AUSTRALIAN GOVERNMENT SPACE ENGAGEMENT

Policy Framework and Overview

Australian Government

Department of Industry, Tourism and Resources

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www.industry.gov.au/space

1. Reasons for Space Engagement

The Australian Government is engaged in space related activities in support of national strategic, economic and social outcomes. This paper outlines the policy framework and summarises the Government's space related activities.

Space is important to Australians – we are sophisticated users of space for national security, communications and broadcasting, environmental and natural resource management, weather forecasting, and navigation and timing services. For example, data from Earth observation satellites and global navigation satellite systems are used by Australian farmers to manage crops and the impacts of drought, and the Bureau of Meteorology participates in the World Weather Watch Program through the operation in Melbourne of one of three World Meteorological Centres.

Space is an important domain for Australian science. Australian astronomers, for example, have made important contributions to our understanding of the universe, based on their internationally recognised excellence and the view of space from Australia's southern hemisphere location.

Space provides opportunities for Australian industry. Australian firms have made advances in a number of niche fields, including satellite operations and services, signal and data processing, space instrumentation, ground station equipment and design, space debris tracking, use of Earth observation data and Global Positioning System (GPS) applications.

Safeguarding Australia's national security is a strategic and national research priority. Space infrastructure, science, research and related technologies contribute significantly to Australia's national security – not only to military and defence objectives, but also to wider security objectives such as border surveillance, anti-terrorism and security of telecommunications.

2. Australian Government Policy Framework for Space Engagement

The Australian Government's space engagement is user- and market-driven, with a key objective being to obtain secure and economic access to the benefits of using space.

The Government and private sector secure access to the benefits of space by participating in a range of international cooperative arrangements and by purchasing products and services in the domestic and global market place. This is supported by the Government's competitive industry development and science/research funding programs.

Securing access to the benefits of space often involves international collaboration. Given the significant expense associated with many activities related to space, international collaboration provides opportunities to share the cost, effort and risks.

Australia's contribution to international cooperative arrangements is primarily in areas where it has competitive advantages. Australia has competitive advantages in the ground-segment aspects of space infrastructure. Australia's location and political stability make it a desirable location for major ground-segment infrastructure. These circumstances have led to Australia being host to major ground station facilities in support of many international endeavours in space, from astronomy, manned space programs and deep space exploration to earth observation and telecommunications.

The Australian Government encourages commercially viable and sustainable endeavours in the space sector. The reasons for Government intervention in the space sector are the same as for most other high-technology industries. These are addressed by Government industry, science and innovation programs and do not require a dedicated space program. The Australian Government does not support a centrally-funded 'space office' or space program – the Australian Space Office was discontinued in 1996.

Researchers and businesses seeking support for their space endeavours can apply to a range of Australian Government industry and science support programs, where applications will be assessed on their merits against published criteria in competition with other proposals.

In summary, Australia's policy framework for space engagement involves:

- participating in and supporting global cooperative and trading arrangements to achieve strategic, economic and social outcomes;
- contributing to those arrangements according to our competitive advantages, particularly by supporting ground-segment systems in Australia;
- providing competitive support programs and targeted initiatives to address market failures in all industries, particularly by facilitating research and development, innovation and investment; and
- managing space-related national security issues.

Australian Government Space Forum

The Government's space related activities and objectives are implemented across a range of government agencies, with the Department of Industry, Tourism and Resources (DITR) having prime responsibility for 'civil space' issues. Whole-of-Government liaison occurs through the Australian Government Space Forum, comprising representatives from Australian Government agencies with space-related responsibilities and interests. The Forum does not supplant the space policy and program development and delivery authority vested in individual government agencies. More information is at www.industry.gov.au/space

The Forum's role is to:

- exchange and coordinate the dissemination of information about Australian Government space-related space policies, programs and activities;
- identify issues that would benefit from a collaborative approach amongst Australian Government agencies;
- be an initial point of contact for domestic and international queries about Australian Government space activities; and
- be a source of expertise or referral on space-related matters upon which Government agencies can draw as required.

3. Australian Government Space Related Activities

The Government's space activities fall under four broad themes. These are:

- Ensuring access to space services;
- Supporting world-class science and research related to space, consistent with national priorities;
- Growing Australia's space industry; and
- Safeguarding Australia's national security.

Ensuring access to space services

Australians make extensive use of the services that space activity provides, such as communications and broadcasting, environmental and natural resource management, weather forecasting, navigation and timing services. Ensuring access to space-derived information and services contributes to the Government's strategic, economic and social objectives.

Australians use three primary space services:

Communications and Broadcasting
Global Navigation Satellite Systems
Earth Observation

Each of these services does not depend exclusively on space-based technology. There are competing or complementary ground-based and/or airborne services which also address these needs. The mechanisms to manage Australian Government interests in the provision of these services are therefore arranged around each service, rather than around the technology used to deliver these services. The Australian Government also has mechanisms to manage cross-cutting issues (such as 'space weather') which affect all uses of space.

Communications and Broadcasting

Satellites make an important contribution to the global communications network, providing broadcasting and telecommunications services.

Space-based communications operate substantially as a commercial activity. The Australian Government is a major user of space-based communications, and purchases a range of services from commercial operators.

The Department of Communications, Information Technology and the Arts (DCITA) is responsible for providing policy advice on the radiocommunications regulatory framework. DCITA works with the Australian Communications and Media Authority (ACMA), which manages spectrum allocation and regulates radio and telecommunications, essential to support Australia's growing space sector.

Global Navigation Satellite Systems

Satellite navigation and positioning provided by Global Navigation Satellite Systems (GNSS) are integral to a wide range of sectors in the Australian economy. Applications include: land, sea and air navigation; timing; commerce; agriculture; mining; water catchment and environmental management; tracking of vehicles; in-car navigation systems; and recreational uses.

Specific examples of Australian involvement in GNSS include:

- Geoscience Australia (GA) uses data from its GPS network to position Australia daily within the global reference system and in turn, to monitor the movement of the Australian continent (about 1.5 mm per day). GA also uses satellite laser ranging stations to measure to the GPS satellites themselves as quality control on their orbits.

- The Bureau of Meteorology (BoM) has a network of 50 upper air stations that provide a range of data, including atmospheric upper-wind profiles. These wind data, important in weather forecasting, are calculated by tracking an ascending weather balloon as it moves with the wind currents. Sixteen of the stations use GPS technology to track the balloons.

Earth Observation

Data from Earth observation have many uses, including meteorological, scientific, environmental management, agricultural, geospatial, emergency management, national security and commercial.

Geoscience Australia operates Australia's principal Earth resource satellite ground station and data processing facility. The agency’s goal is to maintain and periodically refresh a comprehensive archive of Earth observation data to help ensure that fundamental geographic information is available for the benefit of the Australian community.

In 2005, the Australian Government signed a five-year Memorandum of Understanding with the Japanese Aerospace Exploration Agency, granting Geoscience Australia the rights to acquire and distribute data from the Japanese Advanced Land Observing Satellite (ALOS) in Australia, New Zealand, Papua New Guinea and the South Pacific Islands. In 2006, Geoscience Australia became the first of only three receiving stations outside of Japan to acquire and process ALOS data. ALOS will provide an alternative source of data and a level of back-up should the Landsat 5 satellite fail. Currently, a number of government and community agencies in Australia rely on Landsat satellite data to deliver their program objectives.

The Bureau of Meteorology (BoM) operates satellite ground stations to receive meteorological and environmental satellite data and to help position satellites, as part of the World Meteorological Organization’s World Weather Watch system through which data are exchanged globally, free of charge. BoM uses satellite and related data and systems in performing the functions of a National Meteorological Service.

BoM assists the national meteorological services of Asia-Pacific countries, especially developing economies, and has been involved in exporting and installing satellite ground stations in the Philippines, Fiji and Bangladesh. BoM has also co-sponsored, with Japan, China and the World Meteorological Organization, education and training programs in satellite meteorology for less technologically advanced countries. In collaboration with Japan, BoM has made available Computer Aided Learning systems and helped Asia-Pacific countries to use satellite data for environmental and weather monitoring.

Space Weather

Australia is dependent on space technology for many of its services, its information and security. Space 'weather' conditions can affect radiocommunications, navigation, power supply and geophysical exploration, and through these, can affect public safety, information services, defence, industrial processes and transport.

IPS Radio and Space Services acts as the Australian Space Weather Agency, providing the Australian national radio propagation and space weather services. Its space related responsibilities include:

- providing space weather services to customers in government and private sectors;
- monitoring the space environment;
- providing policy advice relating to the influence of the space environment on technology;
- archiving space environment data for the purpose of research and services;
- training in the mitigation of space weather effects on systems; and
- providing support for international and domestic research into the space environment.

Access through International Collaboration

The Australian Government's international collaboration includes exchanging space data with other nations (e.g. for meteorology); hosting or participating in ground station networks (e.g. Canberra Deep Space Communications Complex); negotiating bilateral cooperative arrangements, often involving the provision or sharing of ground facilities (e.g. with the US National Aeronautics and Space Administration (NASA), European Space Agency (ESA) and the international astronomy community); engaging in multilateral forums (e.g. United Nations Committee on Peaceful Uses of Outer Space); and observing international arrangements (e.g. United Nations Space Conventions, Missile Technology Control Regime).

Australians Using Space

Australia makes widespread use of space technologies, ranging from precision farming to gathering training data on athletes. Following are some examples illustrating the diversity of these uses.

Earth Observation

Precision images projected from satellites allow us to predict changes in crop yields, measure sea surface temperatures and track bushfires.

An Australian based company has successfully commercialised a government consortium-developed technology called 'Pastures from Space' which allows farmers to download and analyse their pasture growth rates from satellite-derived data.

The CSIRO, in collaboration with the National Oceans Office, have utilised new satellite imagery to track changes in sea surface temperatures in Australia's oceans. The research will assist marine scientists and the fishing industry in understanding ocean variability for the sustainable planning and management of marine industries and the impact of climate change.

The Sentinel fire mapping system obtains data from the NASA Earth observation satellite 'Terra'. It is an internet-based mapping tool that provides timely fire location data to emergency service managers across Australia.

Global Navigation Satellite Systems

The GPS Global Navigation Satellite System is used extensively in Australia for positioning and navigation.

An Australian company specialising in GPS technologies for sport has developed a device which uses satellites to transmit athletes' training data. The system can record and store athletes' times, distances, speed, altitude, direction and heart rate.

The Birds of Australia Atlas Project used GPS to locate and record the presence of different bird species. As a result, 4000 distribution maps were produced for more than 650 bird species.

CSIRO Marine Research, in conjunction with the Aquarium of Western Australia, used satellite tracking to monitor white shark movements, with tags on the sharks transmitting population and behavioural information to researchers.

Satellite Communications

The Australian community benefits from the use of satellite telecommunications technologies.

An interactive e-learning initiative in New South Wales and the Northern Territory uses satellite technology to streamline distance education for remote areas of Australia. The initiative, funded through the Australian Government's National Communications Fund and supported with in-kind and financial contributions from the project's partners, enables students to participate in group discussions, share course materials online, enjoy high-speed internet and email chat facilities and an interactive electronic whiteboard.

Following the Bali bombings in 2002, an Australian satellite service provider installed a satellite communications system for the Australian Federal Police (AFP). The company supplied and installed a 2.4m satellite ground station, including a transceiver and satellite modem, to provide high speed communication from the Intelsat ground station at Oxford Falls, New South Wales, back to AFP headquarters in Canberra.

Supporting world-class science and research related to space, consistent with national priorities

Australia has a strong science and research base in niche areas related to space, with an international reputation in the application of Earth observation data, astronomy, geodesy and geomagnetic observation, and near space science (including ionospheric observation and prediction). An analysis of Australian research papers and citations over the period 2001 – 2005, published by the Thomson Corporation in May 2006, has found that Australia excels in space science and geoscience. Papers by Australian authors are cited well above international average rates. Australian space science (including astronomy) is cited 38 per cent more than the global average.

Given the significant costs associated with many research activities related to space, international collaboration can provide opportunities to share the effort and risks and achieve critical mass required for large-scale projects. Australia values such collaboration where it can contribute to achieving national objectives, but weighs up the costs, benefits and risks before taking decisions to enter into international partnerships. The risks can include program slippage, cost escalation and unilateral decisions by international parties that may not be in the interests of all partners.

Advanced Along Track Scanning Radiometer – AATSR

The Advanced Along Track Scanning Radiometer (AATSR) is an imaging radiometer primarily designed to measure global sea surface temperature to the high levels of accuracy and stability required for climate research and modelling. The prime scientific objective of AATSR is to contribute to climate research. AATSR is also engaged in remote-sensing of land surfaces, particularly vegetation and also produces high quality visible and thermal images.

AATSR was launched in March 2002 aboard the European Earth observation satellite ENVISAT. The $40 million AATSR is the product of collaboration by Australian and UK scientists. With a $13m investment by the Australian Government, it represented a major Australian contribution to developing an international scientific instrument.

Over several decades, Australia has played a prominent role in space-related science and exploration through international collaboration and cooperation. Examples include contribution of space tracking facilities to support NASA and European Space Agency (ESA) space exploration programs.

In astronomy, Australians regularly make significant discoveries, particularly in collaboration with international colleagues. For example, the CSIRO's Australia Telescope National Facility (ATNF) and NASA's Chandra X-ray Observatory observed a 'mini-black hole' in the Milky Way Galaxy (*Science*, 4 October 2002). And in January 2005, the ATNF radio telescopes and those of the University of Tasmania, along with 12 other telescopes in the USA, China and Japan, were used to track the European Space Agency (ESA) Huygens probe as it descended on to the surface of Saturn's moon, Titan. The data collected by the ATNF and other international telescopes was then transmitted to the Netherlands for central processing.

Research and development, and operational activities in space science and remote sensing, are also undertaken by the Bureau of Meteorology, which exemplifies Australian contributions to the international application of space for peaceful purposes. These include diverse uses such as satellite monitoring of the genesis, movement and decay of weather systems like tropical cyclones, monitoring ocean temperatures or volcanic ash clouds, and assimilating satellite observations of winds, temperature and moisture into supercomputer weather prediction models.

Science and research related to space are important elements of Australia's wider scientific and research effort. Although space is not a specific research priority for Australia, space-related research can contribute to the four National Research Priorities announced by the Prime Minister in December 2002.

The Australian Government's National Research Priorities are:

- an environmentally sustainable Australia;
- promoting and maintaining good health;
- frontier technologies for building and transforming Australian industries; and
- safeguarding Australia.

Australia's excellence in areas of space-related science and research is underpinned by its overall strong science, research and innovation capacity, and strong international engagement on science, education and training. The Australian Government's objectives for investing in science and research include:

- enhancing innovation performance through a strengthened science and technology base;
- strengthening and diversifying national and international linkages and collaboration;
- strengthening the ability of the higher education sector to generate and use new knowledge;
- raising the quality of Australia's international engagement in education, research and training; and
- enhancing research and development in key national priority areas.

Current Status and Activities

Funding for fundamental and applied science and research is available through a range of Australian Government programs, usually on a competitive basis.

The Australian Research Council's (ARC) National Competitive Grants Program funds university research and collaborative research partnerships. The *Discovery* element of the program funds individual researchers and projects. The *Linkage* element helps to broker partnerships between researchers and industry, government and community organisations as well as the international community. The ARC *Centres* element builds research scale and focus and strengthens major research partnerships and networks. An example of excellent space-related research supported by ARC funding is the HyShot scramjet project based at the University of Queensland.

The Australian Government also contributes to space science research through funding the Cooperative Research Centres (CRC) Program. For example, space plays a central role in the CRC for Spatial Information. Through the CRC Program and an AusIndustry innovation program, the Australian Government also contributed about $22m over the seven year operational period of the CRC for Satellite Systems (CRCSS), which was established in 1998 and concluded in 2005. The CRCSS constructed the Australian satellite FedSat, which was intended to establish and demonstrate Australian capability in micro-satellite technologies. FedSat was launched successfully in December 2002. In January 2006, Fedsat's operation was transferred to the Department of Defence, one of the original CRCSS stakeholders, which will use FedSat for a range of scientific research and experimental activities, as well as to train its staff in the control of satellites.

Australia invests millions of dollars each year in astronomy. Since 2002, the Australian Government has awarded more than $50 million to research projects in the astronomical sciences under the National Competitive Grants Program. In addition to astronomy conducted by Australian universities, significant research, development and operations in space-related fields are conducted in CSIRO, including:

- ground-based radio astronomy through the Australia Telescope National Facility (ATNF);
- spacecraft tracking operations both through ATNF and on behalf of NASA at the Canberra Deep Space Communication Complex;
- support for scientific ballooning activities;
- Earth observation applications and data reception, through the Earth Observation Centre and other units of CSIRO; and

- satellite antenna and systems development.

The Australian Government also contributes to the operations of the Anglo-Australian Observatory, ATNF, Canberra Deep Space Communication Complex and, through the Major National Research Facilities Program, to Australia's participation in the development of the international Gemini Telescope and Square Kilometre Array projects.

The International Science and Technology component of the Innovation Access Program (IAP-IS&T) provides support for travel and workshops associated with international collaborative projects. Such programs are not specific to space-based projects, and funding applications are assessed competitively against program criteria. In 2006, an IAP-IS&T Round 10 grant of more than $280,000 was awarded to the University of Melbourne to develop a low frequency demonstrator telescope in conjunction with US partners, for the next generation radio astronomy telescope, the Square Kilometre Array.

HyShot/HyCause Scramjet Project

Scramjets are air-breathing supersonic combustion ramjet engines which may find use in high-speed aerospace applications and space launch systems. Scramjets have the added benefit of not having to carry most of their propellant, since they use oxygen from the atmosphere.

The Australian Research Council has contributed $3.4m for the Hyshot scramjet project. The Department of Industry, Tourism and Resources provided $80,000 under the APEC Market Integration and Industrial Collaboration Program and $17,400 under the Innovation Access Program towards the HyShot project.

The Hyshot project is an international collaboration involving researchers from Australia (University of Queensland Centre for Hypersonics), the United States, Britain, France, Germany, Korea and Japan. The first successful HyShot test launch took place in July 2002 from Woomera, South Australia. The test launch was a world first for the collection of supersonic combustion data from a scramjet under flight conditions. The launch was designed to take the scramjet engine to a speed of Mach 7.6 (or more than seven times the speed of sound) for the successful experiment, which took place in the last few seconds of the 10 minute flight.

In 2003, a Memorandum of Understanding established the Australian Hypersonics Initiative (AHI), a partnership formalising the cooperative relationship between Australian organisations which participate in hypersonics research and development. The AHI partner organisations are: the University of Queensland; the Australian National University; the University of NSW at the Australian Defence Force Academy; and the Defence Science and Technology Organisation (DSTO), along with the State Governments of South Australia and Queensland.

This collaboration has led to the AUD$4.6 million (US$3.4 million) Hypersonic Collaborative Australian/US Experiment (HyCause) agreement between the US Defense Advanced Research Projects Agency (DARPA) and AHI. Two more scramjet test flights were conducted at Woomera under the HyCause program in March 2006.

In November 2006, the DSTO and the United States Air Force established an eight-year, US$54 million Hypersonic International Flight Research Experimentation (HIFiRE) project to further advance research into hypersonic flight. The HIFiRE project, which will also involve other AHI partners, will see up to ten hypersonic flight experiments conducted at Woomera over the next five years.

Growing Australia's Space Industry

The Australian Government's industry policy and related programs are built around the four key drivers of economic growth:

- Innovation
- Investment
- International competitiveness
- Global integration.

The Government provides support programs addressing market failures and impediments to these drivers of growth, which apply to industries including the space industry. The Government also undertakes specific interventions in support of the space sector (e.g. project-specific investment incentives, establishing legislative regimes, negotiating treaties). Around the world, government procurement, including defence procurement, is an important market driver for building space industry capability and competitiveness.

Australian Space Industry

The Australian space industry consists of mostly small-to-medium enterprises, operating in niche fields, as well as a few larger companies. Even with Australia's competitive advantages (including a stable political environment, well-educated and skilled workforce, a large southern hemisphere landmass, and niche space capabilities and technological expertise) it remains a mid-level player in the global space market. The high costs and risks of participating in space suggest that Australia's positioning as a global player is unlikely to change significantly in the future.

The Australian space industry has strengths in niche areas, including:

- satellite operations and services;
- signal and data processing;
- space instrumentation;
- ground station equipment and design;
- space debris tracking;
- use of Earth observation data;
- GPS applications;
- some propulsion technologies; and
- astronomy spin-offs e.g. ground antennae, detection equipment.

Industry is supported by a well-developed services sector, providing legal, financial, insurance and other business services. Australia has the potential to build on its niche strengths and target global supply chains where commercially sustainable demand exists or is emerging.

Australia's space infrastructure does not currently include launch vehicle manufacturing capability, operational orbital launch facilities, or any large-scale satellite manufacturing capability.

Launch Sector

The Australian Government has undertaken targeted interventions to facilitate commercially sustainable space launch proposals. Several proposals have been put forward over a number of years to use Australia as base for commercial space launches and for Australian firms to provide internationally competitive launch services. The role of the Australian Government has involved negotiating treaty level and other inter-governmental arrangements, often to facilitate deployment of sensitive dual-use launch technologies for peaceful purposes.

There are currently two proposals to develop commercial launch facilities in Australia – by Rocketplane Kistler and the Asia Pacific Space Centre (APSC). In 1998, the Australian Government entered into an Operations Agreement with Kistler to provide a licensing framework for a project to operate a reusable launch vehicle from Woomera in South Australia.

Legislative Regime

The Australian Government has introduced the *Space Activities Act 1998* and related *Space Activities Regulations 2001*. These provide a comprehensive space safety regulatory regime providing for civil space launches and returns and related industry development. The Government established the Space Licensing and Safety Office to regulate space activities under the Act. The Act and Regulations are administered by the Department of Industry, Tourism and Resources, which is responsible for civil space matters.

Industry Innovation Programs

The Australian Government supports the space industry on its merits through the generally available competitive programs. There is no dedicated space industry support program because space industry development issues are similar to those faced by other high-technology areas (e.g. aerospace, electronics, advanced manufacturing, systems and software engineering, defence industries) and are addressed by the available generic programs.

A number of competitive programs administered by AusIndustry within the Department of Industry, Tourism and Resources are available to the space industry. The programs generally address market failures in R&D, commercialisation and investment and include:

- Commercialising Emerging Technologies Program (COMET)
- Innovation Investment Fund (IIF)
- Pooled Development Funds
- Venture Capital Limited Partnerships
- Commercial Ready Program

See www.ausindustry.gov.au for more information on AusIndustry products.

Access by the Space Industry to
Australian Government Industry Innovation Programs

Space industry firms have received support under a range of industry innovation programs administered by the Department of Industry, Tourism and Resources. Since 1996, more than **$30 million** has been provided to space-related projects, including satellite systems and communications, satellite imaging, GPS applications, space debris tracking and international collaboration. The projects demonstrate Australia's position as a sophisticated user of space. They highlight our ability to contribute to space in a way that builds on our strengths in the areas of ground support infrastructure, communications and data analysis and down-stream exploitation. Examples include:

DSpace Pty Ltd

DSpace is an Adelaide-based company specialising in data communications and is an acknowledged authority in signal processing for satellite communications. DSpace has created and assembled enabling technologies which collectively make the fully mobile, high-end consumer market in high-speed satellite data communications a reality.

Since 2000, DSpace has received the following support from the Australian Government:

2006 - $1.65 million **Commercial Ready** grant for commercialisation of mobile satellite modems;
2004 - $1.2 million via **R&D Start**;
2002 - $5 million **Innovation Investment Fund** capital (combined private & Government)**;**
2001 - $100,000 for advanced satellite modems via **Comet**; and
2000 - $1.1 million for satellite based mobile internet access, via **R&D Start.**

Further information on DSpace can be found at: www.dspace.com.au

Electro Optic Systems (EOS) Pty Ltd

EOS develops and produces products incorporating advanced electro-optic technologies for the aerospace market, focusing on space surveillance and control. EOS specialises in space information based on the use of EOS-developed instruments and sensors to detect, track, classify and characterise objects such as satellites and debris in space.

EOS operates a space debris tracking system at its Mt Stromlo Space Research Centre in the ACT. In 2004, EOS also provided Geoscience Australia with a Satellite Laser Ranging facility at Mt Stromlo, under a long-term contract for the provision of laser tracking data by EOS to Geoscience Australia.

To support its space business, EOS also develops and produces a wide range of space-related infrastructure in the form of sub-systems, such as telescopes and beam directors. EOS is widely known as the largest producer of major optical telescopes in the world.

EOS has received the following support from the Australian Government:

2004 $8.4 million via **R&D Start** for laser de-orbiting of space debris;
2001 $2.8 million via **R&D Start** for laser tracking of space debris.

Further information on EOS can be found at: www.eos-aus.com

The Australian Government has introduced a concessional item in the *Customs Tariff Act 1995* (Item 69 space concession) which enables the duty free entry to Australia of certain space-related goods for use in authorised space projects.

Emerging Issues and Opportunities

Demand is growing for satellite communication and broadcasting services such as direct to home TV subscription, remote and rural communications and broadband. Commercial investment in new satellites is substantially dependent on demand for satellite based services, and satellite operators must compete with terrestrial delivery of these services.

As an advanced nation, with large land and associated marine areas, possessing important natural resource industries and with an educated population, Australia is well positioned to contribute to innovative applications of space data and techniques to a wide variety of problems of practical interest (e.g. agricultural and environmental management). Future opportunities for Australian companies are likely to come from building on existing niche capabilities and targeting involvement in global supply chains.

Using space services and participating in global supply chains requires a competitive capability to support access to, and manipulation and use of, space-derived data. Such activities need skilled workers and engineers, scientific and research expertise, a sound business environment, support for investment in R&D and innovation, effective capital markets and so on. This offers R&D and commercial opportunities in a number of fields, such as signal detection and processing, software engineering, high performance computing, satellite operations and services, space instrumentation, ground station equipment and design, debris tracking, use of Earth observation data and global positioning applications. Australia has capability in these areas.

Safeguarding Australia's National Security

In 2002, the Government announced *National Security, Defence and Counter-Terrorism* as a Government Strategic Priority, and *Safeguarding Australia* as a National Research Priority. See www.defence.gov.au/whitepaper/ and www.dest.gov.au/priorities for further details of these priorities. More information on Australian national security issues is at www.nationalsecurity.gov.au

Space infrastructure, science, research and technologies contribute significantly to achieving Australia's national security objectives. For instance, space is important to the Australian Defence Force for providing data on meteorology, positioning, intelligence, timing, mapping and communications. Data are obtained for these purposes from a range of allied, commercial and defence resources under various arrangements. On 20 June 2006, the Minister for Defence, the Hon Dr Brendan Nelson MP, announced greater funding for the Australian Defence Force's military satellite communications capability. As part of the Defence Capability Plan 2006 – 2016, more than $1 billion is to be invested in next generation satellite and ground station infrastructure to ensure continuity of service and flexibility through digital content.

National security concerns include the proliferation of launch vehicle technology. There is also increasing competition for the finite bandwidth resources necessary for data to be transmitted to and from space.

The Australian Government has initiatives in place to safeguard Australia's access to space-sourced data. Examples are:

- The Australian Communications and Media Authority (ACMA) has responsibility to take action when licensed space-related frequencies experience interference. For example, in 2004 the ACMA amended the *Radiocommunications Act 1992* to prohibit devices that can be used to jam signals of GPS and other radio-navigation satellite services.
- Data are routinely collected to assist in discriminating between the effects of natural phenomena and intentional interference.
- Research is sponsored for data management, component design and other innovations designed to protect data and optimise the likelihood of successful transmissions.
- A communications payload owned by the Department of Defence on-board the Optus C1 satellite permits military access to space communications in support of operations and other security-related requirements within Australia's geographic region.

The Australian Government will maintain a focus on acquiring appropriate protective capabilities in conjunction with broader investment priorities. The Government will also maintain its awareness of existing and emerging strategic, technological and related developments that might impact on its access to space-sourced data.

The Australian Government's capacity to meet its space security challenges will depend in part upon the availability of high quality research and development, supported by an innovative Australian space industry. There will continue to be a strong and mutually supportive relationship between Australian Government agencies involved in space and the relevant components of academia and industry. These arrangements, along with established international alliances, with the United States in particular, will support Australia's future national security in the space arena.

Space Industry Contribution to National Security

Auspace Ltd is an Australian engineering company serving the scientific, commercial and defence communities in space engineering, communications, and associated technologies and systems. The company has made significant world-leading achievements and has project experience in the fields of aerospace, science, commercial and defence in space, airborne and ground-based systems.

Auspace successfully completed a Capability Technology Demonstrator (CTD) project in 2004, co-funded by the Department of Defence to the value of $2.5 million, and by Auspace to the value of $2.0 million. This CTD outcome supported Defence's strategic requirement for self-reliance in certain national capabilities and specifically in the area of advanced satellite modem technology.

Work is now underway toward a production version of the software-defined satellite modem known as the Defence Multi Mode Modem (DM3), and a pre-production model will be available for demonstration in mid-2007. The modem supports backward compatibility with legacy waveforms, interoperability with coalition waveforms, an efficient secure IP-based waveform, a waveform supporting assured delivery, and a waveform to support satellite coordination planning. These waveforms, together with the design capability and programmable nature of the modem, offer the Department of Defence both a significant and an evolving capability. The DM3 modem is world competitive in the area of satellite modem technology and offers both an in-country design authority and a future proofed capability. The DM3 was entirely developed within Australia by Australians.

Auspace is a recognised authority in satellite communications, signal processing, earth observation and space system technologies and enjoys export sales of its advanced waveform implementation services.

More information on Auspace can be found at: www.auspace.com.au