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Satellite Telecommunications

Part of Our Daily Lives

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Satellite Telecommunications – Part of Our Daily Lives

Satellite Telecommunications – What For?

Without us realising it, satellite communications permeate our lives. Many everyday events that we take for granted happen because telecommunications satellites are in orbit, 36 000 km above our heads - they are reliable and can be used in a plethora of ways.

- Did you know that many news-papers and magazines are produced centrally, but printed locally? The content of the paper is sent to the printing plants using satellite links.
- Did you know that even when a news or sports event shown on the television takes place just a few kilometres from the studios it has probably been transmitted via satellite?
- Did you know that most news agencies use satellites to distribute text, audio or video to their affiliates?
- Did you know that in many remote European villages access to the Internet is by satellite communi-cation only?
- Did you know that when you make a call from an aircraft or cruise boat, it is transferred via satellite?
- Did you know that satellites are being used for tele-education, telemedicine and video-confer-encing systems?

Advantages over Terrestrial Systems

Satellite communication has several advantages over alternative terrestrial systems.

- The signals sent by satellites positioned in geostationary orbit directly reach whole countries and even continents. This is optimal for broadcasting services: TV, radio, data or any other new service.

- New services can be deployed quickly. Satellite signals are sent directly from the satellite to the end user, while terrestrial networks need lengthy upgrades to the infrastructure. An example of this is digital television: many service providers and broadcasters chose satellites to introduce the first digital TV services. This is because satellite technology is the best way of making services available universally, quickly and at the lowest price.

- The versatility of satellite communications systems makes them very suitable for infrastructures that need a quick deployment, such as for emergencies or disaster relief. Satellite technology can also provide specific high-capacity temporary links on demand, for example for journalists transmitting videos of news, sports or other events from any place on the globe.

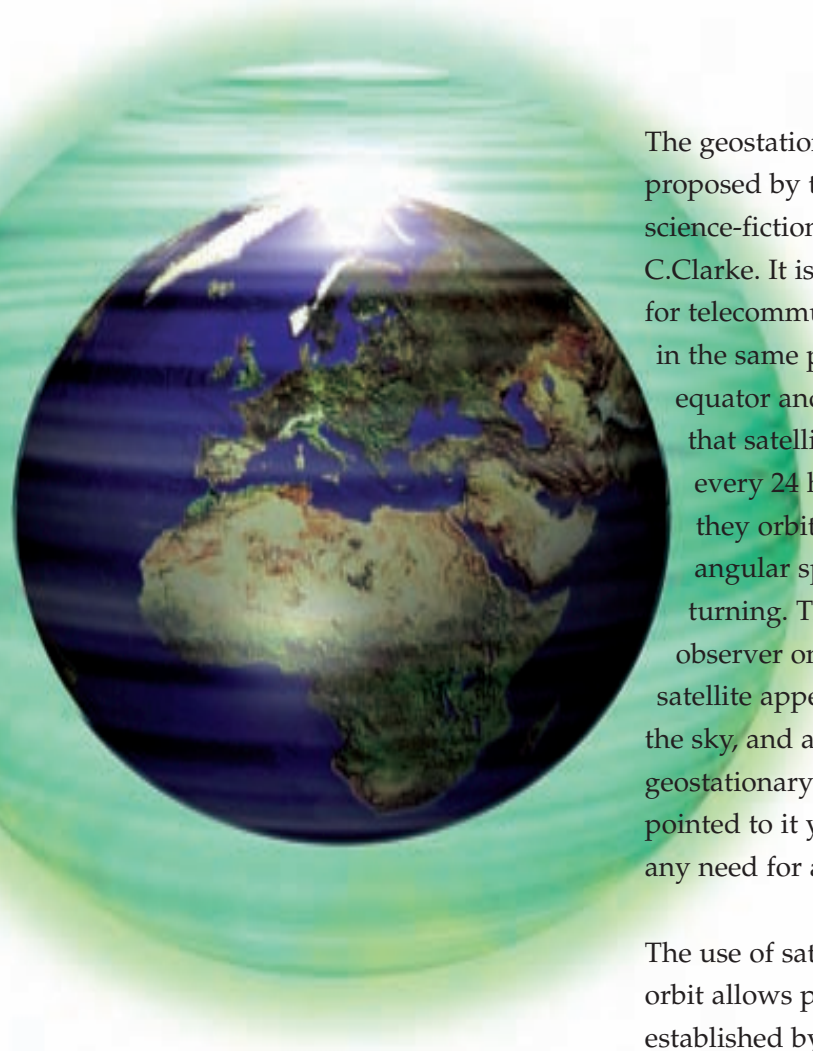
- The cost of a satellite link is independent of the distance between the locations that are connected. While high-capacity trunks are generally being replaced by fibre-optic systems, satellites continue to be a key element of thin routes of public networks in countries where the deployment of a terrestrial network would be unrealistic. In this case satellites are the most economical, and often the only solution.

- Mobile satellite telecommunication systems provide the means to communicate with ships, aircraft and other vehicles, no matter where they might be.

There are many types of telecommunications satellites and they vary in design according to their purpose. They use different orbits, different frequencies and they transmit very different types of signals using a variety of power levels.

Orbits

A fundamental principle behind telecommunications satellites is the type of orbit they use.



The geostationary orbit was first proposed by the British science and science-fiction writer Arthur C.Clarke. It is tremendously useful for telecommunications, because it is in the same plane as the Earth's equator and at a distance such that satellites complete an orbit every 24 hours. This means that they orbit the Earth at the same angular speed at which it is turning. Therefore, to the observer on the ground the satellite appears to be stationary in the sky, and an antenna pointed at a geostationary satellite will remain pointed to it year after year without any need for adjustment.

The use of satellites in geostationary orbit allows permanent links to be established by just transmitting a radio-frequency signal like the signals used to broadcast terrestrial television, but using a higher frequency. The signal is received, amplified and transmitted back to the Earth allowing communications between points that are thousands of kilometres apart.

A particular property that makes geostationary satellites extremely attractive is their capacity to broadcast to large areas. Indeed, the signal that is transmitted by the satellite can be picked up by antennas anywhere within its coverage area. This can be an area the size of a region, a country, a continent, or the whole face of the Earth that the satellite can see. But the most important effect is that anyone with a relatively small antenna (sometimes as small as 40 or 50 cm in diameter) can become a direct user of the satellite.

In the last decade other system concepts have been developed around the use of constellations of low Earth orbiting communications satellites. LEO systems, as they are generically called, require many satellites to cover the whole planet and provide the required services. In fact, these orbit the Earth in around 90 minutes, at heights of just a few hundred kilometres. Several of these systems are designed to provide communications to mobile terminals: since the satellites are closer to the Earth, the signal received is strong and the receiving antennas can be smaller.

The Satcom Market

The market for satellite communications has been expanding at a sustained rate of more than 15% per year. When launchers, user terminals and specially derived services are taken into account, this market, which is currently worth around 90 billion Euro, is expected to grow to around 220 billion Euro in the next 7-8 years. Satellite communications and launchers have been by far the most important application of the space programme both in Europe and other countries.

In the fast-moving world of telecommunications, Internet and multimedia applications, the latest trends are all important. Yesterday's technology is quickly superseded. Modern businesses need to adapt and respond quickly to changing market conditions. For the telecommunications marketplace - it's crucial.

Role of The European Space Agency

European industry and European telecommunications operators are at the forefront of this huge international market, thanks in part to the vision and the effort the European Space Agency and its Member States have put into developing new technology and satellite systems over the past three decades.

ESA is Europe's gateway to space. ESA shapes the development of Europe's space capability and ensures that investment in space continues to deliver benefits to the citizens of Europe.

By coordinating the financial and intellectual resources of its 17 Member States, ESA can undertake programmes and activities far beyond the scope of any single European country.

ESA's Member States are: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom. Canada, Hungary and the Czech Republic participate in some projects.

ESA Telecom Department

The Telecommunications Department is part of ESA's Directorate of European Union and Industrial Programmes. As a major facilitator of R&D activities, it enables European and Canadian businesses to develop world-class products and services, helping European citizens to benefit from high-quality, cost-efficient telecommunications.

The Department is responsible for managing telecommunications projects, the technology activities related to telecommunications, and monitoring the performance of the ESA telecommunications satellites in orbit. It is also supporting international efforts in the fields of interoperability, standardisation and frequency coordination. ESA's telecommunications programme covers the requirements of different actors in the telecommunications value chain: space-segment suppliers, satellite operators, equipment suppliers, ground-segment developers and integrators, service providers, applications developers, and last but not least users.

ESA's telecommunications strategy aims to set the pace, keeping European business and industry at the very forefront of the information age. Designed to adapt to changing circumstances and trends, it will act as a catalyst for the imagination so that new technologies can be conceived and developed. ESA is pursuing a programme called ARTES (Advanced Research on Telecommunications Satellites) that is looking at innovative ways of developing and using communications technology.

More Than 30 Years of Satcom Experience

ESA (then ESRO) started to develop communications satellites in 1968 and launched an Orbital Test Satellite (OTS) 10 years later. OTS was used for more than 13 years by ESA and Eutelsat (the European telecommunications satellite organisation) and by European national telecommunications companies to demonstrate new services, such as broadcasting content to be inserted into cable networks and direct-to-home television. Its design inspired the conception of many subsequent satellites in Europe.

Following this pioneering work, ESA developed and launched four European Communications Satellites (ECS) between 1983 and 1988 for use by Eutelsat. Each ECS allowed coverage of the whole European continent for cable television, telephone communications, specialised services and Eurovision transmissions.

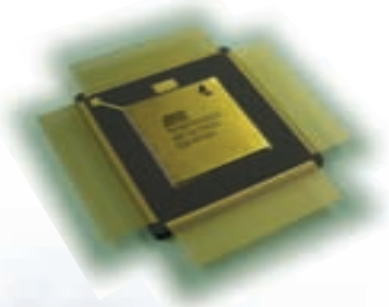
For communications with mobile stations, especially ships at sea, ESA developed two Marecs satellites. Launched in 1981 and 1984, they were later leased for operations to Inmarsat, the international maritime satellite organisation. Their L-band payloads, with global coverage, could handle around 50 telephone circuits.

ESA's Olympus experimental satellite was the largest civilian telecommunications satellite in the world at the time of its launch in 1989. Its design incorporated many key technologies, and its direct-to-home TV broadcasting payload allowed national network programmes to be captured with antenna dishes as small as 30 cm in diameter.

Technological breakthroughs, a world premiere in space, European engineers rising to meet the challenge of a launch malfunction – these are the achievements of Artemis, ESA's latest telecommunications satellite launched in 2001. It is the most advanced communications satellite yet produced by the Agency, being designed to develop new areas of mobile communications, and to initiate a European data-relay system involving satellite-to-satellite communication.

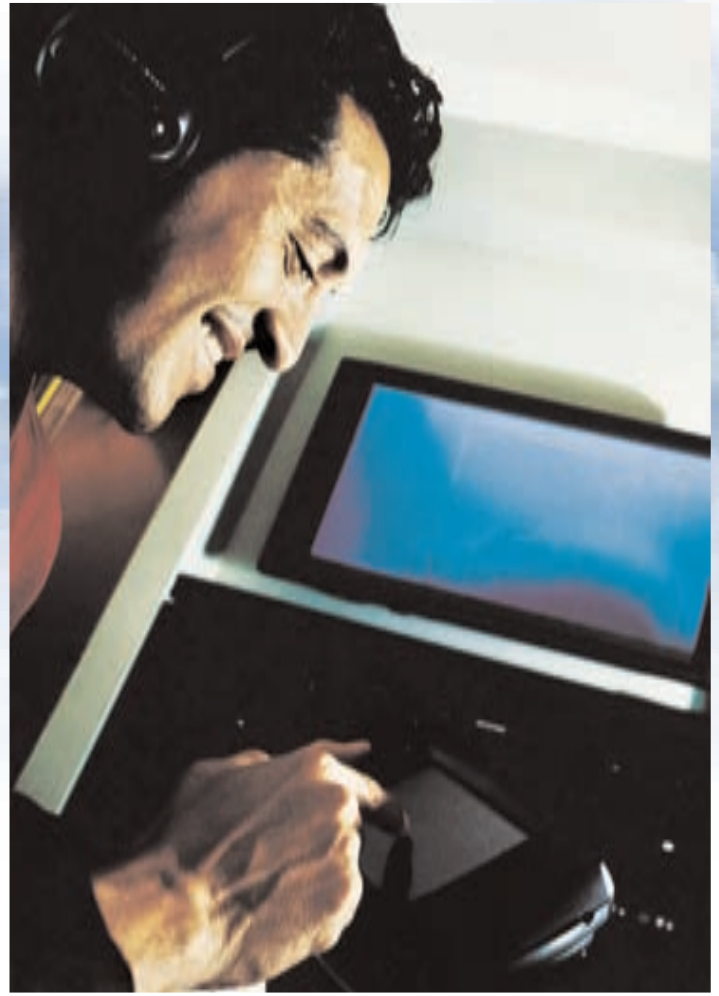
Investing in New Technology

Working closely with industry, ESA coordinates and sponsors the R&D necessary to bring new technologies to near-market-readiness. By investing in new technological avenues, the Agency helps European industry to develop emerging products and services and exploit new markets.



It is ESA's task to support the development of equipment and services that correspond to the future requirements of operators and users. At the same time, an important part of ESA's role in telecommunications is to research and develop technologies and concepts of a very advanced nature with high application potential for the long term.

Broadcasting



At the beginning of the 21st century, more than 70 million European homes watch TV programmes through direct satellite reception or through cable distribution systems. Today this market sector represents the biggest part of space-capacity sales. High Definition Television (HDTV), digital cinema and interactive television are new markets for broadcasting.

Imagine:

- movies delivered via satellite to cinemas located in Europe
- immersing yourself in 'edutainment/game TV shows', and competing in teams with the actual protagonists in the show
- playing your favourite game with friends in other countries via satellite.

SATMODE - A New Dimension for Interactive Satellite-based TV

Remote interactivity is the key element needed for the continued growth of satellite digital television. ESA is working with an industrial team to develop a new dimension for satellite-based interactive television.

The SATMODE project involves a satellite modem for two-way interactive television, enabling viewers to access and respond to interactive content presented on the screen. It connects individual TV consumers to each other, to their entertainment providers and to other communications infrastructures.

SATMODE operates in real time, is secure, and is always on. Services range from chat rooms, SMS, e-mail, tele-voting, polls, and interactive advertising to home shopping, betting and standalone or multi-player games.

For more information visit:
http://telecom.esa.int/satmode

Mobile Communications

Mobile-related communications represent an important portion of the global telecommunications commercial market. Today voice and data point-to-point communication and broadcasting to mobile terminals is a fast-growing sector.

For communication with aircraft, trains, cars or ships, satellite is often the only available option.

Imagine:

- audio, video and web-based services, directly from the satellite to moving cars
- Europe-wide in-car satellite radio
- broadband access on the train
- marine weather-forecasting services while on the high sea
- digital air-ground communications for efficient aircraft fleet management.
- communication via satellite with aircraft cockpits for Air Traffic Control (ATC) and and air-traffic operations.

Telemedicine - Medical Care from Space

Health professionals today use telemedicine via satellite for prevention, diagnosis, treatment and education. Thanks to modern telecommunications links, diagnostic and therapeutic medical information can be passed between patient and doctor without either of them having to travel.

Satellite technology plays a significant role in the management of emergencies, disasters and trauma.

Imagine:

- having a daily check-up with the nurse from the comfort of your home, using a satellite connection with the hospital
- being able to track ambulances and medical staff after an earthquake or other disaster, when terrestrial phones or Internet services are no longer working
- keeping medical staff up to date with advanced telemedicine courses delivered to their practice via satellite
- providing teleconsulting in case of emergencies to isolated or remote sites like ferries or ambulances
- having in-the-field radiology, employing telecommunications equipment onboard an ambulance and being directly linked to the hospital's radiology department
- remotely monitoring the health of heart patients fitted with pacemakers as they go about their daily lives.

ESA's telemedicine projects are active in developing the hardware, software and content elements required by specific telemedicine applications. The resulting systems are then used in a pilot utilisation phase with real users under truly operational conditions.

For detailed information about the various ESA telemedicine projects visit: http://telecom.esa.int/telemedicine

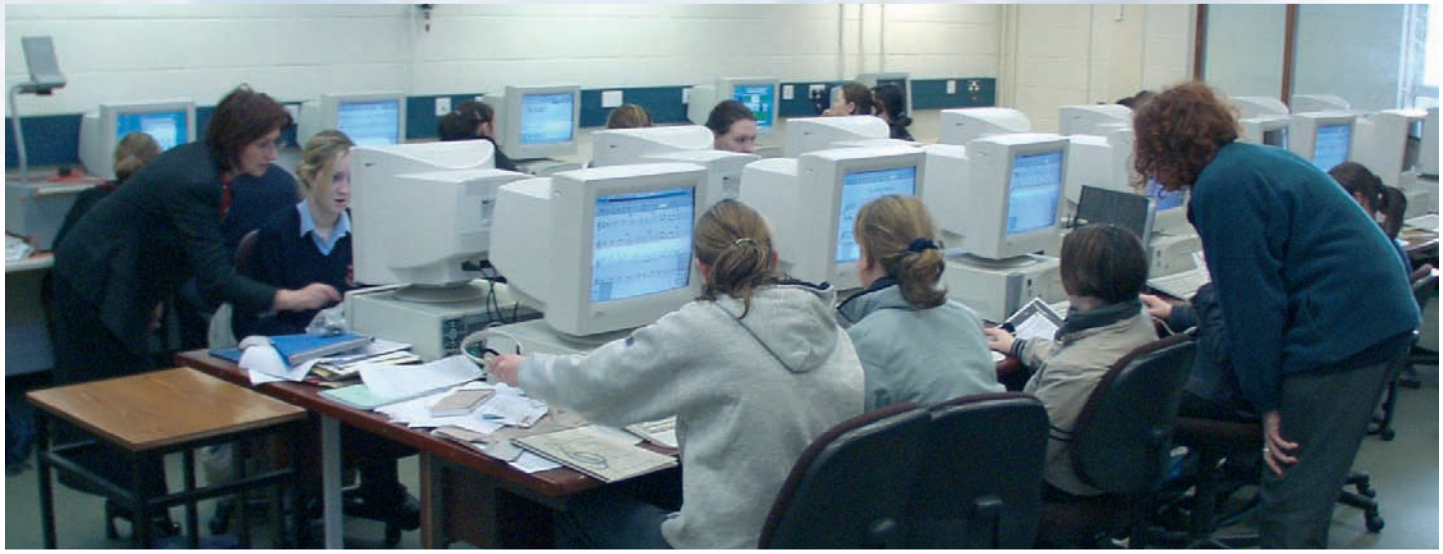
Distance Learning via Satellite

Since the late 1980s, ESA has been active in promoting activities in satellite communications for distance learning.

The possibility to distribute IP (Internet Protocol)-based content via satellite to many users simultaneously has opened new opportunities for tele-education via satellite. Today, students all over Europe are able to use products and technologies developed under ESA contracts.

Imagine:

- a satellite-based e-learning multimedia platform providing real-time audio and video streaming of university lectures and Internet-based interaction
- fast access to the Internet for schools in remote areas of Europe
- a satellite tele-education service for itinerant people, like those in the circus or fairground communities.



Satellites Save Lives

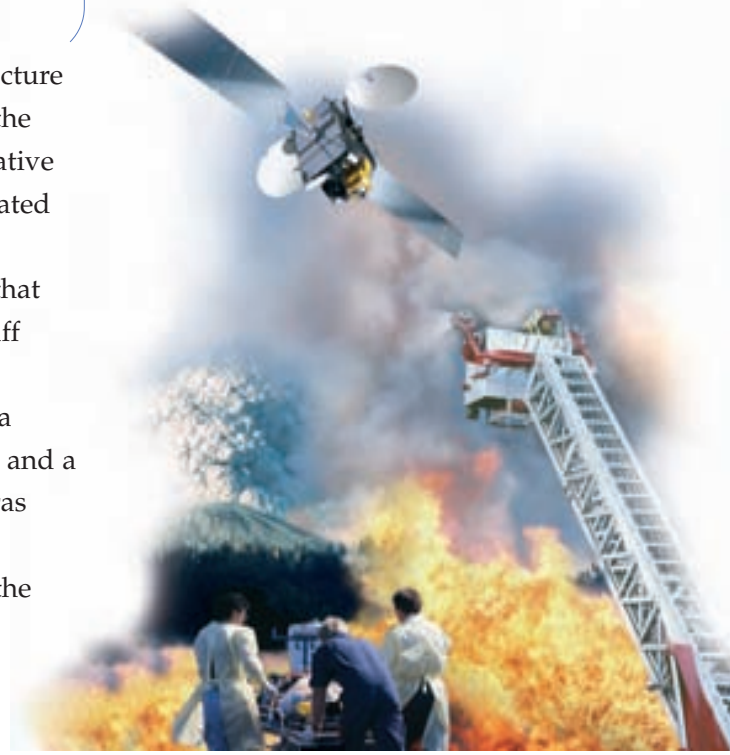
Information and Communication Technologies (ICT) have a crucial role during the management of emergencies by providing the right information, at the right time and at the right place in order to take the right decisions.

Access to information is very important during crisis situations, but communications links are almost always disabled or disrupted during the first hours of a major disaster. When relief workers arrive on the scene, there is an urgent need to establish effective and comprehensive communications links between the affected area, national disaster-response facilities, and the larger international community.

Satellites are the only infrastructure element immediately available in case of emergencies. Their coverage, worldwide connectivity, high bandwidth and robustness make them an excellent choice for civil protection and disaster management.

Imagine:

- smart clothes equipped with sensors to monitor the position and vital signs (body temperature and heart beat) of the emergency staff
- a communications infrastructure that provides personnel at the scene with medical consultative expertise from centrally located emergency trauma staff
- advanced hand-held units that allow supervision of the staff in the emergency area
- a portable weather station, a system for flow monitoring and a series of surveillance cameras deployed along the river to monitor a potential rise in the water
- immediate access to near-real-time Earth-observation products, fully customised for the purpose of emergency management: fire index, hot-spot maps, damage assessments, weather forecasts and fireline propagators.



Bridging the Digital Divide

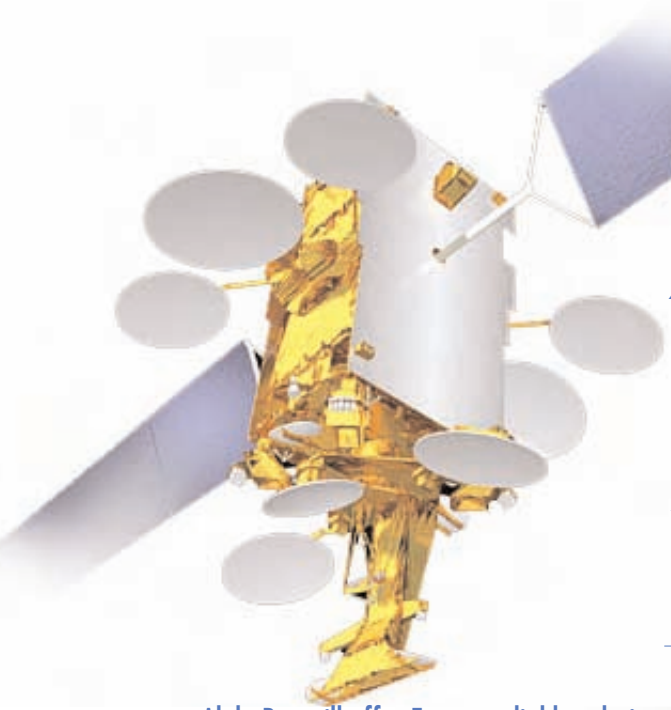
Current forecasts estimate that large numbers of households in the 25 EU member countries will still have no access to broadband services in 2010, either at home or at work. This is due to the economic and technical limitations of terrestrial broadband services.

The disparity between rural and urban areas with regard to Internet accessibility still affects most European countries. What is commonly known as the 'Digital Divide' can considerably hamper economic development.

Enterprises wishing to relocate to the countryside are currently hindered in doing so due to the fact that broadband access - ADSL or fibre - is quite simply unavailable.

Since satellites deliver uniform coverage over vast areas and can be deployed without pre-existing terrestrial infrastructures, they are well-suited to delivering an equal quality of service everywhere and for everyone.

The ESA-supported INSPIRE project, for example, provides Internet access via satellite to consumers in selected European regions which are currently not served by terrestrial broadband infrastructures. The cost of a satellite terminal can be shared among several subscribers, allowing service providers to offer broadband services at a price level compatible with the consumer segment.



AlphaBus – the New European Platform for the Next Generation of Telecommunications Satellites

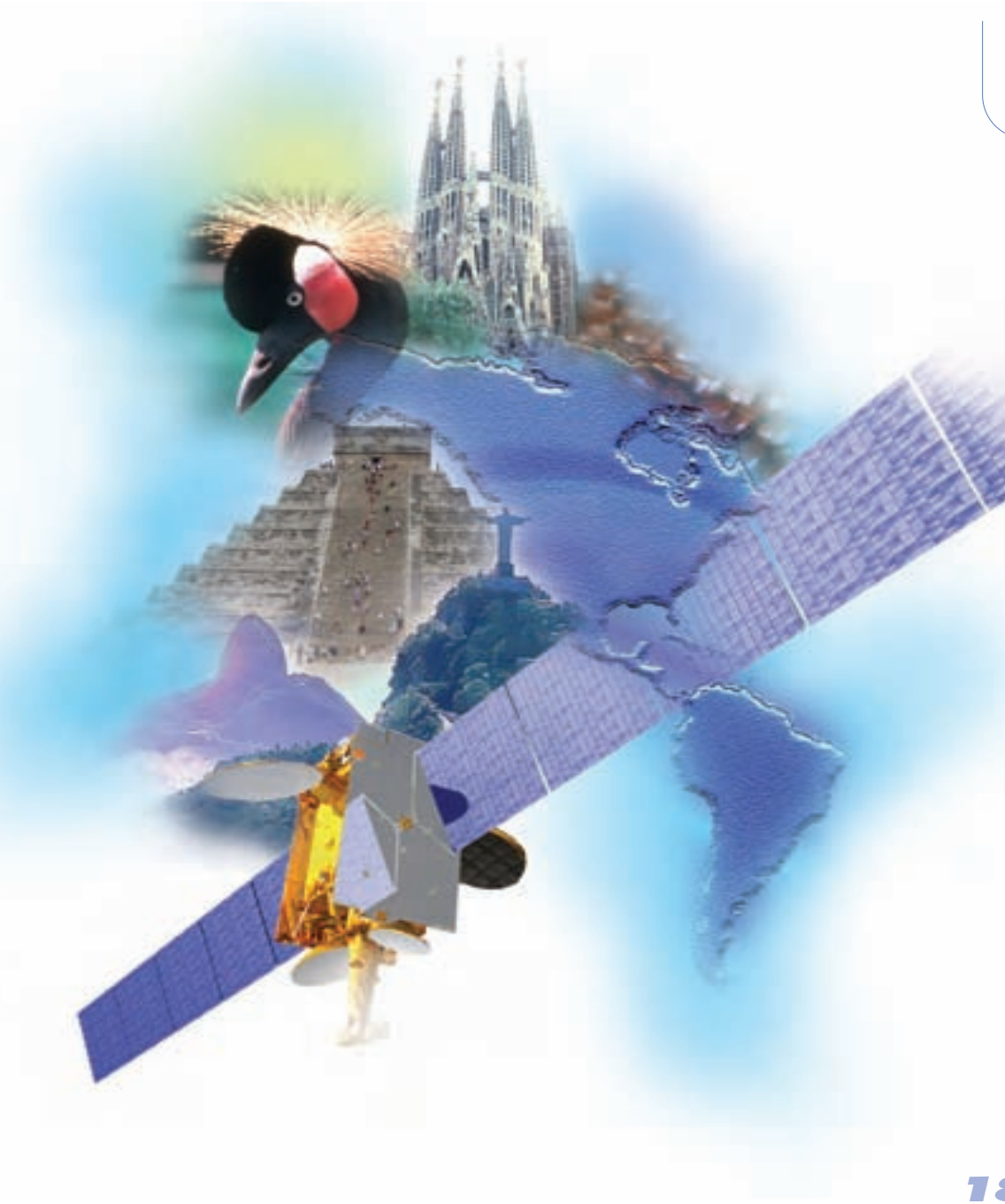
AlphaBus will offer Europe reliable solutions matching world demand for very-high-power satellites. It will be commercialised by European industry from 2007 onwards.

The AlphaBus platform has been designed for telecom satellites delivering payload powers of 12 to 18 kW.

AlphaBus will contribute to the replacement of the major operators' satellites, by offering a lower cost per transponder and the capability to fly reconfigurable missions.

AlphaBus will make new services possible, including the next generation of mobile and broadband services, digital radio broadcasting and high-definition TV.

For more information visit:
http://telecom.esa.int/alphabus



AmerHis – The First Switchboard in Space

Launched on 5 August 2004 and now located in geostationary orbit at 61 degrees West, the AmerHis payload carried by the Amazonas satellite heralds a new era in satellite communications. It makes Amazonas the first European telecommunications satellite with onboard processing, enabling the Spanish satellite operator to provide high-performance interactive multimedia services to North America, South America and Europe.

AmerHis can support a wide range of services, such as video broadcasting on demand, interactive TV, news broadcasting on demand, file transfers, video telephony and telemedicine.

With coverage including all of South America, the United States and Canada, as well as transatlantic capacity allowing coverage of Europe and northern Africa, AmerHis is also a prime example of what can be done to bridge the Digital Divide.

For more information visit:
http://telecom.esa.int/amerhis

The Future of Satellite Telecommunications

In the fast-moving world of telecommunications, the latest trends are all-important. ESA is keeping European business and industry right at the forefront in the 21st century.

There is a continuous push for cheaper, smaller and lighter equipment with improved performance and reliability. This push is present in all satellite-technology areas, resulting in a need for upgrading of all types of satellite equipment – payload, platform and ground segment – at regular intervals.

Users can expect new technology and services for broadcasting and interactive television. Broadcast Satellite Services are expected to continue their expansion in geographical regions not yet exploited. Services such as interactive TV and other forms of broadcasting will be favoured by the major reduction in transmission costs.

Broadband access definitely represents one of the most important opportunities for satellite communication systems to generate a new cycle of growth. Low-cost user terminals and multispot beam antennas will allow more rural communities to use broadband access to the Internet via satellite. European Industry is already able to supply competitive medium- and high-power platforms to the world market. Thanks to ESA's AlphaBus programme, the high-end platform market will also soon be covered by European suppliers. It will carry communications, navigation and technology payloads that will allow the introduction of new experimental services and the testing of new technologies.

Small satellites are important in order to reduce the risk associated with new applications over satellite or new markets, or as a fast replacement or backup solution. Having a European competitive Small GEO Platform will ensure that European Industry is able to compete in this market segment also.

Keep in touch

If you would like to have more information about specific ESA telecom projects, please take a look on our Internet site http://www.esa.int or get in touch with us by sending an e-mail to telecom@esa.int.

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Prepared by: Ninja Menning &
Anna Jacobs
Telecommunications
Department,
EU and Industrial
Programmes Directorate

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