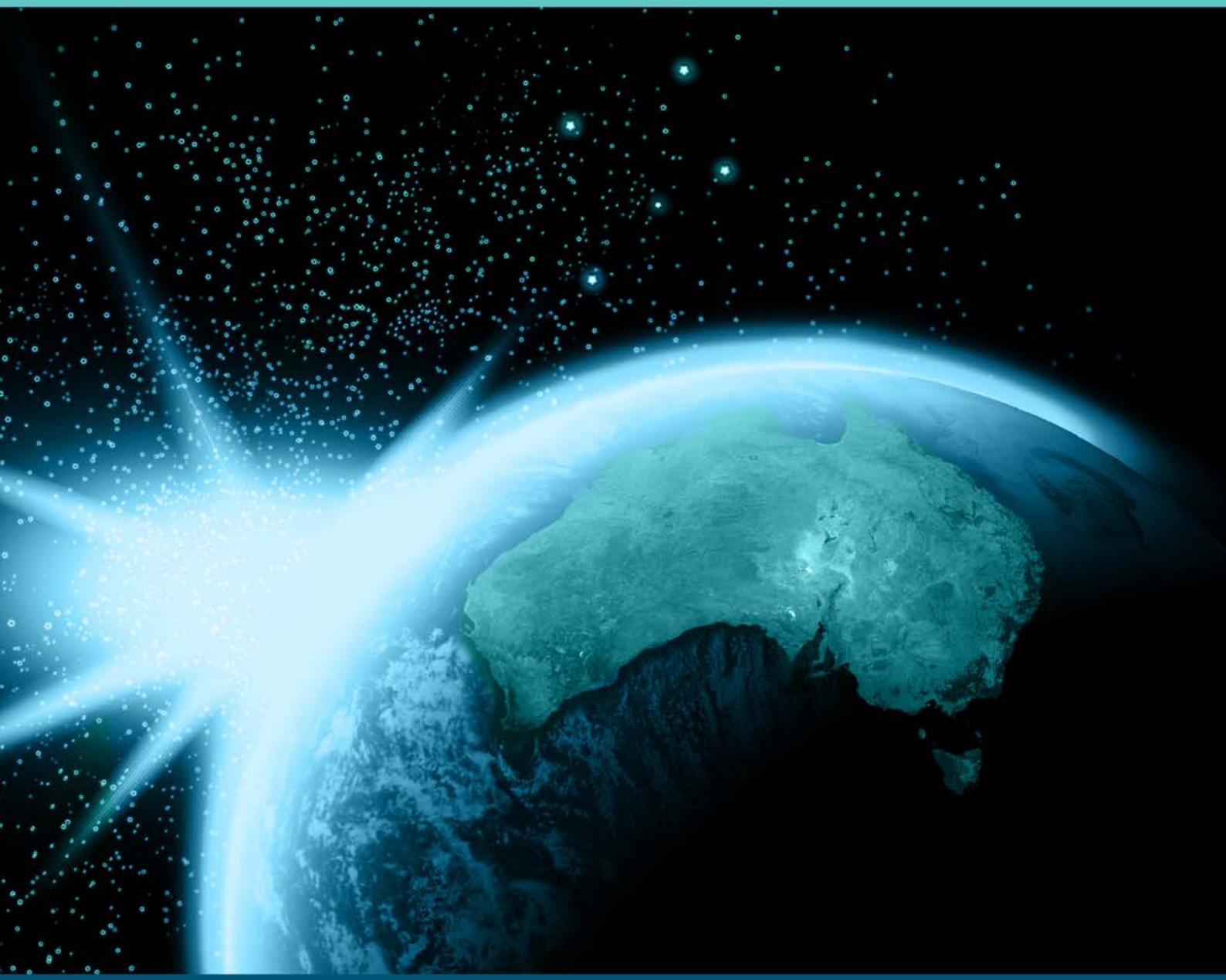
Australian Government
Department of Industry



STATE OF SPACE REPORT

Australian Government Space Coordination Committee

2014

SPACE.GOV.AU

Table of Contents

Executive Summary

As reflected in Australia's Satellite Utilisation Policy (ASUP), the membership of the Space Coordination Committee (SCC) comprises agencies across the Australian Government with an involvement in civilian space activities. This report aims to capture and summarise the civilian space-related activities of the members of the SCC,.

This inaugural report will be provided to the Department of Industry's Coordination Committee on Innovation (CCI), with subsequent reports to be provided to the CCI on an annual basis. The CCI is an information sharing forum for Australian Government innovation activities and for co-ordination of cross portfolio advice on innovation matters. The CCI will, where appropriate, provide advice or issues through the Minister for Industry on the matters contained in the report.

In preparing responses for this report, Australian Government agencies were asked to outline their involvement in key civil space activities as they relate to the principles set out under the ASUP. These principles reflect a focus on the following:

- **Principle 1:** Space applications that have a significant security, economic and social impact, specifically Earth Observation, Satellite Communications and Position, Navigation and Timing;
- **Principle 2:** Ensuring resilient access to those space systems on which we rely now and to those important to our future national security, economic, environmental and social well-being;
- **Principle 3:** Strengthening those relationships and cooperative activities on which Australia relies, and will continue to rely to a substantial degree, for space system capabilities;
- **Principle 4:** Continuing to support rules-based international access to the space environment; promoting peaceful, safe and responsible activities in space;
- **Principle 5:** Enhancing the coordination, understanding and strategic direction of Australia's uses and approach to space;
- **Principle 6:** Promoting collaboration between Australian public and private research and development organisations with industry in space-

related activity, including space science, research and innovation in niche areas of excellence or national significance; and

- **Principle 7:** Ensuring Australia's space capabilities will be used to enhance, and guard against threats to, our national security and economic well-being.

The following Australian Government agencies provided input to the 2014 State of Space report:

Australian Communications and Media Authority (ACMA)

Attorney-General's Department (AGD).

Bureau of Meteorology (the Bureau).

Commonwealth Scientific and Industrial Research Organisation (CSIRO).

Department of Communications.

Department of Foreign Affairs and Trade (DFAT).

Department of Industry – Space Coordination Office (SCO).

Department of Infrastructure and Regional Development and portfolio agencies.

Geoscience Australia (GA).

Highlights of the 2014 State of Space Report

ASUP Principle 1 – Focus on space applications of national significance

- With respect to Earth Observation from Space (EOS), CSIRO noted that it invests approximately $15m per annum in Earth observation capabilities. Earth observation-related activities at CSIRO are undertaken in 9 Flagships by approximately 100 staff.

- The Bureau is leading preparation for the design and implementation of a national rolling review of requirements for EOS information, an EOS backbone for enabling access to standardised and calibrated EOS information, and protection of the radiofrequency spectrum for EOS related uses.

- The first of two Ka-Band satellites that NBN Co will use for the National Broadband Network (NBN) long term satellite service is expected to be in operation by early 2016. These satellites will provide high-speed

broadband coverage to eligible premises across mainland Australia and Tasmania as well as outback areas and Australia's islands.

ASUP Principle 2 – Assure access to space capability

- The Bureau has commenced detailed planning and preparations for the data reception and dissemination of Japan's next-generation geostationary meteorological satellite, Himawari-8, as well as stakeholder training in the effective use of this data.

- The Australian Maritime Safety Authority (AMSA) will undertake significant space procurement activity commencing in 2014-2015 by establishing a contract for a satellite receiving ground station in WA, the "Medium Earth Orbit Local User Terminal" (MEOLUT), and installing a central processing computer in Canberra over the next few years. Through a specialist service provider, AMSA will also seek to access Synthetic Aperture Radar (SAR) imagery for an oil spill monitoring programme.

- In 2014-15, GA will prioritise updating the national assessments of the current and potential economic value of EOS to Australia as well as Australia's future EOS data requirements and priorities. Beyond 2014-15 GA will prioritise securing ongoing access to data from the EC Sentinel series of satellites, and undertake the necessary development work to integrate that data into GA's data processing and distribution systems.

- The Department of Communications will maintain oversight of the process to renew 15 year spectrum licences to existing licence holders, if appropriate. This includes spectrum licences in satellite spectrum bands (27, 28 and 31 Gigahertz (GHz)), which have a tenure period of 15 years and expire between January 2014 and January 2016. The Australian Communications and Media Authority (ACMA) is responsible for managing the process throughout 2014 to 2016.

ASUP Principle 3 – Strengthen and increase international cooperation

- CSIRO will coordinate the Committee on Earth Observation Satellites (CEOS) Chairmanship in 2016, via a multi-agency secretariat and support active participation by CSIRO experts in key CEOS working groups before and after the specific chairmanship period.

- GA will support a strong team Australia approach to CSIRO's chair period, and will be increasing their contribution to the international EOS community through relevant CEOS groups and projects.

- CSIRO radioastronomy will continue to epitomise international cooperation through its 'open skies' policy of making radioastronomy assets available to researchers worldwide.

- CSIRO hosted 50 years of Space Tracking Cooperation with NASA on 19 March 2014 and together with the Space Coordination Office and DFAT extended the Bilateral Space Tracking Treaty with the USA on 24 February 2014 until 2018.

- The Bureau successfully hosted the 4th Asia-Oceania Meteorological Satellite Users Conference in October 2013, with attendance from 120 participants, including over 60 international guests.

ASUP Principle 4 – Contribute to a stable space environment

- DFAT has invested significant effort in supporting the European Union's efforts to progress its valuable initiative for a Code of Conduct, to address the proliferation of space debris which poses a risk to the critical space-enabled services of all nations.

- In 2013-14 the SCO continued its role as co-chair of Expert Group D, assisting the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS) Working Group on Long-term Sustainability of Outer Space Activities.

ASUP Principle 5 – Improve domestic coordination

- The SCO's key priority, as the central point of contact and coordination for all civil space activities, continued.

- In 2013-14, the SCO undertook activities to improve the domestic coordination of civil space activities, including establishing and maintaining the Australian Government coordination framework for civilian space activities. This included the formation of the SCC and acting as secretariat to this committee.

ASUP Principle 6 – Support innovation, science and skills development

- CSIRO currently has approximately 350 staff involved in space science activities, primarily focussed on using space-based systems and data

streams to perform research and deliver nationally significant outcomes, where space provides the most effective and efficient means for delivering this impact.

- GA and CSIRO will continue development of the Australian Geoscience Data Cube, a system that intends to enable government, industry and researchers to access and extract value from the nation's massive holdings of EOS data using High Performance Computing such as the National Computational Infrastructure.

- CSIRO has developed extensive capability in space-related areas that include earth observation; navigation and communication; advanced aerospace technologies, spacecraft tracking and radioastronomy.

- The DoI announced a Cooperative Research Centre on Space Environment Management on 21 February 2014. The centre will monitor, analyse and mitigate space debris and develop new approaches to preserving the space environment.

ASUP Principle 7 – Enhance and protect national security and economic wellbeing

- The SCO and AGD established a Space Community of Interest (CoI) in the Trusted Information Sharing Network (TISN) for Critical Infrastructure Resilience. The Space CoI will work with other critical infrastructure sectors on a risk assessment to identify critical infrastructure dependencies on space infrastructure, and propose options to mitigate identified risk.

- DFAT progressed inter-agency discussions on the *Transparency, Oversight and Compliance* (TOC) regime, which aims to create a regulatory framework for ground based civil space infrastructure.

- Airservices Australia has made a major capital investment in space infrastructure through the nation-wide Automatic Dependent Surveillance – Broadcast (ADS-B) surveillance network. The Civil Aviation and Safety Authority (CASA) has put in place a number of Global Navigation Satellite Systems (GNSS) based surveillance and navigation mandates that come into effect progressively from December 2013 until February 2017.

The Australian Communications and Media Authority (ACMA)

Synopsis

The ACMA is a statutory authority within the Australian Government portfolio of Communications. The ACMA is Australia's regulator for broadcasting, the internet, radiocommunications and telecommunications.

With respect to space-related activities, the ACMA's responsibilities include:

- managing access to the radiofrequency spectrum, including licensing;
- representing Australia's space spectrum management interests internationally;
- providing support and a regulatory framework for satellite services in Australia and meeting the communications needs of Australia’s space sector and the Australian public;
- facilitating spectrum requirements for operations by agencies involved in science services (e.g. radio astronomy), including the Square Kilometre Array (SKA); and
- filing and coordination of Australian satellite systems with the International Telecommunication Union (ITU).

These activities enable the use of, for example, broadcasting, mobile and radionavigation satellite services.

The ACMA also provides advice to the Minister for Communications and the Department of Communications in areas of its responsibilities.

Key outcomes include:

- coordinating access to the radiofrequency spectrum for space communications; and
- protection of Australian interests in international fora.

The ACMA invests annually an estimated budget of approximately $1-1.2 million in space-related activities, including staffing and travel to participate in international fora. However, the exact amount allocated can be difficult to quantify as work may impact both space and terrestrial services.

An issue to highlight is preparation for the ITU *World Radiocommunication Conference* (WRC) *2015 (WRC-15)*. This issue has an overarching effect as it relates to a wide range of services, not just space/satellite services. ACMA involvement includes, for example, management of the consultative processes associated with coordinating Australian inputs to and participation at relevant regional and international meetings.

Key relevant activities/investments conducted by the ACMA fall under ASUP Principles 1, 2 and 4; and are examined below both generally (in the Background Section) and in relation to various financial years.

Background[1]

Principle 1: Focus on space applications of national significance

In relation to space communications, the ACMA:

- oversees Australian satellite networks[2]' adherence to international agreements and provisions of the ITU;
- protects Australian assignments in the ITU Broadcasting-Satellite Service (BSS) and Fixed-Satellite Service (FSS) Plans; and
- assesses the potential for interference between space and terrestrial services.

Principle 2: Assure access to space capability

- Spectrum licensing: spectrum licences in general have duration of 15 years. Upon expiry, if a spectrum licence band is to remain under a spectrum licence regime, options available to the ACMA under the *Radiocommunications Act 1992* include undertaking a re-allocation process and re-issuing licences to the same licensees. An alternative option available to the ACMA is to revert the band back to an apparatus licensing regime. This requires public consultation as well as a recommendation to and a decision by the Minister.

[1] Information provided in this section applies to all financial years

[2] Australian satellite networks are those networks submitted to the ITU by the ACMA

- Apparatus licensing: there are four types of space related apparatus licences - space, space receive, Earth and Earth receive licences. A network that has communications with space objects such as satellites will require one or more licences. Upon receipt of a licence application, the ACMA makes necessary assessments before issuing a licence. There are a range of conditions that the ACMA may attach to a licence to ensure that the operation of the radiocommunication equipment satisfies applicable requirements.

- Engagement: participation in whole of government consideration regarding foreign investment in space companies and/or infrastructure.

Principle 4: Contribute to a stable space environment

The ACMA maintains a high profile within the international radiocommunications community, particularly activities of the ITU Radiocommunication Sector (ITU-R).

The ACMA coordinates Australia's input to the ITU-R in setting international requirements for radiocommunications. This culminates in the ITU treaty level WRC, held every three or four years. The next WRC is scheduled for 2015 in Geneva, Switzerland. The ACMA oversees extensive industry and stakeholder consultation to prepare for international meetings. This is led by the ACMA's Preparatory Group (PG) for WRC-15 (PG WRC-15) and Australian Radiocommunications Study Groups (ARSGs).

The work of the ARSGs generally mirrors that of the ITU-R Study Groups (SGs) and its Working Parties (WPs). The activities of the ARSGs are managed by the ACMA. ARSGs are subordinate to the ACMA’s PG WRC.

Responsibilities of the ARSGs include to study, coordinate and provide expert advice to the ACMA to assist in the development of Australian positions and contributions for Australian Delegations to the ITU-R meetings. For ARSGs 4 and 7, areas of responsibility include space and satellite services. The corresponding ITU-R SGs are SGs 4 and 7, with associated WPs 4A, 4B and 4C, and WPs 7A, 7B, 7C and 7D.

The Asia-Pacific Telecommunity (APT) is a regional organisation within the Asia-Pacific region tasked with addressing radiocommunications and telecommunications issues. Space is one such issue. The APT PG (APG) is the APT Conference PG for WRC. The APT Wireless Group (AWG) is a program group within the APT. AWG responsibilities include space-related issues.

The ACMA:

- manages the consultative processes associated with coordinating the Australian radiocommunications industry and Government input to regional and international fora and to the treaty level Radio Regulations;
- participates in space-related regional and international meetings, including the AWG, APG, SG 4, WP 4A, WP 4B and WP 4C meetings;
- conducts work related to filing and coordination of Australian satellite networks; and
- provides advice to the Government and satellite operators about national and international regulatory requirements as required/appropriate.

Key Outcomes for the 2013-2014 Financial Year

Principle 1: Focus on space applications of national significance

The ACMA:

- coordinated stakeholders' views on Earth Stations on Mobile Platforms (ESOMPs) and worked with stakeholders to develop a position for WP 4A;
- participated in ongoing whole of government consideration regarding foreign investments in space infrastructure;
- conducted a stakeholder forum on spectrum management aspects of the Australian Radio Quiet Zone (Western Australia) that supports, amongst other things, activities of the Australian component of the SKA; and
- included coordination arrangements for space research earth stations as part of the reissue of 2.3 GHz spectrum licences and arrangements for 2 GHz electronic news gathering (ENG) services which have been relocated from the 2.5 GHz band to support the introduction of mobile broadband services.

Principle 2: Assure access to space capability

- Spectrum licensing: the ACMA completed a review of arrangements in the 28 GHz band and recommended to the then Minister for

Broadband, Communications and the Digital Economy that apparatus licensing be introduced in the 28 GHz band once existing licences expired. The Minister accepted the ACMA's recommendation and as a result, on 26 June 2013, the *Radiocommunications (Spectrum Designation) Notice No. 1 of 1998 Instrument of Revocation No. 1 of 2013* was made. Holders of expiring spectrum licences in the 28 GHz band were able to apply for apparatus licences to "replace" existing devices registered under their spectrum licences upon expiry of the 28 GHz spectrum licences. The ACMA has also developed arrangements that allow new apparatus licenses to be issued on a first-in-time coordinated basis in the 28 GHz band.

- For the 27 GHz spectrum licence band, the ACMA is developing a consultation paper on possible future licensing arrangements for the band and will release this in Quarter 3, 2014.

Principle 4: Contribute to a stable space environment

The ACMA:

- provided a response to the ITU-R's request for comments to make changes to the ITU-R Rules of Procedure;
- participated in:
  - the 15th meeting of the AWG (AWG-15) and the 2nd meeting of the APG (APG15-2) meetings;
  - ITU-R SG 4, WP 4A, WP 4B and WP 4C meetings;
- organised and hosted:
  - the inaugural APG training workshop and the 3rd meeting of the APG (APG15-3);
  - PG WRC-15 meetings; and
  - ARSG 4 and ARSG 7 meetings.

Key Priorities for the 2014-2015 Financial Year

Principle 1: Focus on space applications of national significance

The ACMA will continue to conduct ongoing satellite communications related work in space-related areas for which ACMA is responsible. Examples of this work can be seen in Principle 1 of the Background Section.

Principle 2: Assure access to space capability

In relation to spectrum licensing, the ACMA will consider submissions to the consultation paper released in Quarter 3 2014 in forming a view on appropriate future arrangements in the 27 GHz band. It is possible that the outcomes of the consultation paper process will have implications for the expiring spectrum licence process. It is likely that any decisions on future arrangements in the band will involve further consultation.

In addition, the ACMA will continue with other ongoing work in regards to the management of access to the radiofrequency spectrum. Examples of this work can be seen in Principle 2 of the Background Section.

Principle 4: Contribute to a stable space environment

The ACMA will continue to conduct ongoing work in regards to Australia's engagement in regional and international fora where interpretation, application and development of international regulations related to space communications are under discussion. Examples of this work can be seen in Principle 4 of the Background Section.

Key Priorities beyond the 2014-2015 Financial Year

Principle 1: Focus on space applications of national significance

The ACMA will continue to conduct ongoing satellite communications related work in space-related areas for which ACMA is responsible. Examples of this work can be seen in Principle 1 of the Background Section.

Principle 2: Assure access to space capability

The ACMA will continue with ongoing work in regards to the management of access to the radiofrequency spectrum, for example, those indicated in Principle 2 of the Background Section.

Principle 4: Contribute to a stable space environment

The ACMA will continue to conduct ongoing work in regards to engagement in regional and international fora where interpretation, application and development of international regulations related to space communications are under discussion. Examples of this work can be seen in Principle 4 of the Background Section.

The ACMA is responsible for coordinating inputs to Australian positions for the 2015 treaty-level WRC-15. The agenda for WRC-15 includes space communications issues. A key priority of the ACMA is to finalise the preparatory work and participate in WRC-15.

Major Opportunities

Participating in space-related regional and international meetings is especially important to influence the regional and international community to be mindful of Australian space-related interests. Opportunities to participate in space-related regional and international meetings are directly linked to ASUP Principle 2, but are limited by available resources.

Attorney-General's Department (AGD)

Synopsis

The Department of Industry (DoI) and AGD have established a Space Community of Interest (CoI) in the Trusted Information Sharing Network (TISN) for Critical Infrastructure Resilience.

AGD also provides legal advice on international law related to space and utilises satellite technology in emergency management response planning.

Key space-related activities

- AGD and the DoI have established a Space CoI within the TISN for Critical Infrastructure Resilience. The establishment of the Space CoI was identified as a key outcome in the ASUP under the principle of protecting and enhancing national security and economic well-being.
- Within AGD, the Office of International Law's role is to provide legal advice on international space law, to ensure Australia's engagement in the space domain is consistent with our international rights and obligations.
- Also within AGD, Emergency Management Australia uses satellite technology to provide situational awareness for natural disaster planning; particularly with development of the National Situation Awareness Tool which takes data from State and Territory agencies to combine it into a national overview.

Background

The TISN is a forum where owners and operators of critical infrastructure work together and share information on threats and vulnerabilities and develop strategies to mitigate risk.

The TISN compromises seven sector groups (Banking and Finance, Health, Food and Grocery Chain, Transport, Communications, Water Services, Energy) with members including owners and operators of critical infrastructure, Australia, State and Territory government agency representatives and peak and national bodies.

CoI's within the TISN provide an opportunity for cross-sectoral consultation between key stakeholders and government on specific matters. CoI's are

convened when a specific critical infrastructure issue demands attention, and may be disbanded once the issue has been adequately addressed.

Key Outcomes

- The objective of the Space CoI is to bring relevant interested parties from industry, academia and government together to explore vulnerabilities, including interdependencies between space-related infrastructure and critical infrastructure, and to develop options to mitigate risk.

Key Priorities for the 2014-2015 Financial Year

The Space CoI will work with other critical infrastructure sectors on a risk assessment to identify critical infrastructure dependencies on space infrastructure, and propose options to mitigate identified risk.

The Bureau of Meteorology (the Bureau)

Synopsis

The Bureau of Meteorology (the Bureau) is Australia's national weather, climate and water agency. Its expertise and services assist Australians in dealing with the realities of their natural environment, including drought, floods, fires, storms, tsunami and tropical cyclones. Through regular forecasts, warnings, monitoring and advice spanning the Australian region and Antarctic territory, the Bureau provides one of the most fundamental and widely used services of government.

The Bureau operates under the authority of the Meteorology Act 1955 and the Water Act 2007 which provides the legal basis for its activities. It also fulfils Australia's international obligations under the Convention of the World Meteorological Organization (WMO) and its related international meteorological treaties and agreements.

The Bureau provides Australians with the environmental intelligence they need to manage and live within their natural environment, encompassing the atmosphere, oceans, water and land. To achieve this, the Bureau:

- provides forecasts, warnings and long-term outlooks on weather, climate, water and other environmental phenomena;
- monitors and reports on current environmental conditions;
- analyses and explains trends in environmental data;
- fosters greater public understanding and use of environmental intelligence; and
- • extends its understanding of, and ability to forecast, Australia's weather, climate and water resources.

Key space-related activities

The Bureau is co-chair, with GA and CSIRO, of the Australian Government Earth Observations from Space Working Group (AGEOSWG). Through this forum, the Bureau is leading and participating in the design and implementation of a national Rolling Review of Requirements for EOS information, an EOS backbone for enabling access to standardised and

calibrated EOS information, and protection of the radiofrequency spectrum for EOS related uses.

The Bureau hosted the 4th Asia-Oceania Meteorological Satellite Users Conference in October 2013, with attendance from 120 participants, including over 60 international guests.

The Bureau has also commenced detailed planning and preparations for the data reception and dissemination of Japan's next-generation geostationary meteorological satellite, Himawari-8, as well as stakeholder training in the effective use of this data

Background

Himawari-8

In 2014, the Japan Meteorological Agency will launch Himiwari-8, the next generation of geostationary platforms. The satellite is expected to be operational in 2015, followed by the launch of Himawari-9 in 2016. These satellites will replace the MTSAT series of satellites, which are currently the Bureau's primary source of geostationary satellite data.

Himawari-8 and Himawari-9 will result in a significant change in the way the Bureau receives, processes and stores real-time geostationary data. Data will be received over the internet as opposed to direct reception, and data volumes will be exponentially larger due to the higher spatial, spectral and temporal resolutions of the new data streams.

The increase in spatial and spectral resolutions will enable finer details and features to be detected, while the increased temporal frequency will allow rapid changes to be detected and these changing features to be tracked and monitored through time. These advances will allow the Bureau's forecasters and researchers to provide improved forecasts and guidance, particularly in the case of severe weather events. The high frequency imagery (every 10 minutes) from Himawari will also fill gaps in areas where there is no weather watch radar coverage.

Training in the use of high frequency satellite imagery has already commenced at the Bureau of Meteorology Training Centre (BMTC) using experimental high-temporal resolution imagery from Japan's MTSAT-1R satellite.

Bureau/GA Collaborative project

The propagation delays of microwave signals in the atmosphere caused by water vapour are dealt with in space geodetic analyses as ‘nuisance’ parameters. Currently in its routine GPS analysis, GA computes hourly estimates of Tropospheric Zenith Delay for all available Continuously Operating Reference Stations (CORS) that track the GPS in the Asia-Pacific region.

This operational analysis currently runs with a 48-72 hour latency, which is sufficient for geodetic applications but for not for atmospheric meteorological applications that require product generation latencies better than 4 hours.

A whole-of-government approach to the determination of Global Navigation Satellite System (GNSS) derived water vapour estimates was flagged during the National Positioning Infrastructure (NPI) stakeholder consultations. This project would represent a first attempt to do this collaboratively between GA and the Bureau.

International Engagement

The Bureau engages in regional and global forums on satellite meteorology and has close ties with the operators of the meteorological satellites it relies on for its day-to-day operations. This includes close engagement with China and Japan, the European Union and the United States.

The Bureau is deeply involved with space-related activities in the World Meteorological Organisation (WMO) and chairs the WMO Expert Team on Satellite Utilisation and Products.

Bureau staff participate in the science teams for a number of international missions, including: GOES-R, Cloudsat and the Global Precipitation Mission (GPM).

Coordination Group for Meteorological Satellites (CGMS) Virtual Laboratory (V-Lab) for Education and Training in Satellite Meteorology

The Bureau of Meteorology Training Centre (BMTC) conducts in-house training programs in satellite meteorology for both new recruits and to maintain and develop the capabilities of existing forecaster staff. BMTC is also a Centre of Excellence in the Virtual Laboratory (V-Lab) for Education and Training in Satellite Meteorology program. The V-Lab is a global network of Training centres, Satellite operators and Agencies working together to improve the utilisation of data and products from meteorological and environmental satellites. This activity is facilitated by the World Meteorological

Organisation (WMO) and the Coordination Group for Meteorological Satellites (CGMS)

Space Weather

Space Weather Services are engaged in global co-operation via the WMO International Coordination Team for Space Weather (ICTSW) and the International Space Environment Services (ISES). Australia is one of the longest standing Regional Warning Centres in ISES and makes heavy use of satellite products (e.g. ACE, SOHO, STEREO, GOES) In 2013-14, the aviation industry has led a push for international standardisation of Space Weather Services via International Civil Aviation Organisation (ICAO) with a Concept of Operations procedure on which Australia has taken a major role in providing guidance and feedback. Aviation space technology usage includes satellite navigation (SATNAV), satellite communications (SATCOM) and High Frequency (HF) radio communications.

Key Outcomes

The Bureau hosted the 4th Asia-Oceania Meteorological Satellite Users Conference in October 2013, with attendance from 120 participants, including over 60 international guests.

The Bureau has commenced detailed planning and preparations for the data reception and dissemination of Japan's next-generation geostationary meteorological satellite, Himawari-8, as well as stakeholder training in the effective use of this data.

Under the CGMS V-Lab program, from October 2013 BMTC commenced hosting monthly online weather and training sessions to National Meteorological and Hydrology Service provider stakeholders in the Asia-Pacific region as part of a "Regional Focus Group" community of satellite data and product users.

Key Priorities for the 2014-2015 Financial Year

The Bureau is planning to make Himawari-8 data available to the national EOS community when the satellite is operational in 2015. Discussions regarding access to the data have commenced with GA and CSIRO. This activity relates to ASUP Principle 1.

In preparation for the next generation of geostationary meteorological satellites, the Bureau will continue to train internal and regional stakeholders

in the effective use of 10-minute satellite data and multichannel (Red-Green-Blue) products. This will be conducted in consultation with international experts in the field including Japan Meteorological Agency and EUMETSAT.

Key Priorities beyond the 2014-2015 Financial Year

Operational initiatives being pursued include:

- Building on synergies across government and moving toward a national approach to ground station infrastructure, processing and storage;
- Building partnerships internationally, focusing on the relationships with the Japan Meteorological Agency, the China Meteorological Administration and the National Oceanic and Atmospheric Administration;
- Consolidating ground station infrastructure in key locations;
- Increasing the use of satellite data in numerical weather prediction models; and
- Developing new satellite and blended products to provide alternatives to in situ data.

Commonwealth Scientific and Industrial Research Organisation (CSIRO)

Synopsis

CSIRO is an independent statutory authority constituted and operating under the provisions of the *Science and Industry Research Act 1949*, which designates functions to:

- conduct scientific research to benefit Australian industry and the community, and to contribute to the achievement of national objectives;
- encourage and facilitate the application of the results of scientific research;
- manage and make available national facilities for scientific research;
- contribute to scientific collaboration between Australia and other countries; and
- contribute to training the next generation of Australian researchers.

Under the *Science and Industry Research Act 1949*, CSIRO is granted powers to undertake a broad range of activities consistent with performing the above functions. These include arranging for scientific research to be undertaken on behalf of the organisation; forming partnerships, joint ventures and spin-off companies; and deriving income from intellectual property through licensing and royalty arrangements.

Key objective/s with respect to space-related activity

CSIRO currently has approximately 300 staff involved in space activities, primarily focussed on using space-based systems and data streams to perform research and deliver nationally significant outcomes, where space provides the most effective and efficient means for delivering this impact.

Consistent with this strategy, CSIRO has developed extensive capability in space-related areas that include earth observation; navigation and communication; advanced aerospace technologies, spacecraft tracking and radioastronomy

Key space-related activities

CSIRO carries out space-related activities in the following areas:

- radio-astronomy;
- spacecraft tracking and communications;
- Earth observation from space, and
- space applications and technologies, including those related to satellite navigation and satellite communications.

Background

CSIRO's radio-astronomy, spacecraft tracking and communications activities are carried out by CSIRO's Astronomy and Space Science (CASS) Division. CASS operates two major national space facilities: the Australia Telescope National Facility (ATNF) and the Canberra Deep Space Communication Complex (CDSCC). CDSCC is operated by CSIRO on behalf of the Australian Government for NASA. CASS Division has approximately 300 staff in total.

The CSIRO, NASA relationship also extends to CSIRO management of the Tracking Data Relay Satellite System (TDRSS) facility at Yarragadee in WA and management of the NASA ballooning facilities located at Alice Springs.

With respect to Earth observation from space (EOS), CSIRO invests approximately $15m per annum in Earth observation capabilities, and Earth observation-related activities are undertaken across all 9 Flagships as well as CSIRO's National Facilities by approximately 100 staff. CSIRO also serves as the Australian principal on the international Committee on Earth Observation Satellites (CEOS), and will Chair CEOS in 2016. CEOS is an international body that aims for international coordination of civil space-based Earth observation programs and promotes exchange of data to optimise societal benefit and inform decision making for securing a prosperous and sustainable future for humankind.

The ASUP recognises CSIRO as one of three agencies with joint responsibility for the Australian Government's civilian Earth observation activities (along with operational agencies GA and the Bureau). CSIRO co-chairs the AGEOSWG with GA and the Bureau.

CSIRO leads significant multi-million dollar national EOS-related research infrastructure investments including the Terrestrial Ecosystem Research Network (TERN) AusCover facility and the Integrated Marine Observing System (IMOS) Satellite Remote Sensing Facility, and is a member of a consortium which operates the Western Australian Satellite Technology and Applications Consortium (Perth).

CSIRO is a partner with GA and the National Computational Infrastructure (NCI) on the establishment of the “Australian Geophysical DataCube (AGDC)” infrastructure capability at ANU, which will provide access to over 20 years of earth observation satellite data time-series on petabyte storage “spinning-disk” for use in development of new applications for such data by Australia’s Earth observation (EO) research sector.

CSIRO also engages in additional activities related to space applications and technologies through other Divisions and research areas. CSIRO was a partner in two multi-million dollar projects – the Space-based National Wireless Sensor Network Project and the Gravity Recovery and Climate Experiment (GRACE) Follow-on Project – funded under the Australian Space Research Program (concluded in June 2013), which harnessed our wireless technology, sensor networking and high precision manufacturing capabilities in support of Earth observation-related activities.

CSIRO is also a partner in another two international multi-million dollar space-related projects, the joint NASA-ESA Solar Orbiter mission and the USA-led Laser Interferometer Gravitational-Wave Observatory (LIGO), and has additional space-related interests in fields including space situational awareness and in situ resource utilisation.

Key Outcomes

CSIRO has achieved globally recognised innovation in the areas of Earth Observation and related informatics, provided leadership in space forums, progressed innovative radio Astronomy development under the Australian Square Kilometre Array Pathfinder (ASKAP) program, maintained its responsibilities with NASA for space tracking of deep space missions, assisted the construction of new ground station infrastructure, celebrated 50 years of NASA bilateral activities and grew a closer partnership with Defence on space situational awareness.

CSIRO has established the CSIRO Earth Observation and Informatics (EOI) Future Science Platform (FSP), a million-dollar p.a. investment in transformational science supporting Earth observation science and applications. The EOI FSP supports the following main CSIRO Activities in Earth Observation Science:

- Coordinating delivery of underpinning EO Science, ongoing support to CSIRO wide EOI teams and Flagship projects, which includes an accredited and recognised solid satellite data quality assurance and calibration and validation (cal/val) work program;

- Access to Earth Observation Informatics Expertise and Infrastructure (High Performance Computing-Informatics and Information Sciences), that provides EO teams a step-change in ability to manage current and future petabyte-scale EO Datasets; that support sophisticated time-series analysis tools, web-services, model-data fusion and model-data assimilation science and applications projects across the organisation;

- Support for inter-agency and international cooperation, providing the primary point of contact on matters of Earth Observation for CSIRO; and

- Linkages to EO Industry and innovative applications development for next generation satellite sensors, or airborne systems, addressing government, agency, public and industry users both nationally and internationally

CSIRO has also achieved the following outcomes:

- CSIRO, on behalf of Australia, elected as 2016 Chair of the international Committee on Earth Observation Satellites (CEOS);

- ASKAP now being commissioned and located at the Murchison Radio Observatory (MRO) in WA will introduce and test revolutionary technologies vital to the SKA in areas of electronic engineering, digital systems, computing and big data signal transport. Key results and techniques generated through the development of ASKAP will contribute to the international SKA design and development effort. ASKAP will also build Industry involvement and trial green energy power systems that will be relevant to the much larger SKA project. Recent tests of CSIRO's innovative phased array feed (PAF) receivers have achieved the goal for system performance required demonstrating excellent, low noise system temperature of less than 50 Kelvin across the wide frequency range of 0.7–1.8 GHz required;

- CDSCC currently tracks over 40 space deep space missions for NASA and specific International Space Agencies such as European Space Agency (ESA), Japan Aerospace Exploration Agency (JAXA) and the Indian Space Research Organisation (ISRO) and was prime ground station for the recent landing upon Mars of the Curiosity rover;

- The US/AUS Bilateral Space Tracking Treaty & Contract valued at $80M was extended in March 2014 by mutual Australian and US agreement for a further 4 years to 26 Feb 2018;
- NASA has recently invested some $120M in Australia on new 34 metre antenna constructions (DSS35 & DSS36) at CDSCC. The first will become operational in October 2014;
- On 19 March 2014, NASA celebrated with CSIRO its 50th anniversary of the Deep Space Network hosted within Australia underpinned by the visit of NASA Administrator Charles Bolden; and
- CSIRO coordinated and hosted with Defence Science Technology Organisation (DSTO)/Defence, the first national civilian workshop on space situational awareness (SSA), in April 2013.

Emerging Areas of Interest

CSIRO continues to explore areas for the growth of new space activities and the development of international collaborations where there is prudent scientific and cost effective value to Australia. For example:

- NASA has approached Australia to host a Sounding Rocket Program from the Woomera Test Range (WTR) to execute astro-physical studies using X-ray and ultra violet sensors. DoI, CSIRO and Defence are working together to sponsor and host the activity in 2016.
- CSIRO is proposing to join a new US-based proposal for placement of a VIS-SWIR hyperspectral imager on the International Space Station from 2017 onwards.
- CSIRO, in collaboration with Geoscience Australia is developing closer scientific collaboration with the international space agencies developing and operating earth observation sensor systems. CSIRO in collaboration with Geoscience Australia is seeking to promote closer Australia-EC and ESA linkages in space activity.

Key Priorities beyond the 2014-2015 Financial Year

CSIRO will progress in the areas of Earth Observation, innovative radio Astronomy development, space tracking of deep space missions and continue to develop space situational awareness knowledge. Other priorities are as follows:

- CSIRO will continue the innovative ASKAP R&D program to increase efficiency, reduce manufacturing complexity, and lead to reductions in overall cost, weight and build time of radio astronomy instruments to ensure Australia's future in SKA;
- CSIRO will uphold and contribute to the sustainment of International Treaties/Exchanges of Notes and Memoranda as they apply to space engagements between Australia and other Nations, such as:
- Exchange of Notes between the Government of Australia and the United States of America on space vehicle tracking and communications facilities;
- Exchange of Notes between the Government of Australia and the United States of America concerning the conduct of scientific balloon flights; and
- An Agreement between the Australian Government and the European Space Agency (ESA) for a Cooperative Space Vehicle Tracking Program.
- CSIRO will maintain Deeds of Agreement with the Australian Communications and Media Authority for the coordination and radio interference management of a satellite network;
- CSIRO will coordinate CEOS Chairmanship in 2016, via a multi-agency secretariat and support active participation by CSIRO experts in key CEOS working groups before and after the specific chairmanship period;
- CSIRO will ensure other interactions with portfolios and agencies in research, development, applications and exploitation of Earth observation, satellite communications and other aspects of space technology;
- CSIRO will assist NASA to complete and commission two new 34 metre deep space communications antennas at CDSCC;
- CSIRO will maintain partnership of national earth observation facilities including the Australian Government Water Resources Observation Network (WRON), the Terrestrial Ecosystem Research Network (TERN), the Integrated Marine Observing System (IMOS), and the WA Centre of Excellence for 3D Mineral Mapping; and

- CSIRO will continue international leadership within the multinational Group on Earth Observations, and provide technical expertise and support for the development of Group on Earth Observations initiatives on forestry, agriculture, oceans and coastal water quality monitoring, among others.

Major Opportunities

CSIRO is exploring areas of potential further development in Earth Observation, the Square Kilometre Array, space tracking and space situational awareness.

International collaborations and partnerships in area of earth observation of water resources, minerals and land-use and agriculture

CSIRO is partnering with international organisations to co-develop continental and global scale approaches to detection, monitoring and assessment of environmental , mineral and agricultural resources.

Square Kilometre Array (SKA)

The €1.5 billion SKA program is being led by the international SKA Organisation from its headquarters in Manchester, UK. SKA will be a revolutionary radio telescope made of thousands of receptors linked together by high bandwidth optical fibre.

Space situational awareness

A key tenet of Australian policy is the awareness of sensors and communications that overfly Australian land and airspace by foreign powers.

Hyperspectral sensor utilisation

JPL's plans to utilise a new hyperspectral payload to be located on the International Space Station. The payload has the potential for applications in wide area mineral detection, agriculture health monitoring and water resource monitoring to assist farming in Australia.

Support to upwards looking Radar remote sensing

NASA may extend the capability of existing antennas located in Australia through the retrofit of Radar capabilities. This may enable the Southern Hemisphere to play a key part in NASA's Asteroid Missions and assist Australia's space situational awareness capability.

Management of the wider Southern Hemisphere Deep Space Network

Extending the management of CDSCC to include existing ESA and NASA deep space antennas. Australia could benefit financially and strategically.

Invitation to contribute an Australian sensor payload on a future NASA space mission

Australia has been invited to participate in the next generation of NASA deep space missions but will require to balance its response to NASA with due consideration of its current science priorities.

Department of Communications

Synopsis

Within the Australian Government portfolio of Communications, the Department of Communications and the ACMA work closely together in implementing the Australian Government's communications policy objectives.

The Department of Communications provides strategic advice to the Australian Government on the development of policies and programs to realise the full potential of digital technologies and communications services that underpin Australia's future economic prosperity.

This includes provision of policy advice to the Minister for Communications, and the Parliamentary Secretary to the Minister for Communications on the following satellite-related communication policy issues:

- National Broadband Network (NBN) interim satellite service;
- NBN Long Term Satellite Service;
- satellite spectrum issues;
- satellite phone services;
- satellite broadcasting services;
- spectrum for satellite communications services; and
- spatial data policy.

The Department of Communications also has responsibility for strengthening whole-of-government spatial data policy and facilitating and coordinating spatial data management across Australian Government agencies. Supporting the spatial industry is the satellite related systems of Earth Observations and Navigational Satellites. These systems provide highly accurate positioning and earth observation, enabling spatial information to service other industry sectors such as agriculture, mining, environment, infrastructure, defence and insurance.

The Department of Communications also administers funding for the following programs relating to satellite communications services:

- Satellite Phone Subsidy Scheme (concluded 30 June 2014);
- Viewer Access Satellite Television (ongoing); and

- Australian Broadband Guarantee (concluded 30 June 2011, legacy services remain in operation).

The Department of Communications' activities most closely align with ASUP Principles 1 and 2.

Key space-related activities

National Broadband Network Interim Satellite Service

Over the reporting period, a key area of work for the Department of Communications was advice to the Government and provision of public information in relation to NBN Co's provision of satellite communications services in regional and remote Australia through its interim satellite service, ahead of the rollout of NBN Co's Long Term Satellite Service. The NBN interim satellite service (ISS) targeted users without access to an alternative terrestrial broadband service, including users across regional and remote areas of Australia as well as coastal islands. The ISS reached its initial capacity on 18 December 2013.

On 3 April 2014, the Government announced that NBN Co will provide new satellite services for up to 9,000 additional households, farms and small businesses across Australia to address the continuing lack of affordable broadband services in regional, rural and remote Australia. The first of two Ka Band satellites that NBN Co will use for the Long Term Satellite Service is expected to be in operation by early 2016, lifting broadband quality for users in remote locations.

Australian Broadband Guarantee Program

The Department of Communications administered funding for the Australian Broadband Guarantee (ABG) program from 2008 to 2011, and has established a policy framework to facilitate the transition of these services to the NBN. The ABG program provided subsidised satellite broadband communications for targeted premises unable to access terrestrial broadband services.

The ABG program concluded on 30 June 2011, but around 40,000 legacy services remain in operation. The Department of Communications continues to maintain a watching brief on these satellite broadband services, and their transition to the NBN. Following completion of a three year obligation period, ABG customers could register for the NBN ISS if they met the eligibility criteria.

Satellite Phone Subsidy Scheme

The Department of Communications administered funding for the Satellite Phone Subsidy Scheme. The Satellite Phone Subsidy Scheme 2013-2014 was the latest extension to an initiative which commenced in 2002 and has provided over 29,000 subsidies to assist in the purchase of mobile satellite handsets over the life of the scheme. The Scheme concluded as scheduled on30 June 2014.

The objective of the Satellite Phone Subsidy Scheme was to improve the affordability and access to mobile communications for individuals and organisations residing, working or travelling in areas without terrestrial mobile phone coverage. Subsidies were offered at two levels:

- 85% subsidy to residents or organisations based in areas with no mobile phone coverage
- 50% subsidy to people or organisations who spend a minimum of 180 days in a two year period in areas with no mobile coverage.

Viewer Access Satellite Television

The Department of Communications administered funding for the provision of commercial free-to-air digital television services on the Viewer Access Satellite Television (VAST) platform (the national broadcasters – the Australian Broadcasting Corporation (ABC) and Special Broadcasting Service (SBS) – are funded directly through their Budget appropriations to provide their services on VAST). VAST provides viewers in remote areas as well as those in digital television terrestrial black spots in metropolitan and regional areas with access to the same range of commercial and national digital free to-air television services that are available in the metropolitan areas. VAST also carries a range of radio services, including over 45 ABC and 20 SBS radio services.

As at 30 June 2014, 212,330 individual decoders had been approved to connect to the commercial free-to-air television services in 178,863 households across Australia (approval is not needed to access the ABC and SBS on VAST).

Reissue of 15 year spectrum licences

The Department of Communications maintained policy oversight of the process to renew 15 year spectrum licences to existing licence holders, if

appropriate. These licences include spectrum used for satellite communications between the ground station and the satellite.

Spectrum licences in the satellite spectrum bands (27, 28 and 31 GHz) have a tenure period of 15 years. Spectrum licences in the 28 and 31 GHz bands expired on 31 January 2014, and spectrum licences in the 27 GHz band will expire on 17 January 2016.

On expiry, spectrum licences can either be reissued to the same licensee if it is in the public interest to do so, or reallocated via price based mechanisms such as an auction.

Key Outcomes

National Broadband Network Interim Satellite Service (ISS)

The ISS was well-received over the period of its operation, and reached its initial capacity of 48,000 services on 18 December 2013. On 3 April 2014 the Government announced that NBN Co will provide new satellite services for up to 9,000 additional households, farms and small businesses across Australia to address the continuing lack of affordable broadband services in regional, rural and remote Australia. The first of two Ka-Band satellites that NBN Co will use for the Long Term Satellite Service is expected to be in operation by early 2016.

Australian Broadband Guarantee (ABG)

The ABG program provided subsidised satellite broadband communications for targeted premises unable to access terrestrial broadband services. The ABG program concluded on 30 June 2011, but some legacy services remain in operation. Following completion of a three year obligation period, ABG customers could register for an NBN ISS if they met the eligibility criteria.

Satellite Phone Subsidy Scheme

The Satellite Phone Subsidy Scheme facilitated social and economic outcomes by subsidising the costs of access to basic communications in regional and remote locations. The Scheme concluded as scheduled on 30 June 2014.

Viewer Access Satellite Television (VAST)

The VAST service provided viewers in remote licence areas, and those residing in digital television terrestrial black spots elsewhere, with access to a range of free to air digital television and radio services.

Key Priorities for the 2014-2015 Financial Year

ASUP Principle	Lead Agency and co-Lead	Priority	Intended Action/s	Level of Investment (required investment in brackets)	Timeframe
1	NBN Co/ Communications	high	NBN Co design, build and launch two new Ka Band satellites.	~ $2 billion (within existing resources)	Ongoing
1	Communications	medium	Continue to manage provision of Viewer Access Satellite Television (VAST) service	(within existing resources)	Ongoing
2	ACMA/ Communications	medium	Review of technical framework in the 27 GHz band.	(within existing resources)	Ongoing

Key Priorities beyond the 2014-2015 Financial Year

The first of two Ka-Band satellites that NBN Co will use for the long term satellite service is expected to be in operation by early 2016. These satellites will provide high-speed broadband coverage to eligible premises across mainland Australia and Tasmania as well as outback areas and Australia's islands.

The Department of Communications and the ACMA expect to continue other ongoing core priorities, as listed for the 2014-15 financial year above.

Major Opportunities

Satellite communications provide the opportunity to improve access to communications services – particularly for regional, rural and remote Australia, and people living in areas that are unable to access terrestrial communications networks.

Satellite communications can enable widespread productivity, social and economic benefits, by providing more equitable access to basic communications, such as TV broadcasting, internet and telephone services. Access to satellite communications allows regional, rural and remote organisations to capitalise on further opportunities, facilitate contact with

existing and potential customers, and compete more effectively with businesses in urban areas. Improved satellite communications can also assist in addressing physical, economic and social isolation, and bring about improved health and safety outcomes, including in emergency situations.

As highlighted in the ASUP, Australia is fortunate to have a mature commercial satellite communications industry. However, there are further opportunities to leverage existing services to better meet the communications needs of rural and remote Australia.

Department of Foreign Affairs and Trade (DFAT)

Synopsis

As set out in the ASUP, DFAT is responsible for engagement on space-related international security issues. This includes work in relevant international fora such as the United Nations and the Conference on Disarmament, and in regional fora such as the Association of Southeast Asian Nations (ASEAN) Regional Forum. It also includes involvement in key international initiatives relevant to the safety, security and sustainability of outer space.

Over the reporting period, DFAT has developed, in consultation with other relevant agencies, Australia's policy positions on space security issues. DFAT has articulated these positions in regular bilateral dialogues, trilateral talks' (with the United States and Japan) and regional and international meetings on space security issues. It has actively supported the development of the European Union's initiative for an International Code of Conduct for Outer Space Activities. Over the coming period, these priorities remain extant, with work to finalise the proposed Code expected to intensify. In allocating its resources, DFAT must be selective in participating in those international discussions and meeting which are key to meeting Australia's objectives, as set out in the ASUP.

Key space-related activities

DFAT has:

- Held talks with partners on space security issues, including through regular Trilateral Space Security Talks with the United States and Japan, and exchanges on space-related issues at officials and Ministerial levels, including at Australia-United States Ministerial Consultation (AUSMIN) 2013.

- Invested significant effort in supporting the European Union's efforts to progress its valuable initiative for a Code of Conduct, to address the proliferation of space debris which poses a risk to the critical space-enabled services of all nations.

- Progressed inter-agency discussions on the Transparency, Oversight and Compliance (TOC) regime, which aims to create a regulatory framework for ground-based civil space infrastructure.

- Continued talks with international counterparts relating to the establishment and maintenance of ground-based civil space infrastructure in Australia.

Key Outcomes

DFAT has:

- Strengthened our relationships with long-standing and emerging space partners through discussions in bilateral and multilateral fora, including in relation to the Code of Conduct and ground-based civil space infrastructure in Australia.
- Attended the second and third Open-Ended Consultations for the Code of Conduct in Bangkok (November 2013) and Luxembourg (May 2014) respectively.
- Held the first inter-departmental committee (progressing from the working group meetings) for the TOC regime, which established key priorities for ongoing work.

Key Priorities for the 2014-2015 Financial Year

ASUP Principle	ASUP Commitments	Lead Agency and co-Lead	Priority	Intended Action/s	Level of Investment (required investment in brackets)	Timeframe
3	2	DFAT/ SCO	High	Dialogue with international partners wishing to establish ground stations	(within existing resources)	Ongoing
3	3	DFAT	High	Through capital and Posts, represent Australia at key international forums	(within existing resources)	Ongoing
3	6	DFAT	High	Build linkages and common interests with established and emerging partners	(within existing resources)	Ongoing
4	1	DFAT	High	Use regional and international	(within existing	Ongoing

ASUP Principle	ASUP Commitments	Lead Agency and co-Lead	Priority	Intended Action/s	Level of Investment (required investment in brackets)	Timeframe
				fora and create bilateral opportunities to engage on space security	resources)	
4	2	SCO/ DFAT	Medium	Monitor developments in COPUOUS (SCO leading on S&T Committee)	Within existing resources	ongoing
4	4	DFAT	High	Engage actively to finalise the Code of Conduct	(within existing resources)	12-18 months
4	5	DFAT	N/A	Contribution to the UN Group of Governmental Experts (UNGGE) completed		completed
4	6	DFAT	Medium	Participate in relevant international debate	(within existing resources)	Ongoing
7	2	DFAT	High	Coordinate the interagency process to develop a TOC	(within existing resources)	To be determined
7	7	Defence / DFAT	High	Maintain export controls on space-related goods and services	(within existing resources)	ongoing

Key Priorities beyond the 2014-2015 Financial Year

DFAT expects that international cooperation on space-related issues will continue to grow as space security becomes an increasingly important issue internationally. It will remain a key DFAT priority to engage with established and emerging partners on space security-related issues. Upon finalisation of a Code of Conduct to deal with the pressing issue of space debris, other

issues currently under consideration as part of the international debate will come to the fore. These may include various initiatives for international cooperation to address other space-related challenges, and continuing engagement on existing proposals related to the non-weaponisation of space.

Department of Industry (DoI)

Synopsis

The Space Coordination Office (SCO) of the Department of Industry (DoI) is the central point of contact and coordination for all Australian civil space activities. The SCO coordinates the implementation of Australia's Satellite Utilisation Policy (ASUP) and administers the *Space Activities Act 1998*.

To assist the SCO in its coordination role, the ASUP established a governance structure to support information sharing and priority setting across the Australian government and between industry stakeholders.

Underpinning the ASUP governance structure was the formation of the SCC, which is assisted by the SCO in its role as secretariat to the committee. Responsibility for civil space activities undertaken in Australia is therefore not centralised, and each agency reflected in the ASUP governance structure continues to retain Ministerial reporting responsibilities for space-related activities it undertakes.

Beyond its role as the central point of contact and coordination, the SCO, through the Space Licensing and Safety Office (SLASO), is responsible for the administration of the requirements of the *Space Activities Act 1998* and the *Space Activities Regulations 2001*.

The space activities legislative regime gives effect to Australia's international obligations under the five multilateral outer space treaties to which Australia is a signatory. Under these treaties, Australia is required to monitor and regulate space activities on its territory or under its control, and to register with the United Nations any space objects for which Australia is a launching state.

Key space-related activities

- The SCO undertook activities to improve domestic coordination. The primary domestic coordination activities related to the establishment of the Australian Government coordination framework for civilian space activities envisaged by the ASUP, including the formation of the Space Coordination Committee.
- The SCO maintained its portal as a national point of contact and coordination for international engagement on civil space activities.

- The SCO continued to manage bilateral and multilateral agreements, such as an MoU on space cooperation with India, the extension to a space tracking treaty with the United States, and development of a joint statement with Japan on collaborative opportunities for Quasi-Zenith Satellite System (QZSS) applications. Further work continued on other treaty-level agreements with key international civil space partners.

- The SCO continued to contribute to a stable space environment through its involvement with Expert Group D of the Working Group on the Long-Term Sustainability of Outer Space Activities at the United Nations Committee on the Peaceful Uses of Outer Space.

- The Space Licensing and Safety Office continued to administer the provisions of the *Space Activities Act 1998*. In 2013-14, one overseas launch certificate was granted for the launch of an Australian satellite, and one organisation was granted approved scientific or educational organisation status. Guidance on the obligations under the space activities legislative regime was provided to a range of stakeholders interested in developing payloads for launch into space over the coming years.

- The SCO established a Space Community of Interest group to protect and enhance national security and economic wellbeing. The Space COI is part of the Trusted Information Sharing Network (TISN) to bring relevant interested parties from industry, academia and government together to highlight interdependencies between space-related infrastructure and critical infrastructure in Australia and to explore vulnerabilities and to develop options to mitigate associated risk.

- The SCO participated in international forums to strengthen and increase international cooperation. The SCO presented at the International Astronautical Congress, the Asia-Pacific Regional Space Agency Forum and the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS).

- The SCO oversaw the conclusion of the 14 Australian Space Research Program projects. The $40 million program was a success with many of the collaborative consortiums established under the program continuing to strengthen their working relationships and capabilities through new projects.

Key Outcomes

- A key outcome leading up to the reporting period was the launch of ASUP.
- The SCO strengthened domestic coordination with the establishment of the Space Coordination Committee under the Australian Government Coordination Framework for Civilian Space Activities.
- The SCO, with the assistance of other Australian Government agencies, produced this inaugural report – the first time a summary of civilian space-related activities across the Australian government has been compiled into one document.
- The SCO assisted in strengthening relations with Japan through participation at the Asia-Pacific Regional Space Agency Forum (APRSAF). This was further assisted through the making of a joint Ministerial level statement on collaborative opportunities on the Quasi-Zenith Satellite System (QZSS).
- The SCO strengthened relations with the United States in overseeing the extension of a treaty underpinning the operation of the Canberra Deep Space Communications Centre.
- The SCO continued its role as a Co-Chair under a UN COPUOS working group.
- The Australian Space Research Program (ASRP) successfully achieved the objective of developing Australia's niche space capabilities by supporting space-related research, innovation and skills in areas of national significance or excellence. For example:
- The space debris tracking expertise of EOS Space Systems, an ASRP funding recipient, was reflected in the recent announcement of a Cooperative Research Centre on Space Environment Management, of which EOS is an integral partner.
- A number of projects continued their work, albeit in a different form. The Pathways to Space project evolved into 'The Mars Lab' after funding of $2.9 million was secured from the NBN-Enabled Education and Skills Services Program.

- The collaborative consortiums set up under the ASRP program established three space specific centres that continue to operate: the Satellite Positioning for Atmosphere, Climate and Environment (SPACE) Research Centre at the Royal Melbourne Institute of Technology; the Australian Centre for Space Engineering Research at the University of New South Wales Australian Defence Force Academy; and the Advanced Instrumentation and Technology Centre (AITC) at the ANU.

Key Priorities for the 2014-2015 Financial Year

ASUP Principle	ASUP Commitments	Lead Agency and co-Lead	Priority	Intended Action/s	Level of Investment (required investment in brackets)	Timeframe
1	1, 2,4	SCO/ SCC	High	Secretariat to the SCC to facilitate discussion on determining Australia's national requirements from space capabilities and to focus on space applications of national significance	(within existing resources)	Ongoing
2	2	SCO	Medium	As central point of contact for international engagement on civil space activities the SCO will continue to promote Australia as a preferred location for ground infrastructure at international forums such as the International Astronautical Congress (IAC)	(within existing resources)	Ongoing
2	3, 10	SCO	High	The SCO will continue to develop its capability database to monitor domestic capability that can make contributions to international satellite projects.	(within existing resources)	Ongoing
2	9	SCO	Medium	The SCO will actively contribute to the cooperative	(within existing resources)	Ongoing

ASUP Principle	ASUP Commitments	Lead Agency and co-Lead	Priority	Intended Action/s	Level of Investment (required investment in brackets)	Timeframe
				international mechanism for EOS with active participation at APRSAF-21		
3	1	SCO	High	The SCO will maintain its portal as a national contact point for international engagement and coordination processes	(within existing resources)	Ongoing
3	3	SCO	Medium	The SCO will maintain an international events calendar to ensure Australia is appropriately represented at key international forums.	(within existing resources)	Ongoing
4	1	SCO	High	The SCO will continue to managing bilateral and multilateral treaties with our international partners	(within existing resources)	Ongoing
4	2	SCO	Medium	The SCO will contribute to the Long-Term Sustainability Working Group as co-chair of Expert Group D.	(within existing resources)	Ongoing
4	4	DFAT/ SCO	Medium	The SCO will engage with DFAT in regards to discussions finalising the Code of Conduct	(within existing resources)	Ongoing
5	2	SCO	High	The SCO will continue to implement the coordination framework and act as secretariat for the SCC and Space COI as well as actively contribute to working groups.	(within existing resources)	Ongoing
5	6	SCO	High	The SCO will encourage Government agencies that plan to procure/develop space capabilities to discuss these plans with the	(within existing resources)	Ongoing

ASUP Principle	ASUP Commitments	Lead Agency and co-Lead	Priority	Intended Action/s	Level of Investment (required investment in brackets)	Timeframe
				SCC		
6	3,4	SCO	High	The SCO will promote Australia's skills to the global space community at appropriate international forums with the aim to possibly facilitate inter-government and industry exchanges.	(within existing resources)	Ongoing
7	2	DFAT/ SCO	Medium	To SCO will participate in the DFAT coordinated interagency process to develop a TOC	(within existing resources)	Ongoing
7	3	SCO	High	The SCO will continue to act as chair and facilitate the Space COI	(within existing resources)	Ongoing

Key Priorities beyond the 2014-2015 Financial Year

The SCO's key priority is to continue as the central point of contact and coordination for all civil space activities. The SCO continues to administer the *Space Activities Act 1998* and will engage further with our international partners on the development of any necessary treaty-level agreements. The SCO will also further engage with the space industry sector, particularly in the context of the Australian Government's advanced manufacturing agenda.

Department of Infrastructure and Regional Development

Synopsis

Our national transport system increasingly relies on satellite technology particularly position, navigation and timing (PNT) services for communications, navigation and surveillance (CNS). Core applications in Australia utilise data and signals provided from the Global Positioning System (GPS) of the United States.

The wider application of satellite technology in our transport systems can provide enhanced safety, capacity, efficiency and environmental benefits.

The aviation and maritime sectors are significant users of satellite services for CNS provided by satellite based infrastructure primarily GPS. The availability of PNT services with a high degree of accuracy, integrity, reliability and availability is increasingly associated with more precise aircraft and maritime operations.

However while the use and reliance of these sectors continues to mature, potential vulnerabilities may also arise as a result of reliance on a single system, emphasising the importance of back-up arrangements and contingency planning.

By comparison, the rail and road sectors are less advanced in the uptake of satellite based technology although this could be expected to increase in the future.

Rail use of satellite technology continues to advance with the further development of the Advanced Train Management System (ATMS) by the Australian Rail Track Corporation (ARTC). ATMS is a digital communication based network management system that allows track controllers to continuously monitor train movements, enforce safe following distances and issue permission for trains, or work crews, to use track. This will improve safety, increase track capacity and reduce operating costs.

In relation to road transport, technology developing in the area of Intelligent Transport Systems (ITS) is expected to lead to an increase in demand for PNT signals by this sector in the future. The current main example of the use of satellite technology in road transport in Australia is the Intelligent Access Program, which provides heavy vehicle operators with greater access to the road network in exchange for monitoring their compliance with road access

conditions. Further details are provided below for each of the four major transport sectors, *Aviation, Maritime, Rail and Roads.*

Synopsis (Aviation)

Australia is increasingly adopting satellite-based technologies to enhance the safety, efficiency and capacity of its air traffic management (ATM) system.

Consequently there is a growing dependence on aviation communication, navigation, surveillance (CNS) applications which draw on Global Positioning System (GPS)/ Global Navigation Satellite System (GNSS) data.

Australia will continue to maintain a robust traditional ground-based surveillance and navigation capacity, including a modern en-route radar network.

The Civil Aviation Safety Authority (CASA) and Airservices Australia (Airservices) have critical roles in oversighting and guiding the development of Australia's future ATM system.

Civil Aviation Safety Authority (CASA)

CASA is the Australian national civil aviation safety regulator including the regulation of air traffic services.

CASA develops, promulgates and oversights the implementation of appropriate aviation safety standards in accordance with the International Civil Aviation Organisation (ICAO) Standards and Recommended Practices (SARPs).

Many of these SARPs establish the framework and required performance standards for use of satellite based technologies in Australia's ATM system to ensure national safety-based applications and global compatibility.

Airservices Australia (Airservices)

Airservices, as Australia's major civil air navigation service provider, plans to invest over $1 billion over the next five years in new and upgraded air traffic facilities and services including satellite-based ATM technology.

Australia's evolving ATM environment

Australian aviation has been using satellite based technology since the early 1990s in CNS/ATM applications.

CASA has established mandated Automatic Dependent Surveillance – Broadcast (ADS-B) and Performance-based Navigation (PBN) requirements which transition the aviation industry over the next five years to the wider application of satellite-based applications in aircraft and in air traffic control.

SATCOM technology are also being used to provide reduced separation and flexible routing in aircraft oceanic operations.

ADS-B is being implemented to provide surveillance of air traffic across the whole of Australia, except for aircraft operating at lower flight levels. Such extensive coverage is considerably less expensive and much more practicable than using legacy, ground-based radar systems.

GNSS based PBN is being implemented, which will enable an estimated 200 conventional ground-based navigation aids to be decommissioned.

PBN will enable more direct and flexible route structures without the need for ground-based systems.

For aircraft operators, GNSS based navigation equipment will be used for departure, en route, arrival and approach operations.

Both systems are part of the ICAO Global Air Navigation Plan for the improvement of air navigation and global harmonisation.

Global harmonisation of CNS/ATM systems is important for interoperability of Australian aircraft operating internationally but also to enable foreign aircraft to operate in Australian airspace.

Key space-related activities (Aviation)

CASA has a number of GNSS based surveillance and navigation mandates in place that come into effect progressively from December 2013 until February 2017.

Airservices major capital investment in infrastructure, such as a nation-wide ADS-B surveillance network, underpins the increasing provision of air traffic control services using satellite-based technology.

Background (Aviation)

ADS-B

ADS-B is an advanced surveillance technology that enables equipped aircraft to continually broadcast their identification, current position, altitude, and velocity through an on-board transmitter that can be received by ADS-B ground stations or other ADS-B equipped aircraft. Aircraft equipped with ADS–B Out equipment provide air traffic controllers with real-time position information that is more accurate than the information available with current radar-based systems.

ADS-B allows surveillance of equipped air traffic across Australia for a relatively modest cost, increasing safety and the efficient use of airspace.

This is a significant benefit as Australia's radars are mainly located around capital cities and larger regional centres, particularly on the east coast, which is in contrast to the extensive radar coverage in Europe and the United States of America.

The ADS-B mandates apply to all aircraft operating in Australian airspace under the instrument flight rules (IFR). The key ADS-B implementation dates are:

- From 12 December 2013 all aircraft operating at or above FL290 (i.e. above 29,000 feet) are required to have ADS-B transmitting equipment.
- From 6 February 2014 all IFR capable aircraft new to the Australian register must be equipped with ADS-B.
- From 4 February 2016 all IFR aircraft operating in Class A, B, C or E airspace within the 500 Nautical Miles quadrant north and east of Perth must be ADS-B equipped.

GNSS

Global Navigation Satellite Systems (GNSS) are satellite based navigation systems and sensors that provide inputs to aircraft area navigation systems.

These navigation systems enable the aircraft to navigate over complex routes and interface to the modern glass Liquid Crystal Displays with moving colour base-maps and advanced guidance systems.

GNSS derived position accuracy remains precise and constant everywhere, unlike the accuracy of navigation by ground based navigation aids which

decreases significantly with increasing distance from the aid or inertial systems where accuracy degrades over time.

Advanced Surface Movement Guidance and Control Systems (A-SMGCS)

A-SMGCS is a multi-sensor air traffic surveillance system that enables aircraft and vehicles on the aerodrome runways and taxiways to be accurately tracked in all visibility conditions by Air Traffic Control.

It is an important system for reducing the risk of a collision between aircraft and between aircraft and ground based vehicles.

The technology relies primarily on aircraft Mode S transponder and ADS-B transmissions. Airservices is installing A-SMGCS at Sydney, Melbourne, Brisbane and Perth airports.

Terrain Awareness and Warning System (TAWS)

TAWS includes a digital terrain map against which the position and altitude of the aircraft is compared. If the terrain poses a threat to the aircraft, a warning is provided to the pilots.

Aircraft position for TAWS is determined using GNSS.

Automatic Dependent Surveillance-Contract (ADS-C)

The presentation of automatic position reports (ADS-C) from aircraft flying oceanic or in remote areas on Air Traffic Controllers' displays allows the same safety and efficiency benefits to be realised where installation of radar is not practical or is economically unviable. ADS-C usually communicates with the air traffic management system via a SATCOM data link.

Performance-based Navigation (PBN)

ICAO's highest priority is to rapidly implement PBN in order to maximise the associated safety, economic and environmental benefits which have been made possible by advances in navigation technology and the development of internationally agreed navigation standards.

This initiative aims to safely maximise the utilisation of available airspace through initiatives such as reductions in oceanic and en-route separation standards and track miles flown during approach to land procedures in terminal airspace.

PBN is being implemented in Australia and from 4 February 2016 will be based on GNSS.

Key Priorities for the 2014-2015 Financial Year (Aviation)

CASA's next stage for implementation of the avionics mandates is as follows:

- From 6 February 2014 – newly registered aircraft operating under the Instrument Flight Rules (IFR) must be GNSS equipped; and
- From 6 February 2014 – newly registered aircraft operating under the IFR must carry serviceable ADS-B transmitting equipment.

Key Priorities beyond the 2014-2015 Financial Year (Aviation)

The GNSS and ADS-B implementation dates for future avionics mandates are as follows:

- From 4 February 2016 – all existing aircraft operating under the IFR must be GNSS equipped;
- From 4 February 2016 - aircraft operating under the IFR in Class A, B, C or E airspace and that is within the arc of a circle that starts 500 Nautical Miles true north from Perth aerodrome and finishes 500 Nautical Miles true east from Perth aerodrome must carry serviceable ADS-B transmitting equipment; and
- From 2 February 2017 – all existing aircraft operating under the IFR must carry serviceable ADS-B transmitting equipment.

Major Opportunities (Aviation)

OneSKY Australia

A key strategic priority for Airservices and the Department of Defence in the medium term is to plan, develop and implement a new air traffic management platform to meet both organisations' future needs.

Airservices and the Department of Defence are currently undertaking a joint procurement process to secure the new platform.

The new system will be reliant on satellite-based technology for surveillance functions and presents an opportunity to enhance harmonisation of civil and military aviation through the development of a joint operational concept and national solutions to replace or enhance current systems.

Synopsis (Maritime)

The Australian Maritime Safety Authority (AMSA) provides a range of regulatory functions, facilities and services that significantly use satellite-based technology including:

- the Australian Rescue Coordination Centre (RCC) with a capacity to handle maritime and aviation distress situations and by maintaining two COSPAS-SARSAT[3] ground stations and the Mission Control Centre for the detection of satellite distress beacons;
- the provision of navigational services (in the main, a network of aids to navigation to meet the needs of levy-paying commercial shipping) necessary for ocean and coastal navigation;
- vessel tracking services, including administration of the Modernised Australian Ship Tracking and Reporting System (MASTREP) and, utilisation of shore-based and satellite based automatic identification systems (AIS) and long range identification and tracking (LRIT) of ships; and
- a high frequency (HF) distress and safety maritime radio communication network.

Key space-related activities (Maritime)

AMSA is a significant user of satellite technology for a number of applications including pollution surveillance, oil spill and disaster response, ship and navigation safety and ad-hoc imagery.

AMSA collects and uses satellite-sourced AIS information for ship reporting, monitoring and other emerging purposes.

AMSA's search and rescue responsibilities involve a heavy reliance on the detection of GNSS-enabled distress beacons.

AMSA is also active in international bodies, such as the IMO, the ITU and the International Association of Marine Aids to Navigation and Lighthouse

[3] Cospas-Sarsat is an international distress beacon detection system. See http://cospas-sarsat.int/en for further details.

Authorities (IALA) which deal (in part) with radionavigation and satellite-based systems, procedures, policies and radio-communications.

AMSA's key activities that involve a space-based element are provided below. These activities have been categorised under the three main space applications of national significance: Earth Observations from Space (EOS); Position, Navigation and Timing (PNT) and, Satellite Communications (SC).

	Key AMSA Activities	EOS	PNT	SC
1	`		Y	
2	Vessel Traffic Service (VTS) in the Great Barrier Reef and Torres Strait		Y	Y
3	Facilities for Australian Global Maritime Distress and Safety System (GMDSS) Network			Y
4	Search and Rescue (SAR) functions		Y	Y
5	Improved detection of satellite distress beacons		Y	Y
6	Detection of ships' Automatic Identification System transmission by satellites (S-AIS)		Y	Y
7	Facilities for IMO-mandated Long Range Identification and Tracking (LRIT)		Y	Y
8	Promulgation of Maritime Safety Information (MSI)			Y
9	Satellite monitoring of aids to navigation (AtoN) status and performance		Y	Y
10	Pollution Surveillance	Y		
11	Disaster Response	Y		
12	Use of Oil Spill Response Atlas (OSRA) during marine oil pollution incidents	Y		
13	Ad-hoc uses	Y	Y	Y

Background (Maritime)

1. A Differential Global Positioning System (DGPS) network to provide differential correction service – (ASUP) Principles 1, 2, 5, 6 & 7

GNSS (in particular GPS) has become the primary means by which ships determine their position and timing for navigation. As the International Maritime Organization (IMO) has issued operational requirements for worldwide radionavigation systems, GNSS integrity has become as important as observation of position.

AMSA operates a Differential Global Positioning System (DGPS) network that comprises 16 medium frequency (MF) broadcasting stations at selected sites around Australia's coast.

The broadcast MF signal coverage extends approximately 150 nautical miles offshore. These DGPS stations are co-located with GPS reference and integrity monitoring stations.

Integrity monitoring is a vital feature of AMSA's DGPS network. The GPS reference stations test for GPS signals that are out of specification and immediately notify user receivers to disregard such signals.

With the use of DGPS, such a warning is generated within a few seconds of the satellite becoming 'unhealthy', compared to the GPS system itself, where up to 12 hours can elapse before notification is received.

2. Vessel Traffic Service within the Great Barrier Reef and Torres Strait – ASUP Principles 1, 2, 5 & 7

Vessel Traffic Services (VTS) are shore-based organisations that provide a range of services from the provision of simple information messages to ships (such as position of other ships, navigational and meteorological hazard warnings) to navigational assistance and traffic organisation within a port (port VTS) or waterway (coastal VTS).

Usually, ships entering a VTS area report to the VTS authority using marine very high frequency (VHF) radio. The ships may also be tracked by the VTS using radar, received AIS information or other means, including satellite-based technology.

The Great Barrier Reef and Torres Strait Vessel Traffic Service (REEFVTS) is a coastal VTS introduced by the Australian Government in 2004 to improve the safety and efficiency of vessel traffic in the region.

REEFVTS is jointly managed by Maritime Safety Queensland and AMSA and its designated area extends from Torres Strait and the Great North East Channel to the waters of the Great Barrier Reef from Cape York to the southern boundary of the Great Barrier Reef Marine Park.

REEFVTS utilises three different types of sensor input, including the satellite technology, to identify and monitor the transit of individual ships. These sensor inputs are radar, Automatic Identification System (AIS) and Automated Position Reporting (APR) via satellite (Inmarsat-C) as part of the mandatory Ship Reporting System (REEFREP) operating in the Great Barrier Reef and Torres Strait.

The information from these sensors is integrated to provide a single traffic image. REEFVTS relies heavily on ships having accurate position information with high reliability from the GNSS.

3. Facilities for Australian Global Maritime Distress and Safety System (GMDSS) Network - ASUP Principles 1, 2, 5 & 7

The Global Maritime Distress and Safety System (GMDSS) designates 4 Inmarsat ocean regions and each region has a number of associated Land Earth Stations (LESs), which provide the interface between ships at sea and shore telecommunication networks.

The Australian LES is located at Perth (Western Australia) and serves both the Indian Ocean Region (IOR) and Pacific Ocean Region (POR). The Perth LES is part of the Stratos Global network, which also uses an LES at Burum in the Netherlands, giving access to the Atlantic Ocean Regions (East and West) and Indian Ocean.

The Australian Government has designated its surrounding waters as GMDSS Sea Area A3. Ships within A3 Sea Area will typically transmit a ship-shore alert either via Inmarsat-C, Inmarsat-B, Fleet77, high frequency (HF) Digital Selective Calling (DSC), and/or satellite Emergency Position Indicating Radio Beacon (EPIRB).

The Australian GMDSS HF DSC network is provided by the remote-controlled stations located at Charleville (Queensland) and Wiluna (Western Australia). The network consists of a HF DSC alerting network with the ability to provide follow-on HF voice or telex communications on at least two frequencies simultaneously.

The network is centrally controlled and operated from Canberra alongside the RCC with all HF sites being unmanned. The sites are linked directly by

diverse satellite paths (Ku-band satellite and C-band) to the Network Control Centre (NCC) as well as the Back-up Network Control Centre.

AMSA's RCC undertakes distress communications (including broadcast of Inmarsat-C distress relays) with ships via the Perth and other Inmarsat LES. Also, for safety-related operational communications to ships at sea, the RCC uses various systems including satellite communications.

4. Search and Rescue functions - ASUP Principles 2, 5, 6 & 7

AMSA is responsible for monitoring the transmission of COSPAS-SARSAT 406 MHz satellite distress beacons throughout the Australian Search and Rescue Region. AMSA has established two ground stations (also known as local user terminals or LUTs) for the COSPAS-SARSAT system. These two LUTs are located at Albany (Western Australia) and Bundaberg (Queensland) and they are connected to the Mission Control Centre (MCC - also known as data distribution centres) at the RCC, Canberra. New Zealand has established LUTs for Low Earth Orbiting (LEO) and geostationary orbit (GEO) satellites at Wellington, which are also linked to the MCC in Canberra.

PNT information obtained from GNSS is widely used in Search and Rescue (SAR) functions. Any navigational or distress positioning information invariably relies on GNSS. At an operational level, AMSA uses accurate positional data to define and plot search areas.

At a tactical level, it is used by all SAR units to ensure they search allocated areas. This includes the navigation of SAR aircraft, SAR vessels, coastal and inland SAR units using hand-held GNSS devices. An increasing number of marine products are being developed that use GNSS positional data for tracking and distress alerting. Examples include: the SPOT Satellite GPS Messenger (providing personal satellite messaging and emergency communication services) and Iridium-based products.

Additionally, AMSA uses Argos satellites for tracking self-locating datum marker buoys (SLDMB). These buoys are designed to measure surface ocean currents, which AMSA uses to estimate drift in search and rescue and pollution incidents.

5. Improved detection of satellite distress beacons - ASUP Principles 1-3, 5-7

The International COSPAS-SARSAT system is in the process of upgrading its satellite system by placing search and rescue receivers on new medium-altitude earth orbiting (MEO) satellites.

These receivers will augment search and rescue receivers currently installed on LEO and GEO satellites. The augmented system will dramatically improve both the speed and location accuracy of distress beacon detections, and is expected to be operational by 2017.

The Australian component of the MEOSAR satellite system includes construction of a satellite receiving ground station (Medium Earth Orbit Local User Terminal - MEOLUT) in Western Australia and installation of a central processing computer in Canberra.

A joint procurement exercise is being conducted by Australia and New Zealand to provide the MEOSAR equipment ready for operational use by 2017.

6. Detection of ships' Automatic Identification System transmission by satellites (S-AIS) - ASUP Principles 1, 2, 3, 5, 6 & 7

Automatic Identification System (AIS) is a ship and shore-based data exchange system operating in the very high frequency (VHF) maritime band.

AIS is used to exchange information such as vessel identification, position, course, speed, cargo information etc.

AIS is currently being used for numerous other applications – far more than what it was originally intended. Some examples include: vessel tracking, as an aid to navigation, and exchange of application specific messages.

Detection of ships' AIS transmissions by low-earth orbiting satellites is a commercial reality which AMSA utilizes to enhance maritime domain awareness, examine ship traffic patterns, plan ship routing systems, assist search and rescue operations, assist in responding to oil spills and identifying polluters, and in aids to navigation planning.

Satellite AIS provides an extension to Australia's terrestrial AIS receiver network, providing coverage for the Australian search and rescue region. Currently, AMSA's provider of S-AIS uses ground receiving stations outside Australia. Continuous coverage in time is not possible yet, but the satellite constellation is increasing and AMSA will benefit from a more fully populated AIS-S constellation.

AIS data acquired by satellite is also used to verify whether proposals for offshore exploration and extraction operations are proximate to shipping traffic.

AMSA uses both terrestrial and satellite historical AIS ship positions in coastal and high seas environments to ascertain traffic patterns for subsequent nautical advice to proponents of resource exploration and production.

Such nautical advice also has a roll-on effect to the Australian Hydrographic Services for nautical charting action, and for issuing amendment to relevant nautical publications.

AMSA operates an Under Keel Clearance Management (UKCM) system in the Torres Strait to assist ships transiting through the established shipping route. The UKCM system requires ships' position to be monitored via AIS so that minimum under-keel clearance is not violated.

Spatial data sourced from various satellite systems is used in Marine Spatial Planning initiatives, with facilitation of inter and intra agency support.

From 1 July 2013, the Australian Ship Reporting System (AUSREP) was replaced by the MASTREP (Modernised Australian Ship Tracking and Reporting System). MASTREP uses terrestrial and satellite detection of ship broadcast AIS information to provide a near real-time plot of ships' positions for both the RCC and AMSA's other statutory requirements. This information significantly enhances RCC Australia's ability to identify ships to assist in the event of a search and rescue incident.

7. Long Range Identification and Tracking (LRIT) - ASUP Principles 1, 2, 3 & 7

Long Range Identification and Tracking (LRIT) refers to an IMO-mandated system that requires vessels to automatically transmit their identity, position, date/time of position at six hour intervals.

LRIT is international maritime domain awareness (MDA) initiative which allows States to receive position reports from vessels operating under their flag, vessels seeking entry to a port within their territory, or vessels operating in proximity to the State's coastline. MDA provides enhanced security, environmental protection and safety/search-and-rescue benefits.

LRIT system design is based on a multi-tiered receiving system of data centres comprising of distributed data centres that report to a central International Data Exchange (IDE). Vessel position reports are made available to States for purchase whenever a vessel is within 1,000 nautical miles of the purchasing coast or when a vessel seeking entry to a State's port.

States can establish one of the three styles of LRIT data centre, namely: a national LRIT data centre (NDC), a Regional or Cooperative LRIT data centre (RDC or CDC respectively) or an International LRIT data centre (IDC).

The LRIT terminals are small approved L-band satellite terminals (Inmarsat or Iridium). In search and rescue situations, AMSA's RCC can remotely command a ship's LRIT terminal to update reporting at an increased rate, up to once every 15 minutes, at no cost to the RCC.

AMSA has contracted services of an overseas data provider for the LRIT NDC solution. As such, there is no dedicated infrastructure for LRIT in Australia. However, the Inmarsat LES in Perth (Western Australia) may be used by the ships to transmit their LRIT messages.

Australia has expanded its NDC to become a Cooperative Data Centre (AusCDC). The AusCDC is also operated by AMSA's LRIT provider, with services for Papua New Guinea, Cook Islands, New Zealand and Palau under a cooperative arrangement.

8. Promulgation of Maritime Safety Information - ASUP Principles 1, 2, 3, 5 & 7

Maritime Safety Information (MSI) such as a navigational warning is issued by the RCC within Australia's maritime area (search and rescue region, and NAVAREA X). The MSI also contains a section, approved by the Bureau, on meteorological information promulgated in a similar manner under the GMDSS.

The RCC and the Bureau provide MSI through Inmarsat's SafetyNET system. In addition to SafetyNET, the RCC may avail itself of the Inmarsat-B/Fleet77's "All Ships" broadcast facility for search and rescue type broadcasts. These broadcasts cover an entire ocean region.

Under the World Wide Navigational Warnings Service, Australia is the area Coordinator for NAVAREA X. RCC issues two main types of warnings: coastal warnings and long range warnings, to align as closely as possible with World Wide Navigational Warning Service and Inmarsat recommendations. NAVAREA X warnings are promulgated on Inmarsat-C on both the POR and IOR satellites.

The RCC may initiate the following types of broadcast using Inmarsat-C Enhanced Group Calling (EGC): distress messages, urgency messages, NAVAREA X warnings, AUSCOAST warning and general messages.

The Bureau initiates two types of broadcasts: forecasts and warnings.

9. Satellite monitoring of aids to navigation status and performance - ASUP Principles 1, 2, 3, 5 & 7

Satellite AIS is being used to provide a second means to verify the operational status of AIS aids to navigation (AtoN), as a backup to the terrestrial AIS network. In addition, small Inmarsat and Iridium satellite terminals are used to provide status of visual, radar, and other AtoN, outside the range of terrestrial cellular mobile networks, whether near land or further off shore.

Within AMSA's AtoN network, there are over one hundred AtoN that utilise satellites for remote monitoring purposes.

Additionally, there are also a number of AtoN that use satellite information for other purposes such as timing and synchronisation (e.g. AIS stations - base stations, repeaters and AIS AtoN) and tide gauge sites that use timing information and, AtoN with GPS synchronisation equipment used for synchronised lights.

For satellite monitoring the AtoN are polled via satellite twice per day and the reports are sent back to AMSA's AtoN contractor via email where they are logged in a database. AMSA utilises satellite monitoring for AtoN in very remote areas that do not have 3G or 4G mobile network, fixed line or AIS coverage.

10. Pollution Surveillance - ASUP Principles 1, 2, 3, 5, 6 & 7

Under the National Plan, AMSA manages several oil spill response decision support systems, and conducts research into the use of other technology and services that could assist in oil spill response and monitoring.

In 2012, AMSA conducted a successful initial three month pilot trial in the use of Satellite-based Synthetic Aperture Radar (SSAR) for oil spill detection and monitoring Australian Waters, which was then followed by a second three month trial in the first half of 2013 (also completed successfully).

The purpose of the initial 2012 trial was to demonstrate the utility of near real-time SSAR oil spill and vessel monitoring for Australian conditions, while the 2013 trial tested the capabilities of a recognised service provider and of AMSA to receive, assess and respond appropriately to alerts of a suspected or known spill within Australian waters.

The trials demonstrated that near real-time SSAR would work for Australian conditions. It also tested the ability of the service provider to deliver oil spill monitoring services that AMSA could act upon effectively. Both trials met all of AMSA's expectations, including daily satellite coverage over the areas

chosen, and the delivery of near-real-time notifications supported by analysis and imagery.

Based on the success of these trials, AMSA will extend the capability to use SSAR in the longer term to identify and assist when responding to marine pollution incidents. Apart from providing on-going monitoring for potential oil spills, the service will also provide on-going response support during an actual oil spill event.

If a significant oil spill incident occurs during the monitoring contract, the scope of services can be scaled up to support the response to the incident and an emergency service activated by the service provider.

This project will be a major contribution to AMSA's strategic vision in terms of marine environment protection and environmental response.

In particular, it will assist in providing effective monitoring and enforcement of illegal discharges in Australia's Exclusive Economic Zone. In relation to enforcement activity, positive information derived from SSAR imagery will provide real evidence to substantially enhance capability for legal proceedings against vessels that violate Australian pollution laws.

11. Disaster Response - ASUP Principles 3, 5, 6 & 7

The International Charter "Space and Major Disasters" provides a unified system of satellite data acquisition and delivery through authorised users to areas affected by natural or man-made disasters.

The Charter was activated by Australia to receive satellite imagery, free of charge, during the Rena oil spill incident in October 2011 (New Zealand), and more recently (March-May 2014) during the search for missing Malaysian Airline flight MH370.

Under the Charter, during the Rena incident a number of satellite imagery types were received that greatly assisted the response efforts. The imagery used was mainly of high-resolution and multi-spectral, but some SSAR imagery was also used.

It was found that in an oil spill situation there are varying degrees of benefits in using different types of imagery. The SSAR imagery captured during one of the spills clearly showed the extent of the oil slick whilst the high-resolution, multi-spectral imagery was useful for locating drifting shipping containers which had fallen overboard from Rena.

The main issue however, was that of imagery acquisition frequency, which can be critical during an oil spill incident. Because of the fast dynamics of the

oil slick and containers moving with the current, and the large delays between acquisition and final delivery of satellite imagery, the images provided limited benefits.

The main benefit was the provision of a method for validating and quantifying the accuracy of the trajectory models generated for the spill.

Any advances in satellite-based or ground-based technology, leading to immediate image acquisition and delivery, would greatly improve the benefits of such earth observation systems during oil spill and other disaster situations.

12. Oil Spill Response Atlas (OSRA) - ASUP Principles 1, 2, 3, 5, 6 & 7

AMSA's Oil Spill Response Atlas (OSRA) is a resource atlas based on a spatial database and customised Geographic Information System (GIS)-embedded toolkit designed to streamline the delivery of vital modelling, environmental, biological and logistical information to marine spill responders during marine pollution incidents.

Geospatial data is collected from the various agencies that are involved in oil spill response, and updates to the database are carried out on a regular basis.

Apart from GIS layers, the database also contains extensive satellite remote sensing images covering most of the Australian coastline. On some occasions, these are provided by the States/NT although they are mostly derived from other sources.

The satellite imagery is mainly optical/multi-spectral and is used within OSRA to provide various types of information to support a response such as:

- definition of shoreline types to assist shoreline assessment and clean up teams;
- logistical information relating to access points, existing infrastructure (e.g. road access, boat ramps, jetties etc.) and surrounding topography, all of which are essential factors in planning for equipment deployments, access to affected shores, and waste management;
- to detect and quantify the growth, spread and movement of oil. This then helps to validate and refine oil spill trajectory models used for monitoring an oil spill.

13. Ad-hoc uses - ASUP Principles 1, 2, 3, 5, 6 & 7

Derived satellite imagery products support the work of users across AMSA. For search and rescue purposes, satellite imagery at various scales is used to provide situation awareness of topography and vegetation at an incident site. Hybrid geospatial information solutions (e.g. street maps overlaid onto satellite imagery) are used for location of accidental distress alerting beacon activations.

On several occasions the SENTINEL national bushfire detection system has also been used for searches involving missing aircraft.

High resolution satellite imagery and aerial photography are used to verify site leases or for construction purposes. Coarser satellite imagery or larger cell sizes is not generally used.

High resolution satellite imagery and satellite based synthetic aperture radar information have been used to support search and rescue activities which have occurred in the Antarctic area of the Australian Search and Rescue Region.

In combination with AIS data, additional ad-hoc multi-spectral or panchromatic satellite imagery can also be acquired to provide supporting evidence of vessel discharges when undertaking marine pollution investigations to support prosecutions.

Key Outcomes (Maritime)

1. A Differential Global Positioning System (DGPS) network to provide differential correction service

AMSA's DGPS network was completed in 2002. In 2006, the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) assessed the current and future use of the DGPS system and recommended that in the short to medium term, the DGPS radio beacon remains the most cost effective method for integrity monitoring and providing differential corrections.

IALA further advised national members should recapitalise their DGPS network to ensure their continued reliability. AMSA has subsequently undertaken a partial recapitalisation of its network (four sites) to provide sufficient new equipment and spare parts to sustain the equipment for a further five to ten years.

AMSA has conducted a survey of the users to gauge the uptake and usefulness of its DGPS service. The DGPS user survey ran for six months from October 2013 to March 2014 and consisted of 15 short questions. The survey findings revealed that an overwhelming 98.5% of the respondents (from a total of 134 responses) found AMSA's DGPS service useful.

2. Improved detection of satellite distress beacons

AMSA is involved in a joint procurement exercise with its counterpart in New Zealand to provide MEOSAR capability for Australia and New Zealand.

It is expected that a preferred tenderer will be selected and work commenced in the 2014-2015 financial year, with Australia and New Zealand having an operational MEOSAR capability by 2017.

3. Detection of ships' Automatic Identification System transmission by satellites (S-AIS)

AMSA is planning to negotiate a contract extension with the current provider of satellite AIS data.

4. Pollution Surveillance

The 2012 and 2013 trials were able to successfully meet AMSA's most critical expectations:

- adequacy of satellite coverage – coverage over Australian waters was sufficient for an effective daily spill monitoring. This was comparable to acquisitions over Europe, where this service has been running successfully since 2006.
- image acquisition – acquired up to twice daily (dawn and dusk), as required.
- delivery timing – the service provider was able to deliver analysed imagery in near real-time at an average of 54 and 69 minutes respectively, from satellite acquisition to delivery to AMSA.
- reporting quality – the service provider's system was suitable for AMSA's needs in terms of both near real-time priority and routine communication.
- reception of alerts – AMSA was able to receive and interpret the information through the RCC, assess the report and deliver it to the Pollution Duty Officer for action.

Key Priorities for the 2014-2015 Financial Year (Maritime)

AMSA's significant procurement activities for the 2014-2015 financial year are:

- establishing a contract for a satellite receiving ground station (MEOLUT) in WA and installing a central processing computer in Canberra over the next few years;
- extending the contract for the provision of Satellite-AIS data (over $400,000);
- tendering for a contractor to provide full implementation of an oil spill monitoring service in Australian waters (cost to be finalised); and
- research and build Australian capability to deliver an oil spill monitoring service in the future ($150,000).

Key priorities beyond the 2014-2015 financial year (Maritime)

Over the next three financial years, AMSA plans to fully implement the use of Satellite-based Synthetic Aperture Radar (SSAR) for oil spill monitoring in selected areas of interest (yet to be determined). The two main objectives will be:

- identification of marine pollution incidents for the purpose of compliance and/or response; and
- maintaining the capability to use and scale up access to the service during a response.

Currently, there are no established service providers within Australia that are able to provide the same level of integrated and effective oil spill monitoring service as that which is being provided by the current overseas provider.

It is intended that AMSA continue to use the services of an external service provider in the short term; however, it envisages that a local Australian capability to deliver the same service would be gradually developed in the near future to meet the same level of service.

AMSA will explore and research over the next couple of years how this capability could be established.

Other key priorities (within 3-5 year time frame) include:

- Building and commissioning the new MEOSAR ground facility (MEOLUT) and installing a central processing computer in Canberra;
- Increasing the acquisition of satellite AIS data, and improving the latency of data (perhaps via Australian ground stations);
- Enhancing the use of satellite imagery for marine oil spill response;
- Improving use of satellite imagery for remote area search and rescue activities;
- Renewal of contracts for Inmarsat distress and safety services through Perth Land Earth Station (and Burum, the Netherlands);
- Monitoring developments in satellite-provided PNT; and
- Working nationally and internationally to enhance data communications for ships at sea (by terrestrial and satellite means).

Major Opportunities (Maritime)

1. International Charter

AMSA has identified the International Charter "Space and Major Disasters" (http://www.disasterscharter.org/home) as an additional mechanism to access remote sensing imagery and services during a major oil spill response. AMSA is not a signatory to the Charter and therefore is unable to directly activate it in the event of a major incident; however AMSA may collaborate with Geoscience Australia who is an authorised user of the Charter.

The Charter was activated during the oil spill incident from Rena in New Zealand in October 2011, during which a number of satellite imagery types were received and greatly assisted in intelligence gathering and data validation during the response.

It was also activated in response to the search for missing Malaysian Airline flight MH370 in May 2014.

This opportunity is in line with Principle 1 of the ASUP, which focuses on space applications that have a significance in economic and social impact, and in this case for assisting during a response to a large oil spill event. It also aligns with Principle 7, (specifically Item 4) to help develop systems for

protection of Australian interests - in this case protection of the environment - as well as of assets of economic and cultural significance.

2. Local oil spill monitoring capability

AMSA will develop in the long-term a local Australian oil spill monitoring capability, through opportunities involving established local satellite antennas and imagery analysis and processing expertise. This is in line with Principle 6 of the ASUP, which promotes collaboration between Australian public and private research and development organisations to bring greater efficiencies and cost savings.

3. Inter-agency collaboration

The automated radar-based satellite surveillance system will not only be of benefit for continuous tracking and monitoring of vessels involved in marine pollution incidents but has the potential to also link in and be complementary with that of alternative AMSA requirements (for example VTS) and other Australian Government agencies. These include Australian Customs and Border Protection Services, who have similar interests in vessel monitoring and as such, there could be cost saving benefits involved with this initiative.

The Australian Customs and the Border Protection Command manage the security and integrity of Australia's borders. It works closely with other government and international agencies to detect and deter unlawful movement of goods and people across the border using a range of aerial visual and electronic surveillance systems.

Customs/Border Protection/Coast Watch uses satellite communications systems to transmit data and imagery in near real time between surveillance aircraft and the National Surveillance Centre with this information later distributed to relevant government agencies, including AMSA.

Western Australia's land information agency (Landgate) is currently working on a project developing an oil slick flagging algorithm for use with imagery from MODIS (Moderate Resolution Imaging Spectroradiometer), a multi-spectral sensor aboard the Terra and Aqua satellites that provides free daily low resolution images of the entire Earth's surface.

This will provide the capability to have a continuous monitoring system using MODIS imagery over Australian Waters.

There is an opportunity for AMSA to potentially use this local cost effective service to complement oil spill monitoring using SSAR imagery.

These opportunities are in line with Principle 6 of the ASUP, promoting collaboration between Australian public and private research and development organisations to bring greater efficiencies and cost savings.

It also aligns with Principle 7, to help develop systems for protection of Australian interests, in this case protection of the marine and coastal environments, as well as of assets of economic and cultural significance.

Synopsis (Rail)

The Australian Rail Track Corporation (ARTC), the national interstate rail track access manager, is involved in the development of a digital Global Positioning System (GPS) based train management system to replace ageing track side signalling equipment.

Key space-related activities (Rail)

Much of the signalling infrastructure across the interstate rail network is at the end of its physical life, and the Advanced Train Management System (ATMS) could replace this track side infrastructure with digital technology-based train control.

Background (Rail)

The ATMS is a communications based safe working system being developed by ARTC to replace traditional track side signalling across the interstate rail network. The system will replace physical train control and signalling systems with an advanced geographical system utilising global positioning, mobile broadband communications and satellite technology.

Key Outcomes (Rail)

In 2013-14 ARTC successfully completed a proof of concept and safety trial of ATMS between Port Augusta and Crystal Brook in South Australia with the Australian Government contributing $45 million towards the $102.4 million project.

ATMS will improve productivity of Australia’s interstate rail freight network by reducing transit times and enable additional capacity to be unlocked from existing infrastructure while making rail freight transport safer and more efficient.

ATMS also has the potential to improve rail safety through the ability to automatically stop a train where a potential safety issue has been detected by the system.

Key Priorities for the 2014-2015 Financial Year (Rail)

In 2014-15 ARTC is progressing project planning and preparations for the subsequent phases of the ATMS Project. The first of these phases is ATMS Implementation Stage One aimed at deploying ATMS as the accredited and approved safe working system for trains operating between Port Augusta and Whyalla.

This step will allow ARTC to demonstrate the capability of ATMS on a section of network that lends itself to a simple, relatively low risk deployment that can be used to prove its potential for wider roll out.

Key Priorities beyond the 2014-2015 Financial Year (Rail)

ARTC will prepare for the deployment of ATMS on the interstate rail network.

Major Opportunities (Rail)

ARTC's deployment of ATMS's between Port Augusta and Whyalla will demonstrate both the technology and the opportunity for private sector contribution (from rail operators) for a broader rollout of ATMS on the interstate network, including in the Hunter Valley.

Synopsis (Roads)

Transport agencies have formed Transport Certification Australia which provides a technology platform to apply in-vehicle regulatory compliance monitoring of heavy vehicles in exchange for greater access to the road network, through the Intelligent Access Program.

Work is also being progressed by governments and industry to investigate opportunities to leverage telematics for other regulatory and commercial purposes. This work is particularly focusing on demonstrating the benefits to operators of adopting such in-vehicle technology.

Background (Roads)

Intelligent Transport Systems

'Intelligent Transport Systems' (ITS) is an umbrella term for the use of information and communication technology in the transport network to improve transport outcomes. 'Cooperative Intelligent Transport Systems' (C-ITS) is a subset of ITS in which the different elements of the transport network – vehicles, roads, infrastructure – share information with each other. C-ITS applications have the potential to improve safety, productivity, efficiency and environmental outcomes for the transport network, such as through applications designed for collision avoidance and reducing congestion.

C-ITS can utilise a variety of communication mediums, but will primarily utilise dedicated short range communications (DSRC), using the 5.9 GHz radio band. DSRC will allow vehicles to communicate directly with each other, delivering a high level of integrity with low system latency. The 5.9 GHz spectrum has been reserved by the ACMA for possible future use for ITS. Satellite technology is also expected to be a key element of some C-ITS applications.

Heavy vehicle telematics

Governments in Australia are closely examining the use of in-vehicle telematics for regulatory purposes.

An important application of satellite-based heavy vehicle telematics is the Intelligent Access Program (IAP). This is a voluntary programme that uses the Global Navigation Satellite System (GNSS) to monitor heavy vehicles' road use.

Road agencies can provide transport operators using IAP with greater access to their road networks; the data generated by IAP provides them with the assurance that heavy vehicles are complying with agreed access conditions. The IAP is administered by Transport Certification Australia, which certifies and audits IAP Service Providers.

Telematics applications often use GNSS technology to gather and analyse information about heavy vehicle movements. The aim is to drive the voluntary uptake of technology to improve road safety, reduce transport costs and cut emissions, through a partnership approach between government and industry.

An example of the potential use of in-vehicle telematics for regulatory purposes is the Electronic Work Diary (EWD). The EWD is an electronic

recording system that can record work and rest time for a fatigue-regulated heavy vehicle driver. EWDs will utilise GNSS technology to track vehicle location and time, thereby allowing assurance as to work time.

Australian Governments are also working on longer-term reforms to heavy vehicle charging and investment arrangements, which in future could see increased use of telematics technology. Governments are investigating options to utilise in-vehicle telematics to monitor road usage and charge operators for the cost of that usage. Revenue from these charges would then flow back to road investment according to where on the network that vehicle was used. While technically feasible, the broader issues involved are complex and further work is required before governments could consider heavy vehicle charging reforms utilising these types of technology.

Key priorities for the 2014/15 financial year (Roads)

Telematics

An implementation plan for the voluntary uptake of EWDs is being developed by the National Transport Commission (NTC) and the National Heavy Vehicle Regulator, to be provided to the Transport and Infrastructure Council.

Geoscience Australia (GA)

Synopsis

GA is Australia's national geoscience and geospatial agency and exists to apply geoscience to Australia's most important challenges. GA's strategic focus is to apply geoscience to support and deliver value through development of Australia's resources wealth, management of water, enhancing community safety, and managing Australia's marine jurisdiction.

GA also provides national geoscience infrastructure, including access to national data holdings, definition of national coordinate reference systems, operation of observatory networks, and promotion of geoscience. As well as supporting GA's own work program, this infrastructure supports the work of other Australian Government agencies, state and territory governments, researchers, international partners, and industry.

Key space-related activities

GA is Australia's lead agency for the non-meteorological operational uses of EOS, and is the lead agency for PNT and related geodetic sciences. GA has significant national programs in the areas of:

- Earth observations from space (EOS); and
- Positioning, navigation and timing (PNT).

Earth observations from space

GA has roles in leadership and planning, operational service delivery, ongoing maintenance of infrastructure and datasets, and technical collaboration.

GA works with the Bureau of Meteorology, CSIRO, state and territory governments and other stakeholders, to promote a priority-driven whole-of-government approach to the development and management of the national EOS supply chain.

GA receives data from international satellite operators to maintain a continuous record of moderate resolutions land surface observations which inform the activities of governments at all levels. GA also processes satellite data as soon as it is received to provide near-real-time information and imagery for management of natural hazards.

As well as maintaining a national archive, GA calibrates satellite imagery to produce scientific measurements of land surface reflectance. These measurements are foundation data for scientific analysis and operational mapping and monitoring.

Where appropriate, GA produces national products from satellite observations, such as bushfire hot-spots, national mapping of surface water, the Australian Geographic Reference Image which is a base for accurate mapping in remote areas, the national map of Land cover, and specialist products to support emergency response and recovery. These products provide crucial information to those seeking to make decisions about agriculture, water management and the environment.

GA works with the national and international science communities to apply or develop new techniques for quickly and reliably producing relevant information from satellite data sources. This work is also valued by satellite operators as it helps to ensure that the data collected by satellites delivers societal benefits.

GA operates ground stations and communication links to acquire EOS data directly from satellites, where necessary under agreements with satellite operators. GA also cooperates with satellite operators to maintain and share global satellite imagery archives and to share knowledge and experience in these tasks to ensure that EOS data are reliably acquired and distributed.

GA works with the National Computational Infrastructure to improve national capabilities for the management, calibration, processing, analysis and distribution of satellite data.

GA works to enhance the coordination and sharing of satellite data procured from the private sector, through the Optical, Geospatial, Radar and Elevation (OGRE) supply panel and associated information sharing forums, and through promotion of open licences and government policy on sharing of government data.

GA works directly with other Australian government agencies on a case-by-case basis to help them to deliver specific programs that require satellite observations.

Positioning, Navigation and Timing

GA operates two Satellite Laser Ranging stations (one at Yarragadee (WA) and one at Mt Stromlo near Canberra). It also collaborates with the University of Tasmania to operate the Australian Very Long Baseline Interferometry

(VLBI) array which consists of three radio telescopes in Hobart, Katherine (NT) and Yarragadee (WA) respectively.

GA also operates the Australian Regional GNSS Network, which has recently been extended through National Collaborative Research Infrastructure Strategy (NCRIS) and State government funding under the AuScope initiative to over 130 stations.

GA is working with stakeholders, including Australian Government and State Government agencies representing the transport, agriculture and emergency management sectors, to improve national positioning infrastructure. The strategic aim is to deliver a real time positioning capability with an estimated accuracy of 2cm anywhere, anytime on the Australian landmass and its maritime zones. This will also offer increased levels of integrity monitoring of the GPS system and the newly launched GNSS constellations of Russia, European Union, China and India.

International engagement

Recognising the international nature of space, and our reliance on the international community, GA participates in key international committees, including the Committee on Earth Observation Satellites (CEOS), to promote Australia's interests and ensure Australia is recognised as a valued member of the international community.

GA has strong bi-lateral relationships with key agencies including the United States Geological Survey, and seeks to provide valued contributions to their programs. GA seeks to liaise with satellite operators to secure favourable access to future sources of the public-good (non-commercial) EOS data Australia depends on for government program delivery, research and innovation.

Background

Both PNT and EOS already offer considerable benefits to Australia, in the order of $3.3 billion GDP annually in the case of EOS, and there is considerable potential to increase this. GA is working to ensure the nation is well positioned to realise these benefits, and has effective strategies to address key risks.

In the context of EOS, Australia does not operate a single EOS satellite. Of the satellites that do exist Australia is highly dependent on a very small number of them from a small number of nations. This means that Australia is not well positioned to leverage the fully diversity of satellite data available to

realise societal benefit, and creates the potential that a failure in a single satellite may cause significant disruption to Australia.

GA, in collaboration with BOM and CSIRO, works to address these issues and secure the future pipeline of key EOS data for Australia. GA does this by identifying priority missions, engaging with satellite operators to identify valuable contributions that GA can make to their programs, and undertaking the technical work necessary to ensure that data can be integrated into the national supply chain with minimal disruption.

In the context of PNT, Australia is well positioned to take advantage of a multi-GNSS future. The country's unique geographic location provides full visibility to all new constellations, including regional augmentations across the Asia-Pacific.

Through collaborative partnerships with providers of these systems, Geoscience Australia leads and coordinates PNT activities aimed at enhancing access to these systems to support and promote downstream scientific, commercial and public good applications. Whole-of-government planning through Geoscience Australia is contributing to greater awareness and understanding of the societal and economic returns that derive from ensuring issues, such as protection of the relevant electromagnetic spectrum, are well managed.

Key Outcomes

Key outcomes of the PNT activities within GA are:

- Commenced development of the GNSS Analysis Centre which will provide a sovereign capability to augment GPS and the new GNSS constellations producing significant enhancements to positioning accuracies, and to monitor system integrity;
- Formation of governance arrangements for national collaboration.
- Cross-sectorial stakeholder engagement to publicise national initiatives, and to ascertain sector requirements; and
- Development of the UN Global Geospatial Information Management (GGIM) Global Geodetic Reference Frame initiative which aims to enhance the sustainability and robustness of the global framework upon which all positioning, navigation and timing applications occur.

Key outcomes in the EOS context are:

- GA, with BOM and CSIRO, improved national coordination through regular meetings of the Australian Government Earth Observations from Space Working Group. The group bought together Australian Government agencies, state and territory governments, researchers and the broader community.

- GA continued to build the national archive of satellite imagery, increasing it by more than 9000 scenes. The archive now includes over 1.8 m scenes in total, stretching from the present day back to 1979.

- GA became an accredited international co-operator on the United States Government's Landsat-8 mission, which began operational imaging in early 2014, ensuring continuity of supply of moderate-resolution imagery into the future.

- GA completed redevelopment of the Sentinel bushfire monitoring system, ensuring it will continue to build on the successful observation of over 4 million 'hotspots' during a decade of operation by GA and CSIRO. The new system includes additional data and is more user friendly for emergency services and the general public.

- GA improved the efficiency of procurement of EOS data through operation of the OGRE Procurement Panel. The Panel enabled agencies to procure cooperatively, saving money and enabling data to be shared and repurposed across governments.

- GA became an Authorised User of the International Charter on Space and Major Disasters. GA now activates the Charter on behalf of Australia, enabling it to provide emergency managers with access to the latest imagery from space agencies and commercial satellite operators during natural disasters.

- GA became an Associate Member of the Committee on Earth Observation Satellites. GA is now contributing to a number of CEOS initiatives, including the Working Group on Information Systems and Services and the Working Group on Disasters.

- GA initiated the Australian Geoscience Data Cube, a system that enables government, industry and researchers to access and extract

value from the nation's massive holdings of EOS data using High Performance Computing such as the National Computational Infrastructure. In December 2013 GA expanded the data cube to be a cooperative activity including GA, CSIRO and the NCI.

- GA demonstrated that the Data Cube significantly lowers the technical barriers to the use of EOS, enabling analysis of decade's worth of data at national scale in hours. This contrasts with the years such an analysis would have taken under previous models.

- GA delivered the 'Water Observations from Space' (WOfS) product as part of the National Flood Risk Information Project (NFRIP). WOfS shows, for any part of Australia, where water has been observed (by satellites) since 1998, providing a historical perspective for emergency managers, land use planners and the insurance industry.

Key Priorities for the 2014-2015 Financial Year

GA's key space-related priorities for 2014-15 are:

- Further development of the Australian Geoscience Data Cube, to engage with additional stakeholders and progress toward a robust capability for national scale analysis;

- Initial development of the sovereign GNSS Analysis Centre Capability which is central to the National Positioning Infrastructure Plan;

- Updating national assessments of:

  - Australia's dependence on and requirements for EOS data; and

  - The economic value of EOS to Australia

- Engagement with international satellite operators including through CEOS.

- Critical upgrades to current ground segment infrastructure for EOS and GNSS to ensure sustainability and reflect current operational priorities; and

- Enhanced Stakeholder engagement and coordination in EOS and GNSS communities.

Glossary of Acronyms

Acronym	Acronym definition
ABG	Australian Broadband Guarantee
ACMA	Australian Communications and Media Authority
ADS-B	Automatic Dependent Surveillance – Broadcast
AGD	Attorney-General's Department
AGDC	Australian Geophysical DataCube
AGEOSWG	Australian Government Earth Observations from Space Working Group
AIS	Automatic Identification System
AITC	Advanced Instrumentation and Technology Centre
AMSA	Australian Maritime Safety Authority
ANU	Australian National University
APG	Asia-Pacific Telecommunity Preparatory Group
API	Advance Publication information
APR	Automated Position Reporting
APRSAF	Asia-Pacific Regional Space Agency Forum
APT	Asia-Pacific Telecommunity
ARSG	Australian Radiocommunications Study Group
ARTC	Australian Rail Track Corporation
ASEAN	Association of Southeast Asian Nations
ASKAP	Australian Square Kilometre Array Pathfinder project
A-SMGCS	Advanced Surface Movement Guidance and Control Systems
ASRP	Australian Space Research Program
ASUP	Australia's Satellite Utilisation Policy
ATM	Air Traffic Management
ATMS	Advanced Train Management System

Acronym	Acronym definition
ATNF	Australia Telescope National Facility
AUSMIN	Australia-United States Ministerial Consultation
AUSREP	Australian Ship Reporting System
AWG	Asia-Pacific Telecommunity Wireless Group
BMTC	Bureau of Meteorology Training Centre
BSS	ITU Broadcasting-Satellite Service
Bureau	Bureau of Meteorology
CASA	Civil Aviation Safety Authority
CASS	CSIRO's Astronomy and Space Science
CCI	Coordination Committee on Innovation
CDC	Cooperative Data Centre
CDSCC	Canberra Deep Space Communications Complex
CEOS	Committee on Earth Observation Satellites
CGMS	Coordination Group for Meteorological Satellites
CNS	Communications, Navigation, Surveillance
COI	Community of Interest
COPUOS	Committee on the Peaceful Uses of Outer Space
CORS	Continuously Operating Reference Station
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DFAT	Department of Foreign Affairs and Trade
DGPS	Differential Global Positioning System
DSC	Digital Selective Calling
DSRC	Dedicated Short Range Communications
DSTO	Defence Science Technology Organisation
EC	European Commission
EGC	Enhanced Group Calling

Acronym	Acronym definition
EO	Earth Observation
EOI	Earth Observation and Informatics
EOS	Earth Observation from Space
EPIRB	Emergency Position Indicating Radio Beacon
ESA	European Space Agency
EWD	Electronic Work Diary
FSS	Fixed Satellite Service
GA	Geoscience Australia
GEO	Geostationary Orbit
GGIM	Global Geospatial Information Management
GIS	Geographic Information System
GMDSS	Global Maritime Distress and Safety System
GNSS	Global Navigation Satellite Systems
GPM	Global Precipitation Mission
GPS	Global Positioning System
GRACE	Gravity Recovery and Climate Experiment
HF	High Frequency
IAC	International Astronautical Congress
IALA	International Association of Marine Aids to Navigation and Lighthouse Authorities
IAP	Intelligent Access Program
ICAO	International Civil Aviation Organisation
ICTSW	WMO International Coordination Team for Space Weather
IDC	International Long Range Identification and Tracking data centre
IDE	International Data Exchange
IFR	Instrument Flight Rules
IMO	International Maritime Organization

Acronym	Acronym definition
IMOS	Integrated Marine Observing System
IOR	Indian Ocean Region
ISES	International Space Environment Services
ISRO	Indian Space Research Organisation
ISS	Interim Satellite Service
ISU	International Space University
ITS	Intelligent Transport Systems
ITU	International Telecommunication Union
JAXA	Japan Aerospace Exploration Agency
LEO	Low Earth Orbit
LES	Land Earth Station
LIGO	Laser Interferometer Gravitational-Wave Observatory
LRIT	Long Range Identification and Tracking
MASTREP	Modernised Australian Ship Tracking and Reporting System
MCC	Mission Control Centre
MDA	Maritime Domain Awareness
MEO	Medium-altitude Earth Orbit
MEOLUT	Medium Earth Orbit Local User Terminal
MF	Medium Frequency
MLM	Multi-Lateral Meeting
MODIS	Moderate Resolution Imaging Spectroradiometer
MoU	Memorandum of Understanding
MRO	Murchison Radio Observatory
MSI	Maritime Safety Information
NASA	National Aeronautics and Space Administration
NBN	National Broadband Network

Acronym	Acronym definition
NCC	Network Control Centre
NCI	National Computational Infrastructure
NCRIS	National Collaborative Research Infrastructure Strategy
NDC	National Data Centre
NFRIP	National Flood Risk Information Project
NPI	National Positioning Infrastructure
NTC	National Transport Commission
OSRA	Oil Spill Response Atlas
PAF	Phased Array Feed
PBN	Performance-Based Navigation
PG	Preparatory Group
PNT	Position, Navigation, Timing
POR	Pacific Ocean Region
QZSS	Quasi-Zenith Satellite System
RCC	Rescue Coordination Centre
RDC	Regional Data Centre
REEFREP	Ship Reporting System
REEFVTS	Great Barrier Reef and Torres Strait Vessel Traffic Service
SAR	Synthetic Aperture Radar
SATCOM	Satellite Communications
SATNAV	Satellite Navigation
SCC	Space Coordination Committee
SCO	Space Coordination Office
SG	Study Group
SKA	Square Kilometre Array
SLASO	Space Licensing and Safety Office
SLDMB	Self-Locating Datum Marker Buoys

Acronym	Acronym definition
SSA	Space Situational Awareness
SSAR	Satellite-based Synthetic Aperture Radar
TAWS	Terrain Awareness and Warning System
TCP	Transformational Capability Platform
TDRSS	Tracking Data Relay Satellite System
TERN	Terrestrial Ecosystem Research Network
TISN	Trusted Information Sharing Network
TOC	Transparency, Oversight and Compliance
UKCM	Under Keel Clearance Management
UNGGE	United Nations Group of Governmental Experts
AST	Viewer Access Satellite Television
VHF	Very High Frequency
VTS	Vessel Traffic Service
WMO	World Meteorological Organisation
WP	Working Party
WRC	World Radiocommunication Conference
WRC-15	World Radiocommunication Conference 2015
WRON	Australian Govt Water Resources Observation Network
WTR	Woomera Test Range