



Space debris. Photo courtesy of ESA.

A strategic position

A ministerial meeting was held in November to implement the new European Space Policy and to ensure that the region is kept firmly at the forefront of space. Satellite Evolution investigates the policy's priorities and plans for the future.

A resolution was passed in September 2008 that was adopted by the Council of the European Union and the Ministerial Council of the European Space Agency (ESA). This Resolution recognised that the European Union, alongside ESA and its Member States is a major player in space, and welcomed the implementation of the European Space Policy. It encourages the EU and ESA to further strengthen its position through new development and long-term investment in space. The aim of the November meeting was to implement new programmes and to decide on next steps for future programmes to fulfil the EU Space Policy. The European Space Policy is supported by 29 Ministers of ESA and the EU member States. It was adopted in 2007 and it establishes clear strategic objectives for space. The EU and ESA have strived to establish Europe as a space power and have made great impact with work on the International Space Station, for which ESA developed the Jules Verne ATV and became an ISS partner.

Galileo is another landmark project as is the huge achievement of the Ariane 5 programme that has seen successful launch after

successful launch and guaranteed European access to space. There are several areas that Europe must focus on to meet its objectives in space:

- Europe must further develop the benefits of space to society and the knowledge economy, stimulating innovation, creativity and growth;
- It must promote the development of new products and services that benefit daily life;
- It must become increasingly successful on the global market in space systems, service and applications;
- It must meet its defence and security needs for space; and
- It must provide continued access to space.

It is helpful to break down the aims of the European Space Policy into several different areas that each highlight the main concerns of the region and illustrate how space is being used to address the issues that matter most to mankind.



Space as a benefit to society

GMES (Global Monitoring for Environment and Security) is a joint initiative from the European Space Agency and the European Commission that will provide information services regarding the environment and security. GMES is the European contribution to the Global Earth Observation System of Systems or GEOSS, an ambitious 10-year programme adopted in Brussels in 2005 to provide information on 'ecological security and durable development for mankind'. GMES will provide crucial information on

- Land cover change over Europe;
- Environmental stress in Europe;
- Global vegetation monitoring;
- Global ocean monitoring;
- Support regional developmental aid;
- Systems for risk management; and
- Information management tools.

The monitoring and understanding of nature and the impact of global warming, desertification, erosion and deforestation will enable the key decision makers to make informed choices and the information will also be available to the public, to NGOs, environmental organisations etc.

Earth observation is at the core of GMES. At present, a constellation of 25 satellites comprise GMES but five more will be launched by 2011. These satellites will provide a range of data that is then analysed and prepared for end-users who may be institutions, government agencies, environmental agencies, local, regional and national authorities, civil protection agencies etc. At present, GMES is in its 'concrete implementation phase'. This involves the integration of data from space and earth-based observation capacities into services that may be accessed by the end-user. This is a gradual process and the objective will be to validate a number of pilot operational services. Three services have been selected to be 'fast-tracked'-Emergency Response, Land Monitoring and Maritime Services.

The first GMES segment was started in 2006 and will run until 2013. This will overlap with the second phase that will run from 2009 until 2018. Segment one involves the completion of the 'Sentinels' (a series of GMES-dedicated satellites). It will continue to provide reliable and efficient operational access to earth observation data from missions that is required by the user community. Segment two covers the in-orbit validation phase for Sentinel 1A, 2A and 3A and also the initial phases of Sentinel 5. Segment two also covers the development of Sentinel 1B, 2B and 3B and the two Sentinel 4 units that will be carried on the third generation Meteosat and the Sentinel 5 precursor satellite.

Meteorology

Eumetsat continues to be the lynchpin of Europe's meteorological capability and operates a system of satellites that monitor the weather and climate-related data. In addition, the Meteosat Third Generation will enhance the accuracy of forecast by providing additional measurement capability, higher resolution and more timely provision of data. The programme will follow the precedent set by the Meteosat Second Generation development. ESA will procure an additional four satellites on behalf of Eumetsat and this programme will last from 2009 until 2020.

Global Navigation Satellite Systems (GNSS)

The issue of navigational technologies has been high on the European agenda for some time now. The infrastructure for Europe will comprise EGNOS and Galileo with plans to extend the European GNSS Evolution programme. This proposed extension will run from 2009 until 2011 and will include system definition, preliminary design and support studies, research and development in GNSS-related technology, GNSS Evolution test bed and system tools, and associated activities. The extension programme will prepare for the

first evolution of EGNOS by using pilot systems to demonstrate new services and to improve Galileo-related technology with regard to future upgrades of the system.

Meanwhile, in October, representatives of the European Community and the United States met for their first Plenary meeting, the aim of which was to review and discuss matters of mutual importance regarding their co-operation in the use of GNSS. This concerns the promotion, provision, and use of the Galileo system and GPS and their related applications.

Both parties re-affirmed their commitment to working together and provided updates on their respective systems. At present, the US intends to continue to operate GPS – their dual-use system that provides precision timing, navigation and positioning for peaceful civil, commercial and scientific use on a continued, worldwide basis and free of direct user fees. Galileo has moved into its procurement phase and Galileo and EGNOS will provide services including safety-of-life, commercial and public regulated services.

Both systems will be interoperable with each other and also other GNSS in order to promote global economic growth and to strengthen transatlantic co-operation. A common signal, known as L1C on GPS and E1 Open Service on Galileo, has been optimised using a Multiplexed Binary Offset Carrier (MBOC) waveform. Future receivers using this signal should be able to track GPS and/or Galileo signals with higher accuracy in challenging environments. GIOVE-B began to transmit the new MBOC signal in April 2008 and the goal is to ensure that Galileo and GPS remain compatible.



Vega launch vehicle. Photo courtesy of ESA.



In addition, the trade and civil applications for the systems were discussed as were issues related to market access and fair trade and the barriers to the development of the global market for satellite navigation services, equipment and applications. Both parties expressed strong support for continued close co-operation in order to improve services related to space-based positioning, navigation and timing.

Security

Europe's Space Situational Awareness initiative aims to contribute to the protection of European space systems, in particular those related to operational services, against space debris and solar flares. This will help to guarantee the availability of such services by providing timely, quality information on the space environment, threats and the sustainable exploitation of outer space surrounding earth. In the past, Europe has experienced problems first hand as a result of the lack of space situational awareness. In 1996, a French satellite was hit by a piece of space debris from an Ariane 4 rocket that was launched ten years earlier.

The programme proposal will consist of one core element covering governance, data policy, data security, architecture and space surveillance, and three additional optional elements: space weather, Near Earth Objects surveillance; radar components in close coordination with the General Support Technology Programme and pilot data centres.

ARTES to be extended

The ARTES project or Advanced Research in Telecommunications Systems, is dedicated to the support of the technological competitiveness of European industry and is also dedicated to undertaking demonstration projects that will eventually be developed into operational systems. The programme is to be extended.

The extended programme will continue the support to the European space industry through research and development of innovative satellite communications technology, systems and applications to enable industry to meet customer needs, including those of the public sector. ARTES 1 constitutes the preparatory element of the Telecommunications programme. ARTES 3-4 and ARTES 5 are designed to allow the generic development of technology, equipment and systems for industry's target markets and to allow updates and improvements to existing products. The ARTES 8 extension programme proposes to extend the capability of the large platform

Alphasat and to support exploitation of the performances of the Alphasat satellite by developing the required user segment and upgrading the service segment. Finally the ARTES 11 extension programme is aimed at consolidating the Small GEO satellite platform, increasing its competitiveness by means of innovative technologies and enabling the full commercial exploitation of the innovative payloads on board the Small GEO satellite through development of both the ground and user segment.

The European Data Relay Satellite (EDRS) programme (ARTES 7) aims at initiating, in partnership with a service provider/operator, operational capabilities in geostationary orbit to provide data relay and related services to efficiently support ESA and, possibly, third party missions. The EDRS will replace ESA's Artemis data relay satellite that has been operated successfully since 2003, and will reach end-of-life during the first half of the next decade. The programme will be implemented in a stepped approach, with the first step being primarily focused on services to GMES and on the possibility of serving additional commercial, institutional and security needs.

The Integrated Applications Promotion (IAP) Programme will foster the use of integrated space systems and technologies (telecommunications, Earth observation, meteorology etc) alone or in combination with a variety of terrestrial systems, in a wide range of operational services for society and public policies (natural disaster monitoring and mitigation, search and rescue). The programme is based on two elements: Basic activities - to raise the level of awareness of the potential users, identify potential new services and prepare new projects for demonstration- and demonstration activities - projects that will lead to pre-operational services. Service providers, industry and user institutions will be involved from the outset with a view to their taking over the service when the activity is mature enough to lead to sustainable operational services.

Knowledge-based society

ESA's research project into the understanding of the universe and its formation is known as 'Cosmic Vision' and this particular project will begin in 2015 and run until 2025. To fulfil this aim, ESA plans to exercise larger, more technologically challenging missions that are not within the capability of individual ESA Member States.

The EU wishes to deliver the Cosmic Vision as early as possible but is obviously heavily reliant on funding levels to be granted for the period between 2009 and 2013 in order to deliver a world-class programme. The first objective must be to complete the approved mis-

Growing strongly

The UK's space and satellite telecommunications industry has seen its turnover nearly double in the last seven years and looks set to continue to grow strongly, Science and Innovation Minister Ian Pearson told a major international gathering in Glasgow.

The UK space industry continues to show strong growth, with the sector growing by nearly eight percent on 2006/2007 and an overall turnover of £5.8 billion, a new report has found.

The Size and Health of the UK Space Industry 2008 report shows that services continue to be the dominant sector in terms of both overall size (85 percent and worth £5 billion) and growth (eight percent).

The report also reveals that total employment in the UK space industry stands at nearly 19,000 with over 1,600 new jobs created in 2006/2007. Of the total, more than 5,800 jobs in the systems sector are amongst the most highly skilled in the UK economy, with 60 percent of staff holding a first degree and one third of these having a second degree.

The Science and Innovation Minister, Ian Pearson, who launched the report at the International Astronautical Congress (IAC) in Glasgow in October, said that the Government recognised the importance of the space industry.

He said: "Space is increasingly important in all our lives. Satellite communications have made the massive growth in digital TV, global monitoring telephony, Internet traffic and other broadband services possible. They play a vital role in understanding how our climate is changing. The space industry makes a significant contribution to the UK economy. By its very nature it's highly innovative and is one of the highest value adding sectors. It will play a significant part in driving forward the UK's future knowledge economy.

"The UK should be proud of its world leading capabilities in telecommunications and small satellites. Achievements this year include the completion of the Skynet 5 constellation built by Astrium and the launch of five RapidEye satellites based on the Surrey Satellite Technology Limited platform. Alphasat, being built in Britain, is set to bring affordable communications to the developing world."

The theme of this year's 59th IAC, last held in the UK in 1987, was 'From Imagination to Reality'.



sions that are currently under development including projects like BepiColombo that will involve a mission to Mercury. The next goal will be to secure the implementation of future missions.

In terms of exploration, Europe will be able to make full use of the International Space Station for preparing for exploration and providing astronauts with flight opportunities and also to use the Jules Verne Automated Transfer Vehicle as a basis for the development of a new transportation system. In addition, exploration of the moon and recruitment of astronauts will be one of the top priorities. In addition, Europe wants to be at the forefront of the ExoMars mission and would like to adopt a key role in a Mars sample return mission.

Exploring Mars

This particular mission has evolved since it was originally proposed in 2005. Now, it is due for launch in 2016 using either an Ariane 5 or Proton-M heavy lifter and should arrive at 10 months after the launch. The mission will be the first of the Aurora programme and will include the development of a carrier module, the Pasteur and Humboldt payloads, entry descent and landing system and a mobile rover that will be able to drill down into the martian surface to obtain samples. Discussions are underway with Russia and NASA on their potential involvement in the missions to Mars.

The future Mars Robotic Exploration Preparation programme (also included in the European Space Exploration Programme-Aurora) is a preparatory programme for the development of European capabilities to enable the long-term exploration of Mars. It includes the definition of an exploration strategy and roadmaps, and Mars Sample Return (MSR) preparatory studies with a view to a cooperative endeavour that could take place between 2020 and 2030 with NASA and possibly other partners. The programme also covers intermediate missions before MSR (such as rendezvous and capture in orbit, aero-braking, sample collection, high mobility rovers and hard landing demonstrations), exploration technology developments as well as awareness and education activities.

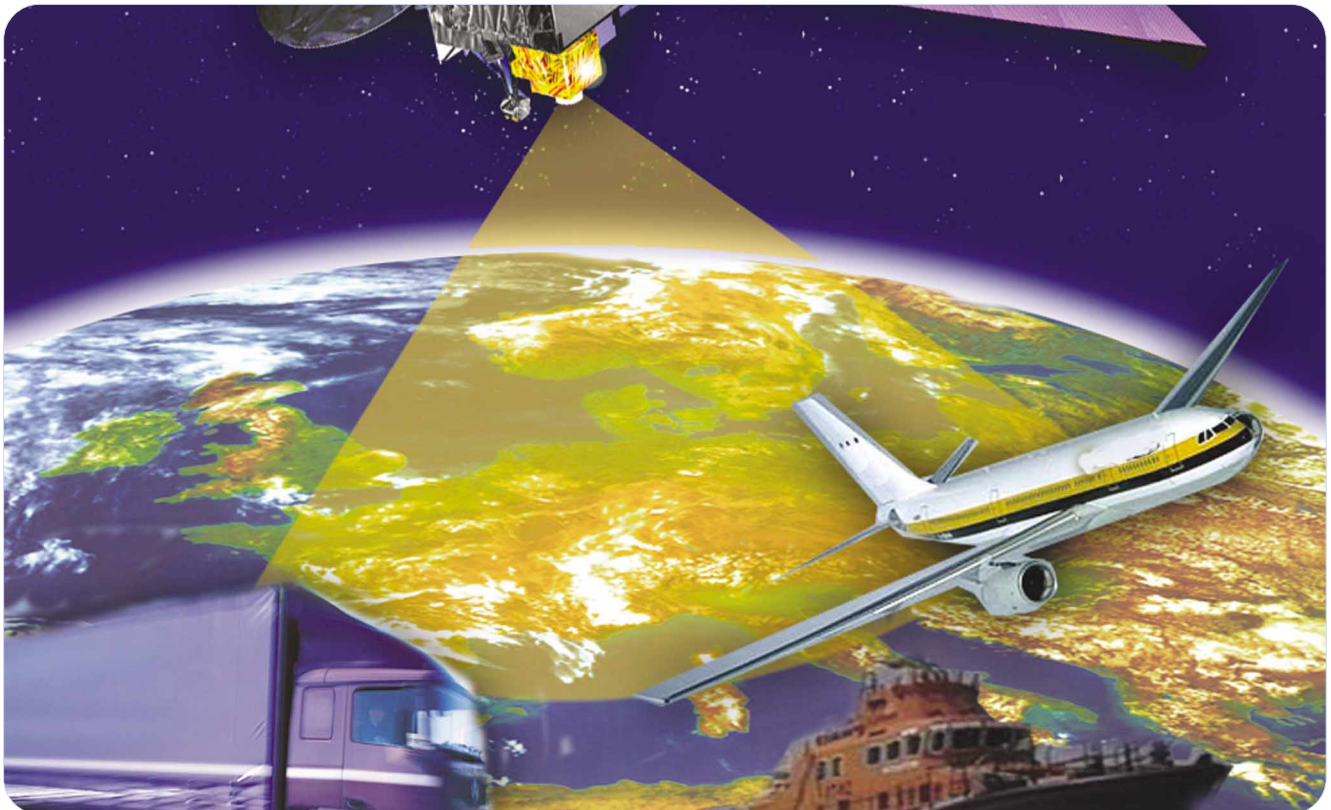
Climate change

The concern about climate change has had a huge influence on the direction of European space ambitions and ESA and its member states are highly committed to developing space-based initiatives to combat the effects of climate change and to provide observational data on all areas of climate change. The Climate Change Initiative will provide consistent, long-term records of 'essential climate variables' required by the Global Climate Observing System (GCOS). This data will be used to help the International Panel on Climate Change and the United Nations Framework on Climate Change. The programme will focus on climate variables such as greenhouse gases, ocean salinity and temperature, sea and lake levels, sea ice and snow and fire disturbance. ESA's ERAS, ENVISAT, Earth Explorer and Sentinel missions will play a great part in this.

The Climate Change Initiative will ensue from 2009 until 2015 and will play a crucial part in the long-term preservation of data from earth observation missions and will monitor long-term global trends. Over the next three years, work will be completed on how this data will be archived and accessed in co-operation with other national space agencies and other owners of data.

Ensuring Europe's access to Space - launchers

This is probably the most crucial part of Europe's entire space programme – ensuring that Europe can actually gain access to space. Without this, none of the policy objectives can possibly be reached. ESA's launcher programme is aimed at maintaining access to space at an affordable price through a full family of launchers – Ariane, Vega and Soyuz. From 2010, all three launchers will be operated from the Guiana Space Centre – the European Space Port. ESA also aims to become more independent of non-European sources. In addition, ESA continues to focus on next-generation launchers and to bring them into operation when the current launcher family reaches its operational limits. The new legal framework that will see the launcher family operating out of Guiana is the result of a new



EGNOS. Photo courtesy of ESA.



agreement between ESA and the French Government. Under the agreement, France will guarantee the availability of the launch range for ESA programmes and activities and ESA will contribute towards the funding of the Guiana Space Centre.

The Ariane 5 Research and Technology Accompaniment Programme Extension will focus upon the elimination of flaws and weaknesses that appear during operational use and to improve the knowledge of the functional behaviours of the launcher when it is in flight. The programme will ensure the status of the Ariane 5 is maintained in its heavy payload class. It will cover sample and testing, flight analysis, flight hardware anomalies, and ground testing facilities. Between 2009 and 2011, ESA member states will put measures into place to ensure that Ariane 5 production will continue in the event of future imbalances and risks in the commercial launch market.

The preparatory phase of the evolution of Ariane 5 is covered in the Ariane 5 post-ECA Programme, planned to run from 2009 until 2011. This programme will initiate activities for the future evolution of Ariane 5 (the ECA version being the current Ariane 5 workhorse) to bring the development of the re-ignitable Vinci engine and of the new cryogenic upper stage to a level of technical maturity that will allow a final decision on the configuration and full development phase of the improved Ariane 5 version in 2011. This will be followed by a qualification flight around 2016/2017 and operational service at some point before 2020. The decision on the development phase will be made on the basis of the results of the preparatory phase, of industrial commitments for development completion and exploitation costs, and of market needs for the period 2015-2020.

The Vega launcher has not yet come into service but already a programme extension has been put into place. This programme will complement the initial exploitation of the Vega and will cover the time period between 2011 and 2012 and will embrace sample and testing, flight analysis, flight hardware anomalies and development activities that will help get the most out of the launcher.

For the longer term, the proposal for the continuation of the Future Launchers Preparatory Programme is aimed at preparing a solid basis for preserving independent access to space, identifying the best option for responding to future institutional needs while maintaining long-term competitiveness on the commercial market (post 2025). The programme will make it possible to achieve a significant step forward in technology maturation and validation through ground and in-flight demonstrators.

The FLPP programme (step 2 of period 2) addresses selected next generation launcher concepts and at the same time investigates new expendable launcher concepts or evolutions of existing launchers. Works also include preparatory activities in advance of the launch of the IXV (Intermediate eXperimental Vehicle) on board a Vega launcher in 2012, as well as ground demonstrators and technology development and verification for enabling promising technologies. Work will continue on the creation of a high thrust engine demonstrator and cryogenic upper stage technologies. This step will also cover re-entry experimentation with regard to re-usable launch technology.

Human spaceflight and exploration

Europe's principal focus in terms of human spaceflight and exploration will be the International Space Station and Europe will be looking to maximise its investment in the ISS through technological innovation and preparing for human space exploration.

The third period of the International Space Station Exploitation Programme is aimed at operating, maintaining and exploiting the European elements of the ISS and providing Europe's contribution to common operations by delivering cargo and services (re-boost, refuelling, attitude control, replenishment of gas and water). This programme also covers the European Astronaut Corps, for which ESA is currently recruiting a new group of astronauts.

The content of the ISS Exploitation Programme consists of Columbus operations, the provision of ATV and the associated Ariane

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5 launches, ATV operations, payload operations, astronaut activities, and reimbursable services to NASA. The programme is structured in five-year periods sliding every three years: Period 3 extends from 2008 to 2012 (Period 4, which extends from 2011-2015 -the current end of the ISS lifetime- is not part of the proposal for the 2008 Council at ministerial level). During these two periods the ESA's commitment is to provide four ATVs in addition to Jules Verne, ATV 2 to 5.

The ISS evolution programme will aim to develop new hardware to enhance the performance of the space station and to provide in-orbit demonstrations of new technology for longer human missions. Some examples are an air revitalisation system, a high speed telecommunication terminal and an external robotic operated platform for smaller payloads.

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Great expectations

Nobody can accuse Europe and ESA of shying away from space ambitions. The desire to ensure that Europe establishes itself as a serious and competent player in space is crucial. The emergence of other nations who are stepping up to the plate in terms of space exploration and innovation such as China, India and South Korea, mean that Europe must continue to stretch itself and constantly think ahead. There is no room for complacency. The new Space Policy places Europe in a strategic position to take on global challenges, and to make more effective use of its resources. It emphasises co-operation with other space nations and tries to ensure that Europe does not miss out on important space opportunities. Independence is also an important part of the policy as it helps Europe assert itself without having to rely on other nations for support. Galileo, the biggest technological development undertaken by Europe has been a millstone around the neck of the European Union, and the wranglings that have taken place over the course of its development will perhaps serve as a lesson on how not to manage a flagship project like this in the future. However, that said, Galileo is moving along and has now entered the all-important procurement phase. Europeans everywhere will be looking forward to its operational commencement.

The future looks both bright and exciting for Europe in space with the promise of a higher standard of meteorological data and data sharing, monitoring of climate change, future launcher development, exploration of other planets and even human space exploration. As they say – watch this space. ●