

Australia's emerging space policy - defence burden sharing in orbit and space domain awareness

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ABSTRACT:

Australia is rapidly moving forward in formulating space policy which lays the basis for a more comprehensive and sophisticated approach to how it accesses and uses the space domain, not only for defence and national security purposes, but also for broader national civil and commercial activities. A key component of Australia's defence policy as it relates to the space domain is our contribution towards assuring space domain awareness. This is critical for monitoring the activities of other states in orbit, including to reduce the risk of counterspace threats, as well as to monitor space debris that could place Australian and allied space capabilities at risk. This paper examines how Australia as a new space power is approaching the challenge of space domain awareness and how it is shaping our approach to multilateral collaboration in this role through the 'five eyes' and beyond. It considers how future sovereign ground and space-based space surveillance capability will emerge and explores to what extent Australia can directly contribute towards 'burden sharing in orbit' with allies to ensure resilience in a contested and congested space domain. It argues that space domain awareness must be a key task not only for Defence, but also for the civil sector, with commercial space companies contributing directly across the full spectrum of space activities.

Introduction

With Space being a key centre of gravity for modern information-based warfare and access to vital space support essential to undertake joint and integrated military operations, a key task for Australia as a new space actor is to contribute space surveillance and space domain awareness.

It's a task that Australia is well placed to support within the 'five eyes' group and beyond, through the provision of ground based facilities, such as that which is being established at Exmouth, Western Australia, and through the 2014 Combined Space Operations (CSpO) Initiative, that includes the 'five eyes' members as well as France and Germany. There is also growing opportunity for Australia's expanding commercial space sector to provide new capability solutions to the space surveillance and space domain awareness mission, in a manner that will allow Australia to have a greater means to 'burden share in orbit' and support resilient multi-mission space capability. The objective must be to boost space resilience, strengthen credible deterrence in space, and reduce the threat posed by adversaries willing to exploit counterspace capability in a contested space domain. For example, Australia could provide space-based space surveillance capability that would complement ground-based space surveillance. Such a step would be further

facilitated through the establishment of sovereign space launch services in Australia's commercial space sector that would allow Australian satellites to be launched on Australian launch vehicles from Australian launch sites in a manner that is rapid, regular and responsive. A more comprehensive national space surveillance and space domain awareness capability that is both ground and space based contributes also towards the essential task of tracking potentially hazardous space debris. That in turn supports an increasingly challenging requirement for space traffic management as the space domain becomes more congested. Australia should seize the opportunity to be a leading contributor to meeting this challenge.

Australia's approach to space domain awareness

Understanding the activities of other states in orbit and tracking hazardous space debris is a vital task, because for a country like Australia, the space domain is becoming far more important than in the past. Without satellites for communications; intelligence, surveillance and reconnaissance; and positioning, navigation and timing services, the Australian Defence Force (ADF) would be far more limited in their ability to understand the modern battlespace, undertake coordinated operations as part of a coalition, and use force in a manner that is consistent with the laws of armed conflict. There

would be a much greater risk of military failure on the battlefield leading to strategic defeat in future war. The consequences of threats to key space systems, whether through deliberate action on the part of an adversary, or through the growing hazard of space debris, extends well beyond implications for Australia's military capability, as much of our national economy and society directly depend on space systems to function effectively. National supply chains, civil communications and data systems, stock markets, manufacturing, and transportation infrastructure all depend heavily on space to function.

With this reality in mind, there has been growing awareness that access to space can't be taken for granted and there are continued risks of dependency on foreign states as providers for the key 'space segment' – satellite networks and launch capacity. Traditionally, Australia has provided a 'suitable piece of real estate' (to paraphrase the late Australian strategic thinker, Prof. Desmond Ball) for ground facilities, but times and mindsets are changing. There is a recognition of a new national opportunity provided by the falling cost of space technology, driven by 'Space 2.0' commercial business models, and the potential lucrative economic opportunities established by growing a sovereign space sector. The establishment of the Australian Space Agency on July 1st,

2018, reinforced government's desire to be more self-sufficient in space, and ultimately, to be an active provider of space capability rather than merely a passive consumer. For both Defence and the civil sector, through the Australian Space Agency, the task of space surveillance and space domain awareness is becoming a key element of Australia's national space endeavor.

This growing importance of the space domain is also occurring against an emerging strategic and geopolitical context of growing risk and uncertainty in the Indo-Pacific region. With this deterioration in our strategic circumstances in mind, the Coalition government of Prime Minister Scott Morrison released its 2020 Defence Strategic Update and Force Structure Plan on July 1st, 2020.

In launching the update, the PM identified negative trends that had sharpened and accelerated insecurity in Australia's strategic outlook, noting:

‘...we have been a favored isle, with many natural advantages for many decades, but we have not seen the conflation of global, economic and strategic uncertainty now being experienced here in Australia in our region since the existential threat we faced when the global and regional order collapsed in the 1930s and 1940s. ... That period of the 1930s has been something I have been

revisiting on a very regular basis, and when you connect both the economic challenges and global uncertainty, it can be very haunting. ... it requires a response... we must face that reality, understanding that we have moved into a new and less benign strategic area, one in which institutions of patterns of cooperation that have benefited our prosperity and security for decades, are now under increasing – and I would suggest almost irreversible – strain.’¹

The 2020 Defence Strategic Update makes clear that Australia’s ‘...region is in the midst of the most consequential strategic realignment since the Second World War, and trends including military modernization, technological disruption and the risk of state-on-state conflict are further complicating our nation’s strategic circumstances.’²

The update points to strategic competition between China and the United States as the principal driver of strategic dynamics. With that context in mind, it is China’s development of counterspace capabilities that is of growing concern in ensuring Australia’s access to space, and a perceived need to ensure

¹ Speech by the Hon. Scott Morrison, Prime Minister of Australia, ‘Address – Launch of the 2020 Defence Strategic Update’, 1st July 2020, Canberra, Australia.

² Department of Defence, 2020 Defence Strategic Update, Canberra, July 2020, p. 3.

resilient space capability.³ Space has always been militarized, and certainly is not a sanctuary, sitting serene and untouched by terrestrial geopolitical rivalries below. Current trends suggest that militarization of space – the use of space capabilities to support military forces on Earth – are giving way to the weaponization of space, in which space is a warfighting domain, as counterspace capability emerges.

The 2020 Defence Strategic Update and its accompanying Force Structure Plan elevates the profile of the space domain, in comparison to the former 2016 Defence White Paper’s language, and pays particular attention to space control, including space domain awareness, as an important task.⁴ It is a response to space becoming contested and congested. Defence broadly conceptualizes space capability in terms of ‘space services’ and ‘space control’. Space services includes the provision of satellite communications; positioning, navigation and timing services; and, space-based geospatial support and intelligence, surveillance and reconnaissance systems to the ADF.

³ Brian Weeden, Victoria Sampson, ‘Global Counterspace Capabilities: An Open Source Assessment’, *Secure World Foundation*, Washington DC, 2020, https://swfound.org/media/206957/swf_global_counterspace_april2020_es.pdf; see also US Defense Intelligence Agency, ‘Challenges to Security in Space’, January 2019, at [https://www.dia.mil/Portals/27/Documents/News/Military%20Power%20Publications/Space Threat V14 020 119 sm.pdf](https://www.dia.mil/Portals/27/Documents/News/Military%20Power%20Publications/Space%20Threat%20V14%20020119_sm.pdf)

⁴ Department of Defence, 3.21 – 3.24, p. 38-39; Department of Defence, *Force Structure Plan 2020*, Canberra, July 2020, 6.8-6.9, p. 62-63.

The ‘Space Control’ component of defence space capability has ‘Space Domain Awareness (SDA) [as] its foundation. SDA is the effective identification, characterization and understanding of any factor, passive or active, associated with the space domain that could affect space operations and thereby impact the safety, security, economy or environment of a nation.’⁵ In the 2020 Force Structure Plan, Defence notes that:

“Australia holds a unique geographical position to contribute significantly to collective space domain awareness with our allies and partners. Space domain awareness enables better tracking and identification of space objects and threats, such as space debris, as well as predicting and avoiding potential collisions.”⁶

⁵ Statement by Defence Media, 6th August 2020.

⁶ Department of Defence, *Force Structure Plan 2020*, 6.8, July 2020, p. 62.

Expanding Australia's space domain awareness and burden sharing in orbit

The Prime Minister in launching the 2020 Defence Strategic Update and Force Structure Plan made specific mention of the space domain. He stated:

“...the Government will significantly increase investment in defence space capabilities, a whole new theatre, including a network of satellites so we have an independent communications network and we're going to invest some \$7 billion (AUD) in those space capabilities over the coming decade, working closely with industry and other government agencies, including the Australian Space Agency, headquartered in Adelaide where I was there to open that agency not that long ago. Working with key partners and allies, we will take advantage of Australia's unique geographical position to better contribute to collective space domain awareness and we will look to enhance the ADF's ability to counter emerging threats in the space domain and ensure our continued access to space-based intelligence and reconnaissance.”⁷

This marks a very significant step forward from the more cautious stance of previous defence white papers, and most importantly, highlights government

⁷ The Prime Minister, the Hon. Scott Morrison, MP, July 1st, 2020.

recognition of the importance of the space domain as being equal to other operational domains, such as air, sea, and land, or cyber. It recognizes that space is contested, and yet Australia must work to ensure access to space capabilities which are crucial to the ADF's effectiveness and ability to protect Australia's territory and national security. For Australia, space is no longer an adjunct that supports traditional domains, but is an operational domain in its own right. Furthermore, the Defence Strategic Update and the Force Structure Plan makes clear that Defence recognizes the challenge posed by emerging counterspace systems – space is contested, congested and competitive – and highlights a key task for Defence going forward in ensuring space control in the face of these threats. The starting point for that task is building Space Domain Awareness.

The 2020 Force Structure Plan highlights the importance of space surveillance as a key component of space control, essentially repeating the 2016 Defence White Paper, which itself 're-announced' the hosting of a US Space Force (formerly USAF Space Command) owned C-Band radar system and a US optical space surveillance telescope at the Harold E. Holt US Naval Communications Facility at Exmouth, Western Australia. Those key sensors are remotely operated from No. 1 Remote Sensor Unit (1RSU), located at

RAAF Edinburgh, near Adelaide, South Australia. They represent the first joint endeavor between the US and Australia and allow an important expansion of the US Space Surveillance Network into the southern hemisphere.

The establishment of an Australian-hosted space surveillance capability was first implied in the 2009 Defence White Paper, and then first formally announced in the 2013 White Paper.⁸ In a key Australian Defence Doctrine Publication, ‘Operational Employment of Space – ADDP.318’, that was released in 2016, the importance of space situational awareness is highlighted as a key element of assured space support, and a 2019 doctrine note (AFDN 1-19), ‘Air-Space Integration’ goes into more detail on specific SDA capabilities, including those facilities at Exmouth, WA.⁹ Defence’s approach to SDA capability acquisition is occurring under Joint Project 9360, with Defence stating that:

“Through Joint Project 9360 – Space Domain Awareness, Defence is seeking to acquire sovereign SDA capabilities including space surveillance

⁸ Department of Defence, *Force Structure Plan 2020*, 6.8, p. 62; see also *2016 Defence White Paper*, 4.14, p. 87; *2013 Defence White Paper – Defending Australia and its National Interests*, 8.37, p. 80; *2009 Defence White Paper – Defending Australia in the Asia-Pacific Century*, 8.28, p. 62.

⁹ Australian Defence Doctrine Publication 3.18, ‘Operational Employment of Space’, 2016, 3.11-3.15; Air Force Doctrine Publication, ‘Air-Space Integration’, AFDN 1-19, 2019, p. 61-64.

sensors and associated mission systems. Defence are in the process of investigating and developing options to further enhance ADF space control capability.”

That highlights that Australia’s approach to Space Domain Awareness won’t be constrained to a C-Band radar and optical space surveillance telescope operated jointly with the United States, but is set to expand beyond these capabilities. The role of Australia’s commercial space sector will be critical in realizing this outcome, in a manner that builds a sovereign space domain awareness capability and allows Australia to burden share in orbit with key partners in the ‘five eyes’ and beyond.

The 2019 ‘Spacefest’ exercise brought together a number of commercial companies and universities that are producing innovative space domain awareness capabilities which can support Australian Defence Force requirements, with a follow-on exercise to occur in 2020.¹⁰ For example, the Western Sydney University’s International Centre for Neuromorphic Systems (ICNS) is developing ‘event-based sensors’ that detect and track satellite activity based on movement based sensors in a mobile containerized

¹⁰ Royal Australian Air Force, ‘SpaceFest at the Edge’, <https://www.airforce.gov.au/our-mission/spacefest-edge>

observatory, even during daytime, allowing a low-cost network of space surveillance sensors across Australia, and to support ADF expeditionary operations.¹¹ Inovor Technologies in South Australia is developing the Hyperion system of space-based space situational awareness based around a constellation of 12U CubeSats deployed into LEO to observe activity in MEO and GEO.¹² HEO Robotics at the University of New South Wales in Sydney are developing space-based space surveillance capability with its Argus project that will monitor GEO, whilst Curtin University is using the Murchison Widefield Array (MWA) low frequency radio telescope in Western Australia as a wide-field passive sensor for space surveillance through detecting reflected FM transmissions of satellites.¹³ Finally, EOS Space Systems, one of Australia's leading companies that focus on space surveillance technologies using laser-optical sensors, operates fixed sites at Mt Stromlo in Canberra, and in Learmonth, Western Australia.¹⁴

Certainly, Australia's approach to space domain awareness is not purely limited to government-run facilities for the ADF, and there is a wide and

¹¹ Western Sydney University – International Centre for Neuromorphic Systems, 'Astrosite – Benefits of event-based Neuromorphic space imaging'

¹² Inovor Technologies, 'Hyperion', <https://www.inovor.com.au/space-technology/hyperion-mission/>

¹³ HEO Robotics, <https://www.heo-robotics.com/>, and Curtin University, 'The Murchison Widefield Array', at <https://www.mwatelescope.org/>; see also 'At the edge – Spacefest 2019', <https://www.airforce.gov.au/our-mission/spacefest-edge>

¹⁴ EOS Space Capability, <https://www.eos-aus.com/space/>

growing commercial space industry involvement. That is also reflected in the Australian Space Agency's civil space strategy document, released in 2019, which emphasizes space surveillance as one of Australia's National Civil Space Priority Areas.¹⁵

The growth of counterspace systems being developed by China, Russia and other adversaries highlights the risks for the ADF to access space capability in a future conflict and undermines the credibility of previous assumptions that Australia will always have uninterrupted access to space capabilities. Part of the basis for making that assumption was a complacent over-reliance on the U.S. for the provision of the space-segment, underpinned by an increasingly out-of-touch assessment that space wasn't a warfighting domain but a peaceful common. That assessment was widely held by government whilst counterspace capabilities were not visible. China's January 2007 ASAT test, and its subsequent development of a full range of counterspace capability has altered mindsets and reshaped the debate within Defence, as the credibility of the argument that space access was assured and that space was a common of cooperation look increasingly eroded.¹⁶ The challenge of space debris, and the

¹⁵ Australian Space Agency, *Advancing Space – Australian Civil Space Strategy 2019-2028*, April 2019, at <https://www.industry.gov.au/data-and-publications/australian-civil-space-strategy-2019-2028>

¹⁶ Mark Stokes, Gabriel Alvarado, Emily Weinstein, Ian Easton, 'China's Space and Counterspace Capabilities and Activities', U.S.-China Economic and Security Review Commission, March 30th 2020, pp. 39-42/

rapid ‘democratization’ of space through ‘Space 2.0’ technologies which is making space an increasingly competitive environment, with many more space actors, both state and non-state, has further undermined the validity of any assumption that access to space is guaranteed.

These challenges increase the justification for Australia building sovereign space capabilities as a means towards space resilience. Space Domain Awareness is a key basis for this effort, but Australia’s approach must extend well beyond ground-based space surveillance systems. The need to assure space access and build space resilience is important for the ADF’s future operational capability and can also make an important contribution towards ‘burden sharing in orbit’ with key allies. Australia is already a key member of the CSpO Initiative within the ‘Five Eyes’ structure, with the CSpO having been expanded to include France and Germany. The opportunity to expand CSpO to other partners – such as Japan and in time potentially India – could be a good first step forward, together with broadening the initiative’s activities to include cooperation on joint development of space-related technology and boosting coalition operational capability.

Australia's commercial space sector is clearly well placed to enjoy 'second mover advantage' in Space 2.0 and leapfrog in key technology areas such as small satellite and fractionated 'CubeSat' architectures, as well as low-cost space launch capability. There's no need to reinvent the wheel in pursuing future space capability, and Australia should be able to move rapidly towards harnessing new technologies and embracing rapid innovation through experimentation and spiral development, rather than long and slow acquisition cycles that traditionally plague defence capability acquisition, or many civil space endeavours.

There is also potential for Australia to directly support international partners in building space resilience. For example, space resilience should include measures towards augmentation of existing space capability prior to, or in the lead-up of a major crisis ('Phase 0'), in a manner that can quickly disaggregate space support across a more resilient and distributed space architecture that is not so vulnerable to a 'pearl harbour in space' type ASAT campaign.¹⁷ Such an approach lends itself especially well to 'space 2.0' type technologies that can exploit rapid innovation cycles for small satellite and CubeSat development.

¹⁷ Bleddyn Bowen, 'Fearing a Space Pearl Harbour: Space Warfare, #highintensitywar, and Air Power', *The Central Blue*, 16th March 2018, at <http://centralblue.williamsfoundation.org.au/fearing-a-space-pearl-harbor-space-warfare-highintensitywar-and-air-power-bleddyn-e-bowen/>; see also Bowen, *War in Space – Strategy, Spacepower, Geopolitics*, Edinburgh, 2020, pp 238-246.

This is an approach that Australia is already demonstrating an ability to support within its own commercial space sector. Secondly, boosting space resilience within a coalition can include expanding the means for rapid reconstitution of lost space capability through building responsive space launch.

Australia is well placed – geographically and technologically – to support space launch using sovereign space launch providers and launch sites. The establishment of two, and potentially three, launch sites in Australia – at Nhulunbuy near Gove in the Northern Territory; at Whalers Way near Port Lincoln in South Australia – and possibly, at Abbot Point in Bowen, Queensland – is underway.¹⁸ The site at Nhulunbuy, being prepared by Equatorial Launch Australia, is well placed for equatorial LEO missions and its close proximity to the equator allows it to take best advantage of Earth’s rotation for lower cost per kg into orbit.¹⁹ The Whaler’s Way launch site, being established by Southern Launch, is ideal for polar orbit missions that would be useful for LEO-based space surveillance tasks.²⁰ Matching rapid progress in

¹⁸ Carley Scott, ‘Australia’s space activities are poised for unprecedented expansion, but are our regulators ready?’, in *Space Connect*, 18th August 2020, at <https://www.spaceconnectonline.com.au/launch/4484-australia-s-space-activities-are-poised-for-unprecedented-expansion-but-are-our-regulators-ready>

¹⁹ Equatorial Launch Australia, ‘Australia’s spaceport at 12 degrees’, at <https://ela.space/>

²⁰ Southern Launch, ‘Southern Launch – small rockets, big future’, at <https://southernlaunch.space/>

launch site development, Australian commercial space launch companies, led by Gilmour Space Technology in Queensland, are developing space launch capabilities, with Gilmour looking towards an orbital space launch capability on its Eris launch vehicle by 2022.²¹

The manufacture of small satellites in Australia, launched by Australian launch vehicles from Australian launch sites, would mark the maturation of Australia as a space power, and dramatically boost Australia's ability to reinforce space resilience for the ADF, as well as contribute towards burden sharing in space with key allies.²² The ability to rapidly develop satellites through exploiting 'fourth industrial revolution' ('4IR') technologies and concepts for rapid production line assembly, and a move to ease dependency on foreign launch providers, would boost Australia's assured access to space in a crisis, and reduce the risk posed by Chinese and other adversary counterspace capabilities. This future vision – Australian developed satellites launched on Australian launch vehicles from Australian launch sites should be at the heart of government's response to the requirement for boosting space resilience and access.

²¹ Gilmour Space Technology, 'Gilmour Space', at <https://www.gspacetechnology.com/>

²² Malcolm Davis, 'Towards a sovereign space capability for Australia's defence', in *The Strategist*, 3rd August 2020, at <https://www.aspistrategist.org.au/towards-a-sovereign-space-capability-for-australias-defence/>

Yet, Australia's government has yet to formally commit policy to support the establishment of sovereign space launch. This seems incongruous given that the commercial sector is moving ahead with just such a capability, even as Defence and the Australian Space Agency offer these companies verbal and financial assistance. It is also out of step with government declared objectives for growing Australia's commercial space sector in a manner that promotes an expanding number of jobs, and revenue, or, from Defence's perspective, easing dependency on foreign providers whilst moving towards greater sovereign capability.²³

The challenge posed by adversary counterspace capabilities, particularly those being developed by China, will only get worse. The following section explores how Australia should respond in the light of growing counterspace threats and the challenge posed by space debris through expanding Australia's role in space domain awareness – from the ground and from orbit. It then concludes with recommendations for responding to this growing challenge based on

²³ Department of Defence, 'Defence signs agreement with Gold Coast space company', 14th May 2020, at <https://www.minister.defence.gov.au/minister/lreynolds/media-releases/defence-signs-agreement-gold-coast-space-company>

future capability aspirations suggested in the 2020 Defence Strategic Update and Force Structure Plan.

Next Steps in Space Domain Awareness.

The 2020 Force Structure Plan highlights space control as a key task, and states that:

“...Defence will need capabilities that directly contribute to war fighting outcomes in the space domain using terrestrial and/or space-based systems. The government’s plans include the development of options to enhance ADF space control through capabilities to counter emerging space threats to Australia’s free use of the space domain and that assure our continued access to space-based intelligence, surveillance and reconnaissance.”²⁴

The key line to note in this statement is ‘...development of options to enhance ADF space control through capabilities to counter emerging space threats to Australia’s free use of the space domain...’ This statement could be taken to imply a means to defend against, or neutralize, counterspace threats directed

²⁴ Department of Defence, *Force Structure Plan 2020*, 6.9, p. 63.

against the space segment, or potentially the ground segment. The essential prerequisite for achieving such a capability must be space domain awareness.

Current ADF Space Doctrine as laid out in ADDP 3.18, ‘the Operational Employment of Space’, echoes U.S. space control language. Both Australia and the United States defines counterspace in terms of offensive counterspace (OCS) and defensive counterspace (DCS), with their view being that counterspace integrates offensive and defensive operations to attain and maintain the desired control of and protection in and through space. ADDP 3.18 states:

“Space control supports freedom of action in space for friendly forces. When necessary, it also supports defeat of adversary efforts to interfere with or attack friendly space systems and negates adversary space capabilities. The components of space control include offensive space control (OSC) and defensive space control (DSC). OSC [includes] measures taken to prevent an adversary’s ability to interfere with or attack friendly space systems. DSC includes measures taken to preserve the ability to exploit space capabilities via active and passive actions, while protecting friendly space capabilities from attack, interference or unintentional hazards.”²⁵

²⁵ Curtis E. LeMay Center for Doctrine Development and Education, Annex 3-14 Counterspace Operations,, 27th August, 2018, at https://www.doctrine.af.mil/Portals/61/documents/Annex_3-14/3-14-D05-SPACE-

Australia has to a large extent copied U.S. counterspace doctrine rather than develop its own. The establishment of the U.S. Space Force, and the June 2020 release of Space Capstone Publication, *Spacepower*, will increase the urgency for the ADF to develop its own updated Space doctrine, and also, address a key missing piece of policy, which is a declaratory Defence Space Strategy Document, akin to the U.S. equivalent, also released in June 2020.²⁶

This document must have as a key foundation a credible ground and space-based Australian space domain awareness capability. The essential components of this capability are already being finalized, with the facilities at Exmouth, Western Australia, being perhaps the most crucial component. But Australia's Department of Defence needs to engage more directly with its growing commercial space sector to provide space-based (or near-space based) space surveillance capabilities, *and* ultimately the means to launch such capabilities *without reliance on foreign launch providers*. That would dramatically boost Australia's ability to support the space domain awareness mission, both for the ADF, and also for burden sharing in orbit. The ability to complement ground-

[Counterspace-Ops.pdf: Department of Defence, ; ADDP 3.18 Operational Employment of Space](#), Edition 2, December 2016, 3.16.

²⁶ U.S. Space Force, [Space Capstone Publication – Spacepower – Doctrine for Space Forces](#), U.S. Department of Defense, June 2020; Department of Defense, [Defence Space Strategy Summary](#), June 2020.

based space surveillance systems, such as the space-surveillance C-Band radar and optical telescope, as well as commercial systems highlighted in this paper, with responsive space-based space surveillance capabilities, provided by the commercial sector, is the logical path forward for Australia if it is achieve credible capability to deliver desired policy outcomes including for ‘space control’ as suggested in this year’s Defence Strategic Update and Force Structure Plan.

Conclusions

Understanding activities in space, whether they relate to potentially hostile actions by adversary states equipped with counterspace capabilities, or, preventing the threat from growing amounts of space debris, is a key element of Australia’s emerging approach to space, as a new space power. Australia is already establishing a world-class reputation with ground-based facilities, both those run jointly by the ADF and Department of Defence, alongside the US military, at Exmouth in Western Australia, as well as with support for commercial initiatives and academic research. The space domain awareness and space surveillance mission is one that Australia is well placed to pursue.

Taking the next steps must involve expanding the ground-based space surveillance infrastructure nationally, and investing in space-based space surveillance capability. Once again, Australia can exploit an increasingly vibrant and active commercial and higher-education sector to pursue these goals, to establish a true network of ground-based facilities across the country to ensure comprehensive coverage of the space domain, using a variety of technologies being developed, and noted in this paper. A space-based space surveillance capability adds to the potential offered by a ground-based segment and allows far more flexibility for on-orbit close surveillance of other satellites, or the tracking of space debris. The potential offered by small satellite and 'CubeSat' technologies to support this mission is key to success at minimal cost and risk, and it's a technology which the Australian Space Agency and the Australian Department of Defence should fully support.

Supporting the establishment of such capabilities needs to go hand in hand with government support of the establishment of sovereign space launch capability in Australia. Certainly, an economic-rationalist argument can be made that risk is reduced (at one level – in terms of up-front investment) and a 'least cost' approach is assured simply by relying on foreign launch providers. But that argument ignores the very real benefits of stimulating growth of new

sub-sectors within the Australian commercial space industry, and taking advantage of Australia's ideal location for space launch – both for Australia's needs in terms of national civil and defence requirements from space capabilities – and the economic benefits of offering space launch to other international customers. Without sovereign space launch, Australia simply misses out on competing in that market, which is likely to grow, as demand for launch increases on the basis of rapid expansion in satellites deployed in mega constellations in the coming decade. In terms of space domain awareness, a sovereign space launch capability means that Australia can directly support the ADF with space surveillance in a responsive manner, and expand its ability to burden share in orbit with key partners under agreements such as CSpO as well as beyond. With more capability to support allies, our strategic capital increases, and as a rising Middle Power, we deliver capability well above our weight. The falling cost of accessing space through reusable rocket technology, or low-cost expendable launch vehicles, means that the argument that Australia cannot afford space launch holds little credibility in a 'Space 2.0' era.