

ARTES: The Future of Satellite Telecommunications



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Throughout its 30-year existence, ESA has played a key role by providing telecommunications infrastructures that have allowed the in-orbit validation, qualification and demonstration of equipment, technology and services. In the past, this has been achieved through the provision of dedicated satellites like OTS, Marecs, Olympus and Artemis, as well as by the implementation of piggy-back payloads on other ESA or commercial satellites. Today, due to the importance of satellite telecommunications, ESA continues to support this sector mainly through its ARTES – Advanced Research in Telecommunications – Programme.

Introduction

Satellite telecommunications has grown to be the most important commercial space application. In terms of business volume, industrial activity and employment generated, 'satcom' is by far the most important segment of the industry. The turnover generated in Europe from the space activity involves some 2 billion Euros in industrial contracts, and nearly 3 billion Euros in transponder leasing fees per year. In addition, the associated ground-segment activities and satellite-driven services generate a volume of business one order of magnitude greater than the space segment.

Telecommunications satellite knowhow, technologies and capabilities represent an important asset for Europe. There are important synergies between security/

Satellite telecommunications systems like AmerHis increase the connectivity

military and civil systems, and the critical technologies overlap. In the USA, the research and development in the security/military field allows the industry to transfer the resulting leadership edge into the civilian market.

Satellite telecommunications is vital to the continuity and viability of the European space industry. Not only the continued health of the communications industry depends on Europe's ability to design and build efficient and competitive telecommunications satellites, but also those of related industries such as launchers, where close to 90% of current business is generated by telecommunications-satellite launches, and of the ground-segment, applications and service providers.

Technical Content

The ARTES Programme was initiated in 1993 to maintain and improve the competitiveness of European and Canadian industry in this important segment of space applications. The activities supported by ESA address the needs of satellite operators, service providers and users in a very competitive market calling for continuous innovation in satellite telecommunications technology.

The main objectives of the Programme are to:

- define, assess and develop systems for advanced fixed, broadcast, multimedia and mobile communications, data relay, search and rescue, navigation, and aeronautical services
- promote the use of satellites, identifying and experimenting with new services to enlarge the field of satellite applications
- undertake experimental and technological missions identified as having good market potential.

Telecommunication Systems, Equipment and Techniques

ESA's ARTES activities are focused on helping industry to enhance its



competitiveness in the telecommunications market. This involves maintaining a well-structured and well-supported programme to improve the commercial and technological capabilities of the industry through the development of the state-of-the-art equipment, subsystems and systems required for each segment of the satellite telecommunications market.

Multimedia

The interactive broadband line of the multimedia programme element of ARTES is providing an important degree of support to European industry. Significant projects like Domino, Euroskyway and

WeB/West are being developed to prepare for the emergence of a new generation of interactive satellite services.

A good example in this respect is the AmerHis system, developed under the Domino project and launched as a piggy-back payload onboard Hispasat's Amazonas satellite in August 2004. AmerHis is the first 'switchboard in space', providing connectivity between user terminals located at any point within the areas served by Amazonas. The innovative feature of AmerHis is the node-switching capability that it provides alongside the conventional satellite-transmission function.



The AmerHis payload: the first 'switchboard in space'



Developing microprocessor technology

generation and validation of new opportunities, and constitute the innovation engine for new applications in terms of new ideas, new entrants and seed opportunities. Due to the relatively high technical and operational risks involved, these activities are kept within small-scale projects until the concept is fully developed and validated.

Solution projects

This application line is designed to provide the financial and legal framework in which to execute, in partnership with the interested parties, a number of 'solution projects'. The main goal is to set up fully functional systems, characterised by service requirements derived by the users, which can be easily extended in terms of scale and penetration, paving the way for sustainable services.

Ad-hoc programmatic frameworks

A specific legal framework is required to regulate the participation of user communities in the management and funding of the different phases of the projects, to guarantee compliance with regulations on competition and state aid for the pre-operational services, to verify the possibility of establishing synergies with regional/national/international development programmes with similar or complementary objectives, and to provide a stable and appropriate funding scheme for the operational phase.

User needs

The areas specifically identified for the development of applications are:

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

Mobile

The mobility line has been dedicated to maintaining European capabilities in the design and implementation of mobile satellite systems. The Broadband Global Area Network system, developed for Inmarsat, will provide services for maritime, aeronautical and land-mobile applications. The AMETHYST project is defining an advanced mobile system concept and new payload architectures for mobile satellite systems. The Satellite Data Link System addresses the air-to-ground communications needs of civil aviation for air-traffic management.

Equipment

The technology and equipment line is providing significant support to European industry for the development of new concepts, as well as for upgrading existing designs to meet current market demands. Equipment prices have fallen over the last few years, emphasising the need for further reductions in recurring costs, implying further technology developments. Equipment items for existing satellite platforms are being updated and improved, and new payloads and ground equipment are being developed. Significant developments under this ARTES programme line include: Li-Ion batteries, a 400 W engine, smaller and cheaper frequency converters for the C-, Ku- and Ka- bands, and solid-state power amplifiers for the next-generation L- and S-band systems.

Applications

These activities relate to the needs of the users, which may be commercial or institutional bodies such as the European Union, government agencies, or other international organizations. The market forces normally address user needs but satellite-based solutions are often beyond the scope and capabilities, or even awareness, of many of the potential beneficiaries of satellite communication systems. There are many applications of satellite communications that can benefit user communities but first require demonstration and promotion. Therefore ESA has reinforced the Applications component of its Telecommunications Programme both to satisfy the needs of society and further develop the demand for satellite communications capacity, equipment and services.

Based on the experience acquired over the past years, three main lines are being followed:

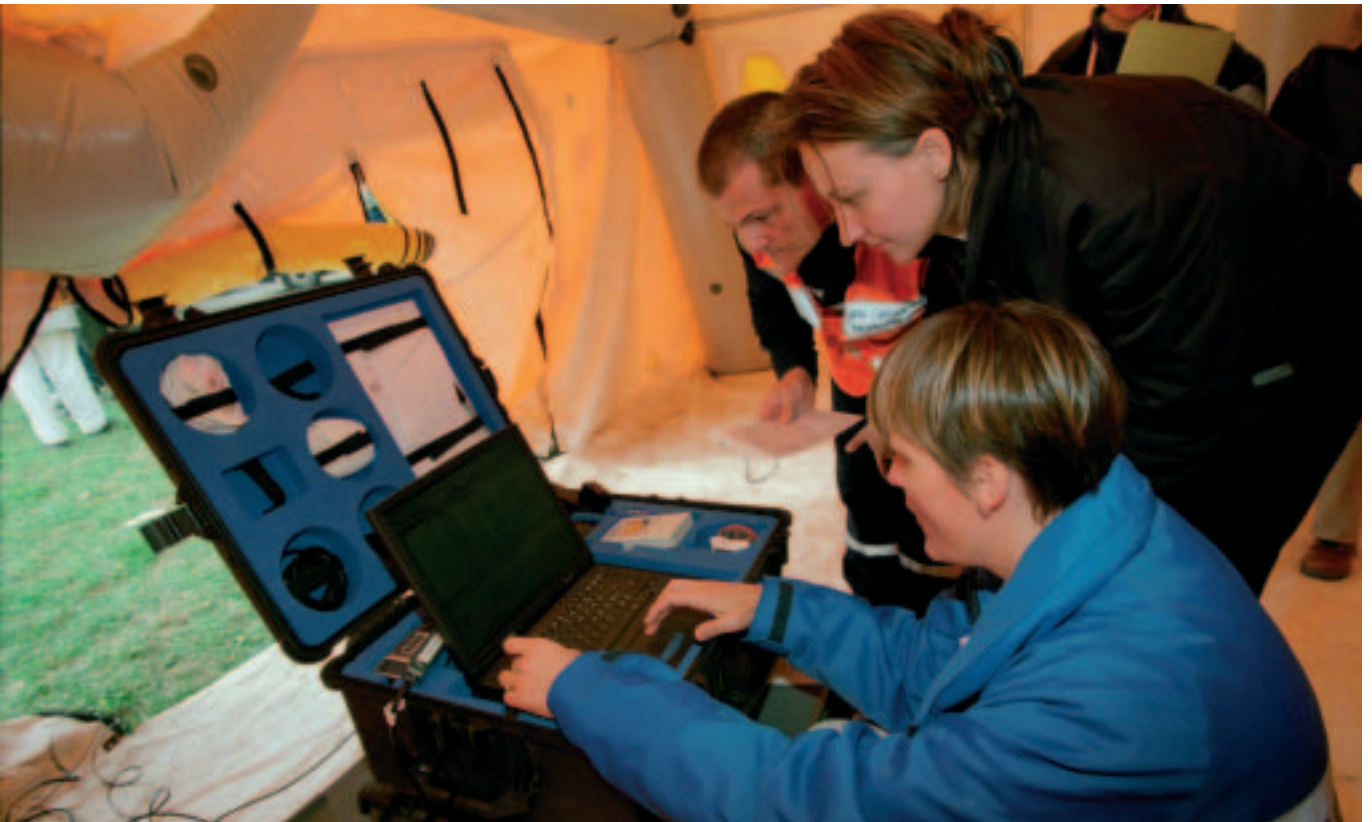
- 'Exploratory Applications' and development of the associated technology.
- Deployment of pilot 'Solution Projects'.
- Setting up of ad-hoc programmatic frameworks to support the operational phase.

Exploratory applications

The traditional 'exploratory applications' activities play a crucial role in the



Telemedicine at work



Connecting with the medical centre



Internet access on trains: connecting with the external world

within the ESA Telecommunications Programme, the first dedicated to Alphabus/Alphasat, and the second addressing other opportunities including piggy-back and small-satellite missions.

AlphaBus/AlphaSat

The goal in developing the AlphaBus platform is to ensure the competitiveness of European industry in the global market for telecommunications satellites in the 12 to 18 kW power range, thereby complementing the existing European commercial product lines in the low- and medium-power range. AlphaBus will initially be developed to protoflight-model level, but since the establishment of customer confidence in the AlphaBus product requires the qualification of the platform in orbit, a first operational mission is essential to achieve the overall objectives. The availability of the protoflight model also represents a unique opportunity for the in-orbit demonstration of new technologies, systems and services. Based on past experience with Olympus and Artemis, it is also especially important for such a high-capacity spacecraft to define its operational use from the outset to be consistent with the level of investment available for mission implementation.

The AlphaSat mission, based on the AlphaBus protoflight model, is therefore envisaged to consist of two main components, a technology package benefiting from the flight opportunity offered by the maiden flight of AlphaBus, and a core operational payload.

Piggy-back and small-satellite missions

Industry has expressed a need to establish an in-orbit heritage for newly developed equipment. Today, satellite operators and insurers are extremely cautious about accepting equipment on new satellites that does not have a proven track record. This is even true for well-proven designs that have undergone up-dating to replace obsolete parts. The ideal way to establish the

Telemedicine: a test case

Telemedicine is an area that has been the subject of a number of applications activities in the past, and for which a specific, coordinated effort is required to move from the exploratory stage to the operational phase. Telemedicine represents an important opportunity in the field of satellite-based applications: the health sector recognizes that satellites can play a key role in several areas of telemedicine, and the large social benefits and immediate perception of the value of telemedicine by Europe's citizens makes it a priority for ESA in its application development strategy.

A range of opportunities for coordinated actions at European level has been identified and ESA's role in facilitating the development of telemedicine via satellite is well-recognised. Telemedicine via satellite will therefore be used as a test-case for the development of applications

within the Agency's telecommunications activities. A strong link with the user community will be established to help ESA in defining priorities and mechanisms for the implementation phase.

Internet on trains: an exploratory application

The provision of Internet access on public transport has been explored. An encouraging demonstration conducted on European trains is paving the way for an envisaged 'solution project' in this domain.

Demonstration Missions

The in-orbit-demonstration component is a very important element of an overall telecommunications programme through its structuring effect on industry and its ability to focus efforts on a well-defined objective, despite all the associated mission considerations and constraints. Two lines of activity are being followed

trustworthiness of newly developed or upgraded equipment is via an in-orbit demonstration immediately after completion of its qualification campaign. Such equipment has therefore been flown as piggy-back payloads on ESA or commercial satellites, for example EMS on Italsat, Skyplex on Eutelsat satellites and, as mentioned earlier, AmerHis on Amazonas.

In the context of testing the market with a new or an existing service in an as yet untried geographical area, established operators are searching for a small satellite with a limited capacity and, most importantly, low cost. New service providers are also looking for small, low-cost satellites to gain entry into the market. Several concepts are under evaluation for

missions ranging from the in-orbit servicing of geostationary satellites, to the development of a small platform for the commercial market.

ARTES, a Helpful Programmatic Structure

In tackling its ambitious task of supporting satellite telecommunications R&D in European industry, ESA is devoting particular attention to applications that can benefit user communities requiring demonstration and promotion initiatives. Within this framework, financial help is currently being provided through the following ARTES elements:

- ARTES-1: Prospective/market studies and new configurations fully funded by ESA and contributions based on the GNP of Participating States.

- ARTES-3 : Multimedia and mobile systems initiated by ESA and co-funded by industry.
- ARTES-4 : ESA/industry partnership element, proposed and co-funded by industry.
- ARTES-5: Advanced systems and equipment for the future, proposed on an annual basis and fully funded by ESA.
- ARTES-8: Large-platform product line and mission, co-funded.

Several of these lines can ultimately contribute to a single project, depending on its content. Activities deemed to be 'near-to-market' are usually be co-funded, whilst those clearly paving the way for future telecommunications initiatives are fully covered by ESA. r