MMICs, onboard processors, SSPAs, beam-forming networks, large antennas, and on-ground user-terminal technology: RF front-ends, receiver ASICs, etc.

Digital Broadcasting to Mobiles

The most successful satellite-communications story of the 21st Century so far is Digital Radio Broadcasting. By offering about 100 channels of high-fidelity, CD-quality sound, subscription services to receivers mounted on cars across the USA, XM Radio topped 5 million subscribers in September 2005, which will produce more than 500 M$ per year in revenue. The rival system, Sirius, which basically targets the same market but with a different approach to the satellite system, had achieved more than 1.8 million subscribers by June 2005. The market, being developed in cooperation with car manufacturers, is far from being saturated as the healthy quarterly growth figures show, with 1.2 million new XM Radio subscribers in the first half of 2005.

Mobile Broadcasting of Multimedia, Data or Television to mobile terminals has also received attention in the context of the provision of broadcasting services to third-generation UMTS services. The evolution of these services towards multimedia broadcasting constitutes a major area of innovation to be supported by the ESA R&D programme.

Satellite Telecommunications and Security

The use of space-based systems to complement and enhance security systems is fully consistent with the Resolution of the European Council of November 2004. Security applications will have higher relevance in the forthcoming cooperation between ESA and the EU, as highlighted in the Report of the Panel of Experts on Space and Security (SPASEC).

The reality today is that the European investment in defence-related space systems is both modest and very fragmented. An analysis of overall European space-based defence capabilities highlights the need for a 9 BEuro investment, 3150 MEuro of which correspond to the telecommunications component meeting a set of high-level requirements, namely: worldwide coverage, secure connectivity, high-data-rate connections, inter-operability, and multimedia and traditional services.

In this context, it is clear that the preparation of European Industry's technological capabilities for this, both strategically and economically important, component of the Satellite Telecommunications market must be a key element of the ESA Telecommunications Long-Term Plan.

Platforms

In terms of the technology required for payload and ground-segment implementation for each of the different service sectors, the satellite industry must be able to provide the satellite platforms required to meet future needs. While current European commercial platforms are competitive and address the mid- to high-end of the Operator procurement requirements, the general trend towards the consolidation of specific orbital positions and the emergence of more power-hungry services has driven the need for a European Large Platform initiative, which is currently being implemented via the AlphaBus Programme.

In addition, there is a perceived need to address the market for Small Platforms. This stems from the requirement of some Operators to quickly deploy a limited amount of capacity to address specific needs, and of the approach followed in some markets of deploying capacity in a scalable manner as a means of reducing the associated financial and commercial risks.

3

The TLTP Environment

ESA is a major source of public support for the space telecommunications sector in Europe, even if it is neither a user of the space communication infrastructure, nor an operator providing services to users. The long-term competitiveness of European Industry is strongly dependent on the support provided by the ESA Telecommunications ARTES R&D Programme.

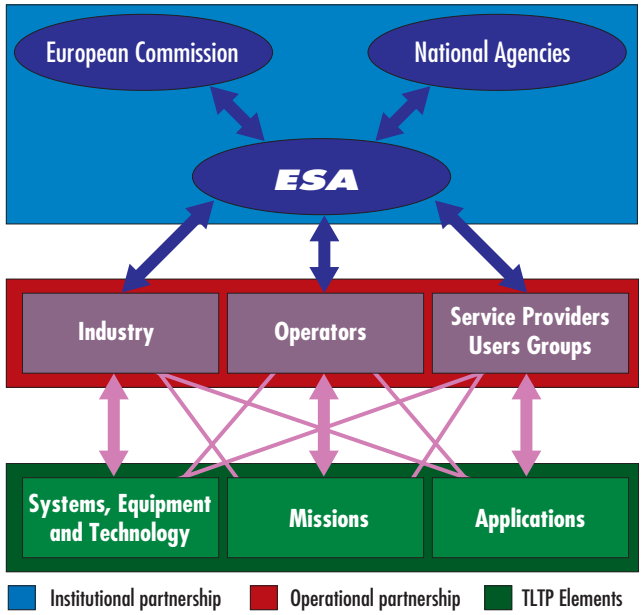

Figure 2. The ESA Telecommunications Programme in relation to its environment

- The core objective of ESA's Telecommunications Programme is enhanced competitiveness of European and Canadian Industry. With this comes the need to maintain a well-structured, well-supported programme to improve the commercial and technological capabilities of Industry. These improvements must address the different technologies, equipment, subsystems and systems required for each segment of the satellite telecommunications market. This is the task of the Telecommunications Systems, Equipment and Technology component of the Telecommunications Programme.

- ESA's activities are driven by the needs of users, either commercial (e.g. corporations, residential users), or institutional, such as the European Union or government agencies. Although market forces should normally address user needs in terms of telecommunications, satellite-based solutions are often beyond the scope, capabilities, or even awareness, of many of the potential beneficiaries of satellite communication systems in Europe and Canada. In other words, there are many applications of satellite communications that can benefit user communities that first require demonstration and promotion. ESA therefore proposes to reinforce the Telecommunications Applications component of the Telecommunications Programme in order to satisfy society's needs and further develop the demand for satellite communications capacity, equipment and services.

- ESA, in partnership with the Satellite Operators, has identified the need for new satellite missions. In general terms, they must:

- demonstrate and qualify new equipment and technologies
- demonstrate and promote new systems and services
- provide the infrastructure that allows the satisfaction of needs otherwise not addressed by the commercial market.

In this respect ESA, in fulfilment of its responsibilities to enhance Industry's competitiveness, must include as a key component of its Telecommunications Programme the capability to generate new satellite Telecommunications Missions.

- On top of these three major components of the TLTP, there is the strategic necessity to evaluate the trends in the Satellite Telecommunications sector from all possible perspectives. This Preparatory Programme component includes following up the market's evolution, analysis of new technology, evolution of terrestrial services, scenarios and feasibility analysis of new satellite system concepts, and very importantly support to standardisation.

In summary, the Telecommunications Long-Term Plan for the period 2006-2010 will be developed on the basis of the following four key components:

- Preparatory
- Systems, Equipment and Technology
- Applications
- Missions.

The actions of ESA are complemented by the programmes of the National Agencies and the activities of the European Union.

Within the framework of the European Strategy on Space, Satellite Telecommunications is a key component of the Exploitation initiatives. ESA's TLTP will therefore be coordinated with and complemented and supported by the European Union's R&D activities, mainly in the context of the European Union 7th Framework Programme. Specific projects, leading to the development of infrastructures or capabilities consistent with EU policy (e.g. Digital Divide, Security), will be supported in their inception by ESA's TLTP, although they may later require a specific programmatic framework.

The cooperation between ESA and the National Agencies will continue to be pursued in order to further develop synergies between national and ESA projects. The models of EMS with ASI (I), AlphaBus with CNES (F), and AmerHis with CDTI (E), have demonstrated their usefulness in 'Europeanising', or developing opportunities around, national initiatives.

SATCOM SERVICES	SYSTEMS	PAYLOAD	GROUND SEGMENT
FSS AND DBS, Mainly C, Ku Band Systems	•Traditional TV Systems •HDTV and iTV •Trunking •VSATs	•Transparent C,Ku Band transponders. •Advanced Antennas •Improved HPAs, MPAs •Improved D/C switches and multiplexers	• Development of TV/HDTV, contribution and Broadcast Stations •Feeder systems •User Terminals
INTERACTIVE BROADBAND Mainly Ka Band Systems	•Multispot beam systems •Flexible Payloads with and without Regeneration •Local TV Bcast Systems	•Multispot beam antennas. •Improved O/P HPAs Flexibility •Complex Time and freq Switching processors.	• DVB S2/RCS Systems • Large Capacity Network Control Systems •Gateways •Improved functionality User terminals
MOBILE INTERACTIVE Mainly L Band	•Based on Multispot. Ref Inmarsat 4. • Complement with Terrestrial: ATC •Other mobile, i.e Ku	• Improved Antenna capabilities: Large reflector. •Processors •HPAs, SSPAs, MPAs. •Flexibility	•Next Gen mobile services and Terminals. •Special systems for Aeronatical, Maritime and collective systems
MOBILE BROADCAST Mainly S Band	•System design Optimization: Capacity vs. performance •Air interface optimization: Standards	•New Regional contoured beam S Band antennas. • High Power O/P> KWs •Flexibility architectures for High power systems	• Multi-platform User Terminals. •Terrestrial Repeaters •Production and Distribution Architecture.
INSTITUTIONAL SERVICES Mainly Ku, Ka but also UHF, X EHF Bands.	• Fixed and mobile services. •Distributed flexible and reconfigurable network Architecture •Encrypted Air I/Fs •ISLs, Optical systems	•Active Antennas •High and low power systems. •Tracking systems. telescopes •Antijamming processors	•RF for terminals in UHF, S and X Bands. •User terminals •Centers of command •ISL Terminals in other satellites/Planes.

Table 1. Systems Equipment and Technology component: summary of activities

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The TLTP Components

Preparatory

The Preparatory activities element of the Telecommunications Programme provide the strategic perspective and the initial analysis of potentially fertile satcom concepts. It also provides a framework for the support activities for each of the programme lines.

The major strategic appraisal areas will be geared to: preparing next-generation systems, evaluating the integration of satellites into terrestrial systems, evaluating the impact of advanced technologies, carrying out feasibility studies of new system concepts, and continuing the support to the standardisation of the user segment and user terminals.

Systems, Equipment and Technology

The System Equipment and Technology component of the programme addresses the major market segments (FSS, DBS, MSS, Broadband, Broadcast to Mobiles and Institutional Services) as shown in Table 1.

Applications

Based on the substantial experience acquired in past years, the TLTP will incorporate:

- Development of associated technology and demonstration of *'Exploratory Applications'*: This component of the programme creates the framework that allows Users and Industry to verify the technical, operational and commercial viability of the proposed applications.

- Deployment of pilot *'Solution Projects'*: This new component of the applications programmes is aimed at setting up fully functional systems, characterised by service requirements identified for a particular community of users, which can be easily extended in terms of scale and penetration, paving the way for sustainable services.

The major candidate areas for the development of such Solution Projects are:

- Internet on Public Transport
- Telemedicine / eHealth
- Broadband Access to Consumer Applications
- Interactive-TV Applications
- Civil-Protection Applications
- Location-Based Applications
- Safety/Security Monitoring and Control
- Support to Development and Capacity Building
- Automotive Applications.

Telecommunications Missions

Within the context of the TLTP, missions are defined as major projects developing end-to-end systems including the development of the space component.

AlphaSat

The AlphaSat mission is envisaged to consist of two main components: a core (pre-)operational payload constituting the main driver of the mission, and a technology package taking benefit from the inflight-demonstration opportunity offered by the maiden flight of AlphaBus.

The candidate (pre-)operational missions identified to make up the AlphaBus payload are:

- Commercial payloads to be operated by private Satellite Operators: The selection of the core mission will be based on the results of an Announcement of Opportunity (AO) issued by ESA, and on consultations with potential public and private stakeholders, users, and operators interested in the mission. These could also encompass institutional missions, including in particular a Data-Relay Package.

- Technology Demonstrations: The candidate technology items identified to be part of the Technology and Service Demonstrator are mainly the elements developed with the 'traditional' ARTES lines for which an in-flight demonstration is a key element for a successful introduction on operational satellites. This includes: Next-Generation MSS Technology, Next-Generation FSS/DBS Technology, Optical Inter-satellite Links, and specific platform and payload technology items taken onboard as experiments.

Following a first Announcement of Opportunity that prompted a lot of interest from various potential AlphaSat Operators/Users, ESA is pursuing an 'open contest' process. Through this process, ESA intends to select its (private) Partner who will contribute to the financing of the Programme, operate AlphaSat, and provide the best combination of services satisfying the interests of ESA on behalf of its Member States and fostering attractive commercial opportunities in the European market. The final stage of the selection will be made at the end of 2006, before entering the main development phase (Phase-C/D) of the programme. The launch of AlphaSat is scheduled for early 2010.

At the end of 2005, three parallel Phase-A studies will be started with three Potential Partners selected during the first round of the Contest. At the end of these three studies in mid-2006, the second round of the Selection Contest will enable ESA to narrow the choice further to one (or two) Potential Partner(s) for the completion of a co-funded Phase-B. The required technology pre-developments will be undertaken in parallel. The Phase-A and Phase-B studies will address the whole mission, including the ESA-supplied Technology Demonstrations.

The Potential Partners, through their initial proposals in the Selection Contest, have confirmed the need for technology developments for low-cost Ka-band services and mobile interactive and broadcasting services, making use of newly available spectrum and based on flexible payload architectures.

Piggy-back

ESA will pursue its efforts to find solutions that facilitate the demonstration of new technologies and services, flying them as piggy-back payloads on spacecraft provided by commercial opportunities. To this end, the Agency will continue its active engagement with commercial operators and agencies with advanced plans for satellite launches, in order to determine the conditions that will make the demonstration of ESA-supported technologies possible. They are expected to define a fee to be paid to the satellite owner for including the newly developed equipment in the payload. Moreover, ESA will continue the dialogue with Operators and Industry to identify payloads for the demonstration of new or improved services. These payloads are foreseen to be included as piggy-backs on commercial satellites or, alternatively, on a small platform.

Small satellites

In the context of testing the market with a new service, or an existing service in an as yet untried geographical area, established and 'want to be' Operators are searching for satellites with limited capacity and, most importantly, low cost. The availability of platforms able to meet these needs also has an important strategic component in as much as it permits the deployment of services or systems tailored to specific institutional requirements.

ESA has therefore established a programmatic framework for the implementation of the Small Geostationary Telecommunication Satellites initiative through the creation of a dedicated ARTES Programme Element, ARTES 11. It embodies the development of a small and cost-effective geostationary platform for a payload capability of up to 300 kg and a payload power of up to 3 kW. ARTES 11 will also include the development of a small satellite carrying a payload yet to be defined on the first protoflight model of the new small bus, following the AlphaBus/AlphaSat example.

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Implementation, Schedule, and Financial Perspectives

The implementation of the various activities proposed here will benefit from the ARTES programmatic framework. Through its Elements 1, 3, 4 and 5, the adoption of an annual work plan, and its specific industrial-policy procedures, ARTES is well-adapted to the implementation of activities on a 'pay as you go' basis, and can easily be reoriented to cope with an evolution in needs or a rapid change in the environment. These 'traditional' ARTES Elements will therefore be exploited as foreseen in the Declaration and Implementing Rules.

The Declaration will be prepared accordingly, it being understood that the Participating States will have "two years prior to the limit of the programme (namely 2008 for the requested extension up to 2010) to decide upon the duration and conditions of the programme for a further extension", and that "subscription by a Participating State to a given extension shall not bind that State to subscribe to any following extension".

The basic schedule is shown in Figure 3.

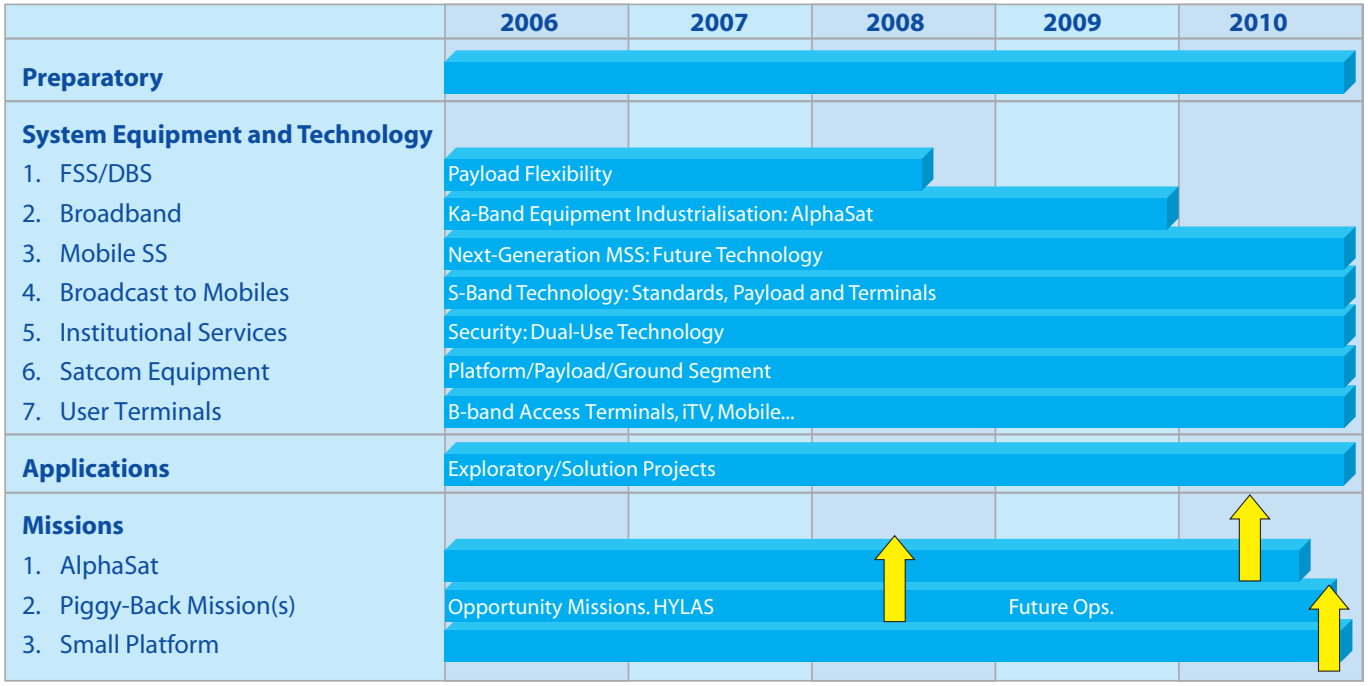

Figure 3. Schedule for the implementation of the TLTP 2006-2010

The financial scheme for the TLTP is based on three key hypotheses:

- Overall level of expenditure: Given stabilisation of ESA resources as confirmed by the majority of Delegations, in coherence with the overall ESA LTP the TLTP foresees a substantial increase in Member-State expenditures for satcom activities. This increase responds to the Director General's intention to focus Agency efforts on the applications of space. It also constitutes an industrial-policy measure at a very difficult moment for the European satellite Industry, supporting this crucial asset in order to maintain a sound and competitive technical and industrial base in Europe.
- Balance of activities: The financial proposal reflects a continuity in the efforts devoted to preparatory technology and system activities at a level close to the current level of expenditures, and the implementation of complementary and focused federating projects as already initiated with the full deployment of AlphaBus.
- The initiation of large-scale application development will be based on a partnership with Third Parties, thereby complementing ESA's own resources.

Table 2 shows a breakdown of the financial requirements, which total 1135 MEuro (at e.c. 2005).

TLTP Component/ ARTES Element MEuro	A1	A3	A4	A5	A8	A11	Total
Preparatory	50						50
Systems+ Equipment +Technology		175	200	150			525
Applications		30	20	50			100
Large Mission: ALPHASAT					300		300
Piggy-Back, Opportunity		30	30				60
Small Satellites						100	100
Total	50	235	250	200	300	100	1135

Table 2. TLTP financial requirements