

## A Review of the International Space Landscape: Executive Summary

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## Executive Summary

This report '*A Review of the International Space Landscape*' has been prepared by Symbios Communications Pty Ltd under contract to the Space Policy Unit (SPU) of the Department of Innovation, Industry, Science and Research (DIISR). The Review has considered the overall structure of the international space sector, as well as activities in each of the key domains of interest to Australia: Earth observation; satellite communications; satellite navigation; space science and astronomy. The main objectives of the Review are: to help the SPU develop a complete and pragmatic understanding of the international space landscape as the context for national policy formulation and implementation; to assist SPU form a view as to which of the many international space fora and agencies should be considered national priorities; and to identify opportunities and threats to Australia's participation in space activities given the international context.

The Review has been formulated as a compilation of expert opinion of the study consortium members. No broad consultation exercise of domestic space actors has been undertaken (this being undertaken within the other studies contracted by DIISR). The emphasis in effort allocated to consultation has been on international experts and counterparts in key space agencies in Japan, Europe and the USA.

*Overview of the International Space Landscape* provides a comprehensive breakdown of the governmental and commercial activities which combine to create the space economy, valued at \$US250Bn as of 2008. It discusses the dominance of the US in both governmental and commercial space and recent policy changes in the US space planning. The influence of emerging space programmes is noted, with more and more countries, both large and small, developing national space programmes. Economic arguments will be a central part of the selling of the need and costs of a national space programme in Australia.

*Australian Space Landscape* explains the roles and responsibilities of the various institutions, including CSIRO (Commonwealth Scientific and Industrial Research Organisation), the Cooperative Research Centres, federal government agencies, and various associations.

*Earth observation (EO)* - the number one satellite-based application worldwide in terms of governments spending (\$US6.7Bn in 2008 - about 20% of government non-classified investment in space). Lower cost satellites and ability to address local issues has made EO the top priority application for a number of countries, particularly emerging space programmes. Growth in EO budgets is also being driven by society's increasing need for information on our planet, the essential foundation for sustainable development policies that are aimed at ensuring our continued health and prosperity in the face of human-made climate change, population growth and degradation of our natural environment.

A significant weakness of the Australian EO sector is that million-dollar Australian government programmes and executing agencies are completely dependent on the health and continuity of the foreign-owned and operated space assets, which provide

the necessary imaging, positioning and data relay services, as well as the vagaries of internal data-policies, and budgetary cycles of operation countries. This data flow is essential for Australia and we access these data by the good graces of our bilateral agreements or through commercial arrangements. We have no independent autonomy in this regard and are therefore highly exposed and potentially vulnerable to changing international arrangements.

*Satellite Communications* – noted to be by far the largest commercial space endeavour and worth \$US80Bn in revenues annually. Australia has a long, proud history in satellite communications and is recognised as one of the most sophisticated operators and users of satellite communications in the Asia-Pacific region and the world. There are currently 14 satellite operators that provide satellite services to, from and within Australia. The Australian government has indicated that one or two satellites will be built as part of the National Broadband Network that will make Australia one of the first areas in the world with 3<sup>rd</sup> generation satellite technology. Australia has a wide range of satellite uplink/downlink facilities around the country. Several teleports exist which have multiple earth stations providing uplink/downlink to multiple satellites and also provide interconnection of satellite traffic into international and domestic fibre optic cable systems.

*Satellite Navigation* –positioning, navigation and timing signals from satellites have become critical in support of Australia’s society and public and commercial systems. Australia should explore the opportunities and benefits from a ‘whole Australia’ approach to planning the exploitation of the space infrastructure investment of other nations.

*Space Science and Astronomy* – Despite the lack of a space programme, Australia makes significant contributions to international space science, primarily via academic collaborations and generally not under official government agreements. The excellence of Australian space scientists has been recognised overseas and is demonstrated by invitations to join international collaborations and space projects.

*Features And Trends of Interest to Australia*, that should be monitored, considered or includes:

- where the US leads with manned spaceflight, major partnerships and investment tend to follow;
- the need for engagement with society for public support and funding;
- the dual-use trend (defence and civil);
- the balance between secured independence and reliance on the necessary space hardware and software being available either on the market or through international cooperation;
- national reporting commitments under international treaties and the role for space;
- the move to operations;
- lower entry costs and increasing number of players;
- space situational awareness.

The “conclusions and recommendations” related to institutional and policy issues identified are presented in a much-abbreviated form:

1. The international space sector is growing rapidly with increases in both governmental and commercial budgets, and more and more countries making active contributions through national space agencies and space programmes (of order 55 at last count).
2. The typical course for a young national space endeavour after establishment of a responsible government unit, would be for the unit to develop a national policy statement, followed by a strategy for its realisation, and an implementation plan (over say 5-10 years).
3. Of the four sectors studied, two already have in place recent 'national' planning documents - for Space Science and for Earth observations. The Australian government might consider whether a similar plan on GNSS (global navigation satellite systems) might provide a 3rd pillar as the basis for the strategy and implementation plan.
4. The SPU (or whatever unit or agency follows the government's consideration of the space review - referred to below as the SPU) should contain specialist departments (and therefore of course specialist staff - ideally well connected internationally) responsible for EO, satellite communications, satellite navigation and space science.
5. The SPU needs a clear and high-level (Cabinet) mandate, even if the amount of independent budget is small. An early agreement with the Dept of Defence, which opens the door for real dual-purpose activities, is essential for Australia's space future, and this also needs to be recognised at Cabinet level.
6. Precise arrangements are the business of government, but there may well be a need for some sort of inter-departmental Space Council - whose terms of reference would need high level blessing - with the job of linking, coordinating and leveraging budgets and requirements in support of the national space activity.
7. Firm institutional foundations and a national strategy (as above) are the first steps before a more aggressive international cooperation activity can be pursued. Cooperation with more advanced space players is an obvious way to accelerate Australian capabilities and to develop capacity and the industrial base.
8. The most obvious partners for Australia's space ambitions remain Europe and the USA. ESA in particular has an outstanding heritage in international cooperation, particularly in education and capacity building and has indicated a willingness to support Australia in this way.
9. 2010 is a year of significant flux in governmental spending in different space sectors, with the US restricting future manned space to low Earth orbit and moving significant funding into Earth observation and Earth science.
10. Australia's regional space-related development programmes and leadership should be enhanced.

11. Although Australia is unlikely to be significantly involved in the expensive manned space or space tourism programmes of the superpowers, it makes sense to track these programmes and to be vigilant for any possible benefit to Australia.
12. The prospect of the weaponisation of space, and the spectre of increasing space junk means that development of space situational awareness capabilities is very much in vogue at present world-wide. Australia should stay closely connected to these activities and monitor developments through the relevant COPUOUS meetings.

International players note that Australia, other than in the applications domain, has no industrial space development capabilities of note. Indeed, whatever capabilities were present in the past have declined in recent years – and this is seen as an obstacle to equitable international partnerships in the space domain with Australia. Further, international players have noted that only through sustained government action over decades will a critical mass and stable industrial capability be achieved.

The abbreviated conclusions and recommendations related to Earth observation are:

1. Earth observation is the dominant budget worldwide for government space spending and should be the number one priority for the Australian government, in particular given the geography and resource issues and challenges that define Australia.
2. Australia should seek to lead regional initiatives and ultimately to contribute more to the global Earth science and climate endeavour by inputting satellite Earth observations into the process. Australian intentions are greater than Australian achievements and the country has limited influence today because of the lack of contribution to the space segment.
3. By virtue of sheer space capability, the key partners will continue to be NASA (National Aeronautics and Space Administration), ESA (European Space Agency) and USGS (US Geological Survey) – assuming relations with the Japanese, Chinese, Indian and Korean space agencies are also enhanced to provide data contingency and opportunities for strategic regional leadership. Australia should consider a strategic agreement with ESA for access to and exploitation of the Sentinel series and the associated GMES (Global Monitoring for Environment and Security) services, similar to the current arrangements in place already with US agencies, but it would be unwise to start down this path until there is a properly mandated space unit in Australia.
4. The relationship and increased participation in CEOS (Committee on Earth Observation Satellites) and GEO (Group on Earth Observations) are key to Australia's engagement in the EO community, and to demonstrating a commitment to contributing to the global effort.
5. Australia should develop and launch its own Earth observing satellite in support of key policy objectives. This should be described as a contribution to the GEOSS (Global Earth Observation System of Systems) and to the CEOS Constellations. A lower-entry cost option here would be for Australia to join one of the current or

proposed multi-national satellite constellation programmes (such as the CEOS Precipitation Constellation).

6. We see little benefit from Australian investment in any of the UN-driven Earth observation activities (other than WMO - World Meteorological Organization), from the high level (COPUOS) to the application level (UN SPIDER - United Nations Platform for Space-based Information for Disaster Management and Emergency Response). In every case, we propose that the equivalent groups involving space agencies directly (CEOS, GEO, Disaster Charter and Sentinel Asia) are more productive and outcome-focused.
7. Earth observation data streams will serve a diverse range of stakeholders in government. The influence and budgets of these stakeholders (eg Geoscience Australia, CSIRO, Bureau of Meteorology, Department of Climate Change and Energy Efficiency, Defence) need to be factored into the formulation of national institutional arrangements such that the full scale and importance of the endeavour is recognised and their requirements understood.

The abbreviated conclusions and recommendations related to satellite communications are:

1. Preserve Satellite Spectrum - the government should take an active role domestically and internationally in ensuring that satellite communications spectrum is preserved.
2. Maximise Australian participation in upcoming government Satcom projects - including the satellite component of the National Broadband Network and the Defence Wideband Global Satcom project.
3. Leverage existing international relationships into broader areas for Australian industry and research institutions.
4. Selectively explore relationships with other international space agencies that build on Australian strengths or provide useful partnerships.
5. Encourage and support Australian R&D in key areas of satellite communications.

The abbreviated conclusions and recommendations related to satellite navigation are:

1. Australian Government policy on space science and industry development should include an explicit national policy on satellite based positioning and navigation (GNSS) based on strengthening, broadening and coordination of existing GNSS activities and strategic commitment to full Australian participation in ground and user segments of GNSS.
2. There is an opportunity to develop a whole of nation solution to precise positioning solutions based on a proposed \$A300Mn ground segment infrastructure investment that could yield a \$A32Bn benefit over the next 20 years. The main operational GNSS agencies and ground station consortia should jointly establish a coordinated approach to strengthening and optimising the national investment in the GNSS data acquisition, processing, archival, distribution and applications

infrastructure that will be needed to handle the massive increase in GNSS availability and user needs over the next decade.

3. Ground segment: Reconciling the Australian Defence Department security concerns, if any, around multi constellation GNSS tracking facilities will be a critical aspect of Australia Space Policy for GNSS. Multi constellation tracking facilities, together with interoperability R&D initiatives would contribute to Australia's international role. International collaboration around the objective of establishing multi-constellation tracking facilities should become a key strategy that focuses on Australia's unique geographic position and its role as a middle power.
4. Space segment: A regional satellite-based augmentation system (SBAS) is worth considering to leverage the planned CORS (Continuously Operating Reference Stations) network for its ground stations and establish satellite communication links to deliver DGPS (Differential Global Positioning System) or even RTK (Real Time Kinematic) corrections to users in aviation and other sectors. Marine beacon sites also have the potential, with suitable upgrades, to be linked into a national CORS network.
  - There has been no real policy support for an SBAS capability or to encourage Australian companies, international companies or their subsidiaries to develop space infrastructure, and leadership is needed for successful collaboration between public and private stakeholders of existing and future infrastructure.
5. User segment: ensuring interoperability becomes the key strategic initiative for Australia's GNSS involvement. Australia's policy makers can continue to foster these successes by focusing on skills development, local take up of GNSS applications, multi constellation tracking capabilities, GNSS augmentation solutions, R&D investment support for local based companies and encouraging international co-operation with the sovereign states responsible for the 6 main GNSS constellations.
6. Australia should strengthen its role and influence in international GNSS through greater development of bilateral and multilateral (including regional) partnerships in GNSS provision, and greater involvement in the International Committee on GNSS (ICG).

The abbreviated conclusions and recommendations related to space science are:

1. Space science priority setting under a national space policy framework: Develop the national space policy objectives with the space science priorities and action plan with the active involvement of the national space science provider agencies, the learned academies and the academic institutions to advise on national priorities for space science, research, education, and applications across all sectors and all levels of government.
2. National space science infrastructure: The main operational space science research agencies should jointly establish a coordinated approach to strengthening and

optimising the national investment in the space science facilities, international collaboration and infrastructure.

3. Space Science Mission Agencies: The space science operational and research mandates of the Australian Antarctic Division, the Bureau of Meteorology, CSIRO and the Ionospheric Prediction Service should be reaffirmed and strengthened, and they should collaborate with the Department of Defence, Geoscience Australia and other Commonwealth and State space science agencies and universities in the progressive development of a more integrated national space science research framework for Australia.
4. Space Science Research and Education: A national plan and funding framework should be developed to build and maintain a critical mass of strategic research and education expertise in universities, key agencies and ultimately industry.
5. Strengthen international collaboration: Utilise our existing international relationships and enter into formal intergovernmental agreements, through development of bilateral and multilateral (including regional) partnerships in Space Science.