The Requirements of a Sovereign Defence Space Capability

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By Dr. Robbin F. Laird

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INTRODUCTION

Recently, the Williams Foundation held its latest bi-annual seminar, this one focused on the way ahead for the Australian space enterprise. Since 2014, the Williams Foundation has held bi-annual seminars on the transformation of the ADF as it embraced fifth generation warfare and working joint force integration.

Since 2018, the focus has been increasingly with regard to how to extend the reach of the ADF given the changing nature of the challenges facing Australia in the Indo-Pacific region. The discussions really began with a 2018 seminar which focused on the importance of long-range strike and was followed by seminars which focused on ways to enhance Australian resilience and sovereign capabilities.

The first seminar of 2021 focused on next generation autonomous systems, and the 1 December 2021, seminar on where autonomous systems, namely satellites, have been a regular feature for both military and commercial purposes for many decades.

The Williams Foundation program announcing the seminar highlighted the purpose and focus of the seminar:

The Requirements of a Sovereign Defence Space Capability

When the United States Air Force conceived and established the Space-based Global Positioning System in 1973 to enable more accurate military navigation, few would have imagined the impact it would have on modern society, the Western national security apparatus, and the Australian way of life.

Fast forward to 2021, global economic security is now dependent on Space-based capabilities, and Defence must play an increasingly prominent role given the quantum of global trade which passes through the region, a third of which transits through the South China Sea.

There are now over 2,600 satellites in orbit and the Australian Defence Force has become increasingly dependent on a sophisticated blend of Space-related technologies which must now develop and accelerate to meet the demands of integrated multi-domain operations to counter new threats and new risks. These demands include resilient long-range communications, and greater levels of situational awareness with the ability to sense, track and identify targets in and from Space in all orbits.

On the supply side, current Space capacity is insufficient to meet these demands, and the need for a sovereign capability must be driven by a better understanding of the full spectrum of Space-related requirements across policy, process, infrastructure, and technology. The imperative to develop Space capability must consider the people and organisational aspects which leverage Australia's relatively small but highly skilled population. It will require a national effort to leverage people, technology and Australia's vast geographical area of interest and highly favourable environmental conditions to conduct activities in and from Space.

Space is becoming increasingly congested and contested and likely to become a warfighting domain in future high intensity conflicts in the Indo-Pacific region, as well as an essential campaign enabler for Shape Deter and Respond missions and tasks. This will drive the need for increased survivability of Space-based systems and the ability to counter and deny competitors across the spectrum of conflict.

Industry Perspectives

Industry involvement will be central to the success of the seminar. While certain aspects of space operations are becoming more affordable as methods of access improve and the economic barriers to entry are lowered, it is vital that Australian sovereign space capability exploits the high value activities which develop a broad and sustainable industrial and technological base linking research and development with fielded operational capability.

In the near term, the majority of the Government's $7 Billion investment in the space domain over the next decade is rightly focused on the defence sector which is well equipped to deal with the acquisition of advanced, complex technologies and platforms while developing a highly skilled workforce. However, this investment needs to be prioritised in a way which sets the conditions for long-term success at a national level to develop a capability edge. Emerging strategic trends suggest that those priority investment areas relate to three specific capabilities:

- *Space Domain Awareness, to provide assured access and control of activities to and from space;*
- *A sophisticated Intelligence Surveillance and Reconnaissance (ISR) enterprise enabled by advanced multi-phenomenology sensors and data management systems, and*
- *A network of resilient and secure communications and data link systems.*

An industry perspective relating to capability development across technology, workforce, organisation, infrastructure, and policy to deliver a sovereign defence space capability is anticipated.

The first point made throughout the presentations by speakers was that Australia has a long involvement in space activities through its working relationships with its core allies, first Britain, and then the United States. The Australians have been engaged in several support activities for the American space enterprise and that domain knowledge and engagement will continue to be critical in shaping Australia's own efforts for enhanced sovereignty in space.

FIGURE 1 DARIN LOVETT, SOUTH AUSTALIAN SPACE INDUSTRY CENTRE, MODERATOR FOR THE SEMINAR

The second point is the need to indeed enhance Australian independent space capabilities. As AIRCDRE Phil Gordon, Director General Air Defence and Space put it: "I would compare our position in space with being a frequent flyer who uses that service. And as we in defence are on the journey from being a consumer of other people's space products to a contributor owner and operator in our own right."

The need for shaping sovereign capabilities comes not only from the enhanced importance of space payloads for both commercial and military activities, but from the nature of crises and the nature of allies. Gordon put it succinctly: "It's relatively easy to have access to space capabilities from allies when there's plenty to go around. But if times are tough, if assets are under attack, if bandwidth is reduced, if satellites and ground stations are targeted and there's just not enough capacity to do all the things we want to do, then where are those priorities going to lie?" This then means for Gordon: "we have to be able to have control and access of our space capabilities without needing to ask someone else's permission."

Second Line of Defence

FIGURE 2 BRIG IAN LANGFORD, DIRECTOR GENERAL FUTURE LAND WARFARE

The third point was embedded in various presentations but put most directly by BRIG Ian Langford. Director General Future Land Warfare. Even though space clearly has its own specific requirements, skill sets and capabilities, it is part of the overall transformation of the ADF and of the next round of the revolution in military affairs, or perhaps we could go back to the term used throughout the Williams Foundation Seminars, namely, a fifth-generation force but now with greater reach.

Langford put it this way: " Two years ago, I was talking to a U.S. Air Force retired four-star general, and we were talking about the revolution of military affairs, which was demonstrated in 1991 during the first Gulf War. And that was demonstrated in that context through the effectiveness of GPS and the use in application of precision strike and advanced munitions, as it related to the ability of U.S.-led coalition forces to be so effective and so profound in the context of that capability overmatch. Now as we are on the edge of a significant defence recapitalization are we also on the edge of the next round of the RMA? And what are we to do about it?"

The fourth point is that a new Australian space enterprise is being crafted. This effort started with the 2018 standup of the Australian Space Agency and will see a new ADF command to be stood up in January 2022. This is being done in the context of a new strategic environment and the shaping of new warfighting approaches. And that environment as I noted in a recent discussion with Dr. Paul Bracken, the well-known strategist, is characterized by ongoing limited war with the authoritarian powers and the ongoing challenge of mastering escalation control and management.[1]

Space assets are crucial to be able for Australia to shape effective crisis management in the ongoing conflicts with the authoritarian powers. Several speakers spoke about the militarization of space and space war. The challenge is to know when a military event in space starts. Both the cyber and space domains are domains within which conflict is ongoing, signaling is difficult, but the need to be resilient crucial to absorb shocks from space events whether naturally or man-made and deliberate.

Dougal Robertson of the Williams Foundation highlighted the interaction between space and the various dimensions of the evolving strategic environment. And he underscored this crucial point: "Gray-zone

[1] Robbin Laird, "Gray Zones or Limited War?" Defense.info (December 27, 2021) https://defense.info/re-thinking-strategy/2021/12/gray-zones-or-limited-war/

traditionally means we are not at war, but we're not at peace. The gray-zone actor might be pursuing national objectives, certainly in relation to nation states, and when we talk about gray-zone activity, they're often pursuing objectives that are linked to military advantage or political or strategic advantage."

If this is the case then, Australia certainly needs space capability which can give the ADF and the government decision making tools to evolute conflicts and crisis management options, occurring in space, and cascading out to the entire combat force.

FIGURE 3 DOUGAL ROBERTSON SPEAKING TO THE WILLIAMS FOUNDATION SEMINAR ON 1 DECEMBER 2021

The fifth point, and a major part of the day's discussion, was on the nature of the space industrial eco-system which Australia needs to shape going forward to have enough sovereignty to have decision making capabilities for both security and defence needs.

Space is expensive and payloads are dynamically changing under the impacts of new initiatives and capabilities generated by the major space powers. So, what can Australia realistically do and how best to do it? That discussion was a significant part of the seminar.

But in general terms, the focus was upon several key aspects which Australia can or needs clearly to do to have a fully viable sovereign space enterprise. One aspect is leveraging the dynamics of change regarding new versus old space, which means new ways to launch space payloads, and to tap into the various new ways to shape satellite payloads and constellations. One only has to think back to the revolution started by Iridium when building the satellites for the first constellation to grasp the possibilities,

That effort will be generated as the major space powers refigure how they are working GEO, MEO and LEO payloads, and as they shape various kinetic and non-kinetic warfare capabilities in the space domain. That is why working with the United States and enhancing working relationship with the UK as they have launched a new space command, or with India, or Japan or European Space Agency are significant parts of how Australia is shaping its way ahead in calibrating its approach to space sovereignty.

Malcolm Davis of the Australian Strategic Policy Institute provided a particularly robust and clear discussion of what Australia's way ahead in space might look like. "We need to think about space resilience, and we need to think about space deterrence, and they should complement the existing projects in space. Sovereign launch is clearly going to happen, and I've always been an advocate for a high, low mix, where Australia contributes a low end in terms of small satellites that can complement the large geo birds. These small satellite systems could contribute new types of capability and new missions for the Australian defence force."

Second Line of Defence

The sixth point is the central role which Australia's geography has and will play going forward. The cooperation between the United States and Australia in part is based on Australia's location and its extensive geography. The establishment of Pine Gap is a case in point. This location is strategically significant because of the ability of the facilitates there to work with various high value satellites as they pass over one-third of the globe, including China, the Asian parts of Russia and the Middle East. And going forward launch locations and ground-based space capabilities will grow in importance as Australia builds out its own capabilities and works with partners and allies in the liberal democratic world going forward.

In the panel, the former air attaché to the United States, Terry Van Haren noted: "If I was a Chinese general, I'd be worried about three things from Australia. First, I would be worried about nuclear powered submarines. Second, I would be quite concerned about long range replenishable strike. The third thing that would worry me would be a robust counter space capability developed and supported in Australia. Why? Because Perth and Beijing are on the same longitude. They would hate to see us develop real space power in this country."

FIGURE 4 PANEL AT THE WILLIAMS FOUNDATION SPACE SEMINAR

Speaking of geography, there is the broader question of the changing nature of Australia's defence geography. When I was last in Australia in March 2020, I started my return to the United States as the COVID wave started to pass over Australia in Perth visiting the subbase and a major shipyard. When you combine the need to operate from Western Australia to the first island chain, with the coming of a nuclear attack submarine, almost certainly to operate from Western Australia, and the already extant space capabilities in the region, which will be expanded, the thin population belts in the West will need to see infrastructure growth for many of Australia's defence plans to be realized.

A good way to conclude this initial look at the seminar was a comment made by the moderator of the seminar, Darin Lovett, who is the Director of the South Australian Space Centre.

"Most of us are here as professionals in the business. We understand the importance of Sovereign Defence Capability in the mission statement of the ADF to defend Australia and its national interests.

"A Sovereign Defence Space Capability is somewhat harder to articulate. And there are two reasons for this. First, the Defence Space Capabilities we still rely on are largely to many people, largely still highly classified and unknown to the general populace. And secondly, our human capital, the professional cadre who underpin any capability are relatively few and they're new. And compared to the rich heritage of land, maritime and air, we just don't have that depth and that backbone and strategic thought that has permeated the other domains.

"But space is no longer just viewed as a conduit for three things, comms, imagery, and Positioning, Navigation and Timing (PNT). It's now seen as a domain in and of itself, to be monitored for belligerent activity and an essential element of a complex society and a way that, and a domain that underpins our way of life on earth in ways we don't understand. The system is too complex to unravel.

"The impact of COVID has reenergized the discussion around sovereignty and resilience, especially as it pertains to space. Now it's a pivotal moment, billions of dollars are slated for defence capability. And we've got a small but dynamic space industry growing, but also large primes who are investing as well.

"We're unencumbered by the legacy approach to space. This is an advantage we're not pushing 20 tons to GEO. We're not a big player like Airbus, Boeing, Lockheed, L3, et cetera. We can move relatively fast. We're changing the paradigm that space is solely or primarily the playground of big powers."

A LOOK BACK AT THE AUSTRALIAN SPACE EFFORT

The conference started appropriately enough with a look back at the history of Australia's engagement in space activities. The Australians have been involved in the space activities of their key allies, first Britain, and then the United States from the dawn of the space age.

That involvement has been based on Australia's key geography and strong alliance relationships. As Australia moves to the next phase of its space efforts, the focus is upon being proactive space efforts. But by being deeply engaged, notably with the United States, Australia can shape its own capabilities with knowledge of how the United States is shaping its way ahead in space as well as providing interactive knowledge with the United States and Australia's allies of the evolution of adversarial space efforts as well.

In other words, a proactive Australian space effort is informed not only by leveraging new commercial opportunities generated by the new space enterprises globally, but by understanding of how the United States and Australia's key allies are evolving their own military space efforts as well. It can be an informed innovative leveraging and insertion capability within the evolving space enterprises for the liberal democracies. And within such a contest, Australia can expand its role going forward.

In part, this opportunity is based on Australia's geographical location vis a vis the core space competitors for the liberal democracies. The history of Pine Gap is a case in point. The noted Australian strategist, Paul Dibb, in his book *Inside the Wilderness of Mirrors* provided the most complete look to date on Pine Gap and its role in the Australian-U.S. working relationship regarding space and intelligence.

As Dibb noted about his first encounter with this site: "We are going to patch you through to listen to the Soviet Northern Fleet Commander in Severomorsk talking to Naval headquarters in Moscow'. It was 1974 and I had just been appointed Head of the National Assessment Staff and I was on my first visit to Pine Gap near Alice Springs. You can imagine how impressed I was to be on the receiving end of this intelligence from a Rhyolite satellite that was 35,000 km away from Earth and with an intercept antenna more than 20 metres in diameter. Later second-generation Orion satellites had an antenna exceeding 40 metres in diameter."[2]

Even though the numbers of Australians involved in Pine Gap has been clearly very limited, this type of engagement by Australia puts it at the head table in understanding evolving U.S. capabilities and thinking, a key aspect for shaping any forward leaning proactive Australian space policy going forward.

At the seminar, Amy Hestermann-Crane of the Williams Foundation and an analyst with the Royal Australian Air Force provided the historical overview.[3]

She noted that the main thrust of Australian space policy has focused on the military side and with Britain and then with the United States. Notably, Britain used Australian territory for its nascent ICBM program and then

[2] Paul Dibb, *Inside the Wilderness of Mirrors* (MUP Academic, 2018).
[3] https://www.linkedin.com/in/amy-hestermann-crane-1403b81b5/?originalSubdomain=au.

the Americans regarding the use of Australian geography for space tracking and control. But over the past decade, there has been more Australian involvement in civil space, as realization of the role which such space plays in the national economy and society has grown.

She underscored: “Although Australia has been involved in various space endeavors since the 1940s, it cannot be said that we were a proactive participant. Just a short look at our space history shows that we were motivated in strengthening relationships with historic and emerging allies, as well as gaining access to potential national security benefits from developed project capabilities”

Britain after World War II established the Woomera Research Establishment in 1946 to shape a highly classified location for the British ICMB and Rocket Development Project that lasted nearly three decades. She underscored that “the Establishment remained under the control of Defence through the Department of Supply and is now under RAAF control as the Woomera Range Complex”

FIGURE 5 AMY HESTERMANN-CRANE, WILLIAMS FOUNDATION

With the British essentially abandoning the Blue Streak program, the United States then became the key space partner for Australia. “In 1956, a request was made to the Australian government to assist in the tracking of U.S. rockets and satellite launches. This request stressed the scientific benefits of the partnership, yet with Woomera being suggested as the first location for a facility, it was the Defence Committee which was asked for comment.

The Committee recommended approving the ground tracking station due primarily to the military significance if the United States managed to find success in their satellite program. And by 1957, the station was operational and supported the launch of the first U.S. satellite, Explorer 1, in 1958. A second facility was built in nearby Woomera in 1969 and continued to support the U.S. Defence Surveillance Program until its closure in 1999.”

The NASA Deep Space Communication Centre in Tidbinbilla gained fame by supporting the Apollo landing in 1969 just a few years after its establishment. And “the United States also supported the development and assembly of Australia's first satellite alongside British and Australian organizations, and WRESAT was launched in 1967. It was designed to increase the understanding of upper atmosphere effects on the weather and the climate, as well as gaining physical data for U.S. research programs.”

“Australia further signed an agreement in 1966 to establish the joint defence space research facility known as the Joint Defence Facility of Pine Gap. And at the time, the Australian government promoted the military and

scientific benefits that this facility would bring but failed to reveal the project's support for United States intelligence collection."

The next major development for Australian space was involvement with the British when the moved on from Blue Streak to a program to develop civilian launchers. "Britain went to Commonwealth and European nations with a proposal for a civilian launch program. Australia was the only Commonwealth nation to join this program, and it was under the condition that Australia only provide facility support. Australia wasn't excited by the civilian research prospect, but instead was motivated to recuperate financial investments in Woomera and the Blue Streak program.

"Several nations did, however, answer Britain's call and formed the European Launch Development Organization, otherwise known as ELDO. It was formed with Britain, Germany, France, Italy, Belgium, and the Netherlands, all of whom were responsible for various rocket segment development. Australia as a full partner only provided access to Woomera, and thus the Blue Streak Project founded the Europa 1 launch vehicle.

"From 1964 to 1970, the project culminated in a total of 10 launches for Europa 1. However, there were five launch failures. However, by 1970, ELDO members no longer wanted to continue using Woomera as its launch facility and Australia provided Darwin as a secondary launch facility. However, this was also rejected by the organization.

"As such, ELDO moved to French Guiana, offering Australia the possibility of remaining as a full organization partner despite no financial contribution. However, the Australian government saw little value in this civilian research program, especially once it moved offshore, and it declined to remain part of the ELDO organization."

"Australia's quiet space years can be considered from the late 1970s all the way through to the 1990s. The use of foreign satellite capability for military use was still beneficial for our needs and it didn't place any undue financial burden on the government. Australia was still motivated by national security and had not yet realized the commercial benefits that space offered. There were several attempts at establishing a commercial launch facility. However, none succeeded."

In this period the Space Activities Act of 1998 emerged. "This legislation, which has undergone several amendments in recent years, still forms the basis for Australian and international organizations to obtain various licenses for space-based objects, launch activities, and reentries."

She concluded that Australia is now shifting to a more proactive space effort, and one which highlights both commercial and military space. This period can be dated from 2018 with the establishment of the Australian Space Agency which is tasked with growing Australian space industry.

"We have relied on foreign satellite capabilities because it was cheaper for our government to do so. We were able to progress forward as a military in that manner. And it's only been in the last few years that we've understood that the space industry and civilian research is fundamental and integral to Australian life.

"The militarization of space has allowed space to be cheaper. We are experiencing a booming startup industry with universities and industry and military, all being able to get involved in different space capabilities and creating greater possibilities for a sovereign capability.

"And such capability is critical so that if something goes wrong in the future or our alliances change, we're going to be able to still rely on our own capabilities that are integral to every facet of Australian life. This ranges from education to water control. And in fighting the brushfires last year earth observation satellites Second Line of Defence

were an important part of the effort. And obviously the military and its ability to use space for communication, for guided kinetic systems and for intelligence and national security is critical as well."

WHAT IS SOVEREIGN AUSTRALIAN SPACE?

Sovereignty is a tricky term, notably when it comes to global economies and to allied based national defence. The COVD-19 crisis and the conflict with the 21st century authoritarian powers, notably China, have reminded the liberal democracies of how vulnerable they are.

And when American allies talk sovereignty what they are talking about are two interrelated dynamics: the first that they have as much independence in decision making from Washington as feasible but at the same time retain or even grow necessary alliance links; and the second is to ensure that they have as much capability to act decisively against authoritarian adversaries to ensure that escalation control is possible to defend that nation's interests.

I have a lifetime of dealing with the French, who are the U.S. allies who talk the most about sovereignty and their freedom of action vis a vis the Americans. But what is sovereignty for a state like France when embedded in the European Union, dependent on a U.S. led Alliance for their ultimate security, and embedded in the global supply chain?

I dealt with this question of what sovereignty in the current period is even for a large power like the United Sates in my edited book *2020: A Pivotal Year*. Several of the essay's deal with this question or theme. Essentially what we are talking about is shaping decision making capabilities for the nation to make choices within the shared sovereignty of modern defence and economic relationships facing the major liberal democratic nations. It is about getting allies and adversaries alike to go down paths favorable to a particular nation's policies or identities.

But how did the speakers at the space conference define what sovereignty meant regarding Australia and its way ahead in the space domain?

The core point was relatively straightforward. And that point was made by Malcolm Davis from the Australian Strategic Policy Institute: "For the first time in a major policy document, the 2020 strategic update emphasized the importance for Australia to have our own capabilities in the operational space domain. That update made clear there is a requirement for space control that is not only about space domain awareness from the ground, but also about an ability actually to assure access to space and counter threats to our space systems and boosted the funding to do so."

FIGURE 6 MALCOLM DAVIS, AUSTRALIAN STRATEGIC POLICY INSTITUTE

One member of the seminar panel underscored: "Exactly how do we define sovereign? Sovereign means different things to different people. We need to decide what degree of sovereignty we need to do the job. That might not be total ownership from start to end. It might be sovereignty of decision making. It might be sovereignty of the networks. It might be sovereignty of the data. I think there's no one size fits all approach to sovereignty, and it really just depends on what is required actually to do the job in an assured way."

It was an interesting exercise to go through the presentations and to look carefully at how the speakers defined or used the word sovereignty to shape what course of action they then advocated. It is interesting above all because how one defines the focus of sovereignty indicates what a realistic course of action for Australia might be, given the high cost of space, the relatively limited skill sets in Australia in this industry, the tradeoffs between working in a globalized commercial space sector, or a targeted Australian funded effort tailored for the ADF.

The moderator for the day highlighted the importance of sovereignty as referring to Australian-based firms, but whether these are outposts of foreign primes or Australian-generated firms is an interesting question. This is how Darin Lovett put it: "The impact of COVID has fundamentally reenergized the discussion around sovereignty and resilience, especially as it pertains to space. Do we divest and, again, rely on a foreign provider or do we invest and build sovereignty? We have an opportunity to leapfrog the old operating system, which we've relied on and gain traction against emerging issues, but we need holistic capability development in Australia to bed in the seeds that we'll provide for the future."

AIRCDRE Nicholas Hogan, Director General of the Space Domain Review, identified various concrete manifestations of new capabilities which Australia needs in order to have the requisite space sovereignty. The first is clearly on the launch side of space. The second is to build out a sovereign space industry, but again one of the challenges here is that companies in the commercial sector and the defence sector do not operate in the same manner and there is the key challenge of foreign primes and local companies in terms of what they build for the global market or for the ADF.

This impacts directly on the question of the workforce and the skill sets to be developed to build out an Australian based space industry. There is clearly a growing overlap between the commercial and military space sectors, but it such an overlap is more of Venn diagram than simply building a unitary workforce, notably because of the requirement for security clearances in the national defence arena.

Terry van Haren, the former Air Attaché in the United States, focused on the challenge of building an effective sovereign space industry. Here he cited the experience of Australia in building indigenous fighter aircraft from 1921 to 1939 which resulted in not very good fighters, but it did generate the infrastructure which then allowed Australia to license-build Spitfires and Hurricanes.

He pointedly used this example to underscore that sovereignty is not about "designing, developing and building everything but it is about doing what you can do well and take advantages of working with partners and allies around the world to work on what you're not so good at doing."

He then cited a concrete example, namely of a company doing very innovative work in space domain awareness. LeoLabs is building a network of ground-based, phased array radars that provide a unique capability, and have approached space domain awareness from a perspective different from partners and allies.[4]

[4] https://www.leolabs.space

CDRE Matthew Doornbos, RAN Director General for Navy Intelligence and Warfare, made a very similar point to that of van Haren. “In our endeavors to set the conditions for long term success in the space domain, we must remain cognizant of maximizing efficient use of our resources, because the reality here in Australia, unsurprisingly, is we only have a limited number of resources. If we are to achieve our goals and ambitions, we'd have to really understand what our sovereign capability should be.

“But more importantly, we have to work efficiently. We have to work collaboratively, across defence, industry and academia. It's our relationships through all aspects of our capability development, that will enable us to achieve our goals.”

FIGURE 7 AVM CHRIS DEEBLE (RETD).

The most comprehensive examination of the relationship between a realistic definition of sovereignty with how Australia should proceed was by AVM Chris Deeble, (Retd.) now CEO Northrop Grumman Australia, but when serving with the RAAF had extensive experience with working with advanced programs, such as the F-35. His experience clearly guided his judgements on how to achieve both enhanced sovereignty but to do so with a regard to a practical way ahead.

“What is sovereignty? The pursuit of sovereignty shouldn't be an excuse for wanting to do everything. Sovereignty and resilience go hand in glove from my perspective and how we build that strategy. We must ensure that from the get-go, we create a viable, scalable, innovative, and sustainable space ecosystem. And it must be underpinned by business cases that can goes to the viability and sustain sustainability at the end of the day.

“This will be a significant challenge for us as we move forward. Defining things in requirements terms is going to be difficult. We will have to be thinking about that in outcomes terms. As a space nation, we must have a clear strategy that articulates our sovereign security and resilient space capability outcomes. We must develop a cohesive and aligned national strategy that meets both the civil and defence needs now and into the future.

“We must ensure that we prioritize and align our investments. We cannot lose sight of the underlying business cases. We can't do it all. We must create a sustainable viable outcome for us as we're moving forward. The lexicon is changing, it's a great first start.

“But if we want to be a space nation, if we want to create space ecosystems for the nation, if we want to have a viable, enduring, sustainable, scalable industry, from now and into the future, we have to turn that rhetoric into reality.”

BRIG Langford brought up a really key point about the impact of having sovereign space or bits of sovereignty within an overall allied space enterprise: "Does a hostile act against a space-based asset, or indeed a cyber intrusion against national infrastructure constitute an act of war under international law? What is the policy framework, when an Australian owned commercial or military space-based space asset is potentially interfered or destroyed as it relates to an attack on Australian sovereignty, and what we might do about it, in terms of our obligations to assert the security versions of ourselves in that sort of environment?"

SHAPING AN AUSTRALIAN SPACE INDUSTRIAL ECO-SYSTEM FOR DEFENCE AND SECURITY

Sovereign Australian space requires an Australian space industrial eco-system to be shaped and enhanced. How might this be done? Crafting, shaping, and building out an Australian space industry able to provide for sovereign capabilities for the Australian government decision makers is based on the enhanced opportunities in commercial space.

Nick Leake, head of satellite and space systems Optus, provided a comprehensive look back at the company's experience in the space business. Optus is one of the largest telecommunications companies in Australia. It has operated satellites as part of its business since 1985. Currently, the company operates 10 satellites with Optus 10 being the latest of their satellites.

As noted by the company: "In 2003, Optus successfully launched the world's largest hybrid commercial and military communications satellite Optus C1, together with the Australian Defence Forces. Optus C1 is the Australian hotbird with twenty-four commercial Ku-band transponders operating in beams covering Australia, New Zealand, the nearby offshore islands, Papua New Guinea, Hawaii, and Southeast Asia. Optus C1 carries subscription TV services and Aurora Free-to-Air radio and television services to remote areas in Australia."[5]

All of this means that Leake spoke from the standpoint of several years of operating experience as an Australian firm with real-world experience in working a commercial telecoms satellite fleet. His discussion focused on the challenges of operating a satellite network in the growing presence of space junk and in the face of powers that believed they had the right through ASAT systems to place deliberate "junk" to disrupt or destroy a perceived adversary's satellites.

Leake underscored several key points about the interaction between commercial space and the need for government to focus on maintaining order for space operations.

"We are looking towards the future. We are looking for some cohesion within Australia with Defence and the Australian Space Agency to develop tools to give us better safety in operating our geostationary spacecraft.

[5] https://www.optus.com.au/about/network/satellite/fleet

FIGURE 8 NICK LEAKE, OPTUS

"The C1 spacecraft is 18 years old. We operate that satellite in what is called inclined orbit. So we operate spacecraft at 36,000 kilometers in a 70-kilometer box. We fly it in a figure of eight because it has the pull of the earth, pull of the moon, pull of the sun, so it is never static. We try to keep it in this box, pointing at earth and if you don't have a spectrum filing, you've got nowhere to put your spacecraft. It's incredibly important that you keep your spacecraft, at your orbital slots and that you maintain those spacecrafts.

"If you move a spacecraft away, you've got three years to put that spacecraft back to keep your filing in use, so it's called bringing into use. That's an important part of a commercial operator, but it's even more important for our Defence forces that they maintain their orbital filings across the orbital arcs where they want to use their spacecraft."

The impact of evolving commercial space for defence and security operations could not be clearer than in the domain of ISR. In his presentation to the seminar, AIRCDRE Richard Keir (Retd.) Strategic Advisor for National Security and Intelligence to Geospatial Intelligence Pty. Ltd, provided a targeted presentation on how the ISR demands for the civil, security and military sectors can benefit from commercial geospatial efforts.

There are several conclusions one can draw from the emergence of a robust commercial space enabling ISR Market. Notably, since 2002, the commercial space-based earth observation market has become very dynamic and global. Australia is involved in this market and there are clear opportunities for the Australian government to get better value out of this market for its national security requirements. In effect, commercial imagery and data from that imagery can be used along with classified sources and methods and thereby enhance the scope and quality of the data collected. By taking advantage of the growing number of commercial satellite capabilities and constellations, the Australian government can enable a whole of government strategy in defence and security.

Because commercial space based ISR data and information is unclassified, it can form a solid foundation for information sharing with a wider array of allies and partners than highly classified imagery. This can prove very useful in terms of crisis management and escalation control, notably as information war is a core reality today. For example. in discussions I had during my past visits with the Maritime Border Command, it is very clear that such capabilities fit right into their evolving approach to working from maritime domain awareness shared with partners and allies.[6]

[6] Robbin Laird, "A Case Study of the Evolving Integrated Distributed Force: The Australian Border Command," *Second Line of Defence* (October 21, 2019), https://sldinfo.com/2019/10/a-case-study-of-the-evolving-integrated-distributed-force-the-australian-maritime-border-command/.

FIGURE 9 AIRCDRE RICHARD KEIR

The Maritime Domain Awareness dynamic is an arena where shared information is crucial for both whole of government and working with partners and allies. In the recently released White Paper which Keir referenced in his presentation which his company just released, the nature of the MDA market for commercial space is explained in the following terms:

"MDA is enhanced by space-based Earth observation as it has unique capabilities to image large swathes of the ocean and complex littoral environments using a mix of EO, IR and SAR imaging sensors – fused with AIS – and increasingly assisted by RF sensors. The latter assistance provided by RF sensors is especially useful in cases where a vessel has not enabled its AIS or has deliberately mis-characterised itself. RF sensors may provide enough of a clue to tip and cue an all-weather SAR capability or a good weather/daylight hours EO capability to classify or identify the vessel.

"The use of more novel sensors can also prove valuable in MDA. For example, the Visible Infrared Imaging Radiometer Suite (VIIRS) is a sensor on board the Suomi National PolarOrbiting Partnership (Suomi NPP) and United States National Oceanic and Atmospheric Administration (NOAA) NOAA-20 weather satellites. The sensor has the capability to detect lights on vessels at sea that are often used to attract fish.15

"Because MDA is an international issue that transcends national borders and spans issues of national security through to economic interests, information sharing is often fundamental to its success. No nation can sustain 24/7/365 full situational awareness of the oceans in isolation, so the most efficient way to achieve the desired level of knowledge is to share information with partner nations. Indeed, counterintuitively, national sovereignty frequently depends on the sharing of data, information, and intelligence between likeminded nations to achieve MDA.

"Commercial space-based ISR data is unclassified, has high resolution, and is capable of 24/7/365 availability across the gamut of EO, IR, SAR, AIS and RF. It is therefore of great value to nations such as Australia in its efforts to facilitate the MDA of developing nations because it will generally have fewer constraints on its use."[7]

The main presentation outlining the current state of the Australian space eco-system and the projected way ahead was provided by Anthony Murfett. Deputy Head of the Australian Space Agency, which was launched in 2018. The purpose of the Space Agency is " to transform and grow a globally respected Australian space industry that lifts the broader economy, inspires and improves the lives of Australians – underpinned by strong national and international engagement." And "the Australian Space Agency aims to triple the size of the Australian space economy (from A$3.9B to $12B) and create an additional 20,000 space jobs by 2030."

[7] *Commercial Space-Based Intelligence, Surveillance and Reconnaissance and Australia's National Security* (Geospatial Intelligence Pty Ltd (December 2021).

The current situation finds the Australian space business operating at a level of AU$4.6 billion with 11,560 jobs existing across the Australian space industry. The investment in space capability growth is AU$7 billion with AU$800+ coming from investment by the Australian government in civil space and AU$2 billion coming from a pipeline of investment across all the Australian federal states and territories.

Growing civil space provides a significant opportunity to expand the capabilities for the Australian defence sector as there are several key areas alignment between the two sectors. Murfett identified four key areas: satellite-based capability and services, Space Domain awareness, Position, Navigation and Timing and Earth Observation.

In the following slide from Murfett's presentation, the extant capacity in adjacent industries within the Australian space industry eco system were identified:

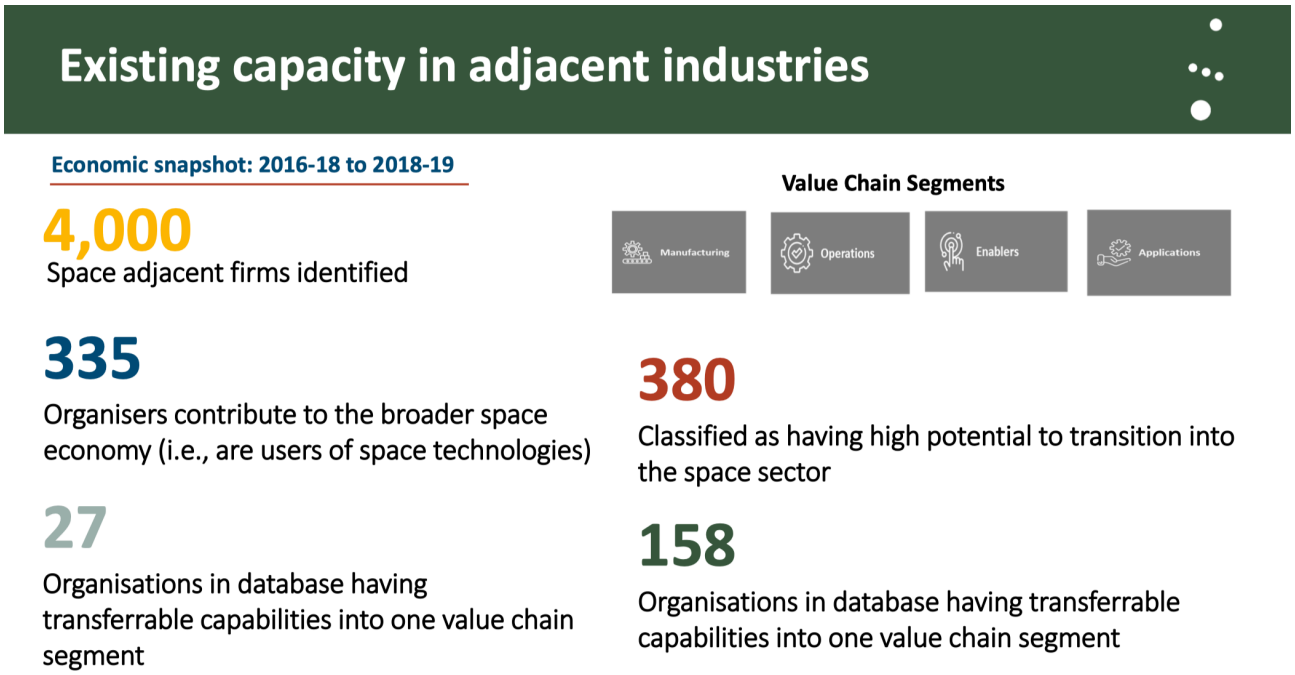


FIGURE 10 SLIDE FROM ANTHONY MURFETT PRESENTATION

He highlighted as well key infrastructure investments being made in Australia which can be leveraged as well to enhance the evolving Australian space industrial eco system. This includes the AU$1.3 billion in the modern manufacturing initiative of the Australian government, the establishment of a robotics, autonomation and AI command control centre (Fugro Marine), a space data analysis facility (Pawsey supercomputing Centre) and a mission control at Lot Fourteen (Saber Astronautics).

There is an agreement with NASA which is part of the way ahead for Australian space as well. The agreement with NASA means that Australia is part of the Trailblazer program of the Moon to Mars initiative. A semi-autonomous, Australian-made rover is to be included in future NASA mission to the Moon. This effort draws on Australia's world-leading remote operations capability and the Rover will collect lunar regolith and NASA will extract oxygen from this.

Shaping a way ahead for Australian space launch capability is a key part of the way ahead. And in this slide from his presentation, Murfett highlighted the perceived way ahead:

FIGURE 11 SLIDE FROM ANTHONY MURFETT PRESENTATION

A number of agreements are being worked to open the doors internationally for the Australian space sector. The first is a technology safeguard agreement with the United States which is establishing principles under which U.S. spaceflight technology can be licensed for export to Australia for use in spaceflight activities. The Australians are working with India on India's first human spaceflight program where the Australian Government and ISRO are working together to track the Gaganyaan mission from Australia's Cocos (Keeling) Islands (CKI). And finally, there is an Australian-UK space bridge framework arrangement which Increases connection, exchange, and investment across AU-UK space sectors.

Murfett concluded his presentation by identifying what he saw as the next phase for the Australian civil space effort: Deliver the remaining technical roadmaps to highlight opportunities for investment; support industry to scale; connect across government to highlight how space can support growth, safety, and security; connect with the Australian community and show the value of space to our everyday lives and to inspire the nation and support the future workforce.

FIGURE 12 ANTHONY MURFETT

Second Line of Defence

This last point was underscored in other presentations as well. For example, in the presentation by David Ball, regional director, Australia/New Zealand for Lockheed Martin Space, he underscored: "The young folks these days aren't coming into space as we would need them to. We need to inspire our younger generation and give them the path and show them there are real, tangible jobs in the space sector in this country."

Murfett provided a fitting comment to highlight the way ahead for defence working with the evolving Australian space industrial eco system: "There is an Australian industry here that can actually deliver on Defence's future ambitions."

I would add that the challenge is to ensure that this happens in the way which fits as well into the evolution of the ADF, its forces, its strategy, and its concepts of operations.

HOW DEFENCE CAN CONTRIBUTE TO AND LEVERAGE THE AUSTRALIAN SPACE INDUSTRIAL ECO-SYSTEM

AIRCDRE Terry van Haren (Retd.), former air attaché to the United States, provided a very clear focus on how he thought the ADF can best leverage an Australian space enterprise. His focus was upon the emergence of "new" space which he had observed in the United States and the significant opportunities which such a strategic shift in the space business provided for Australia.

In his briefing, he presented a slide which nicely captured much of his argument:

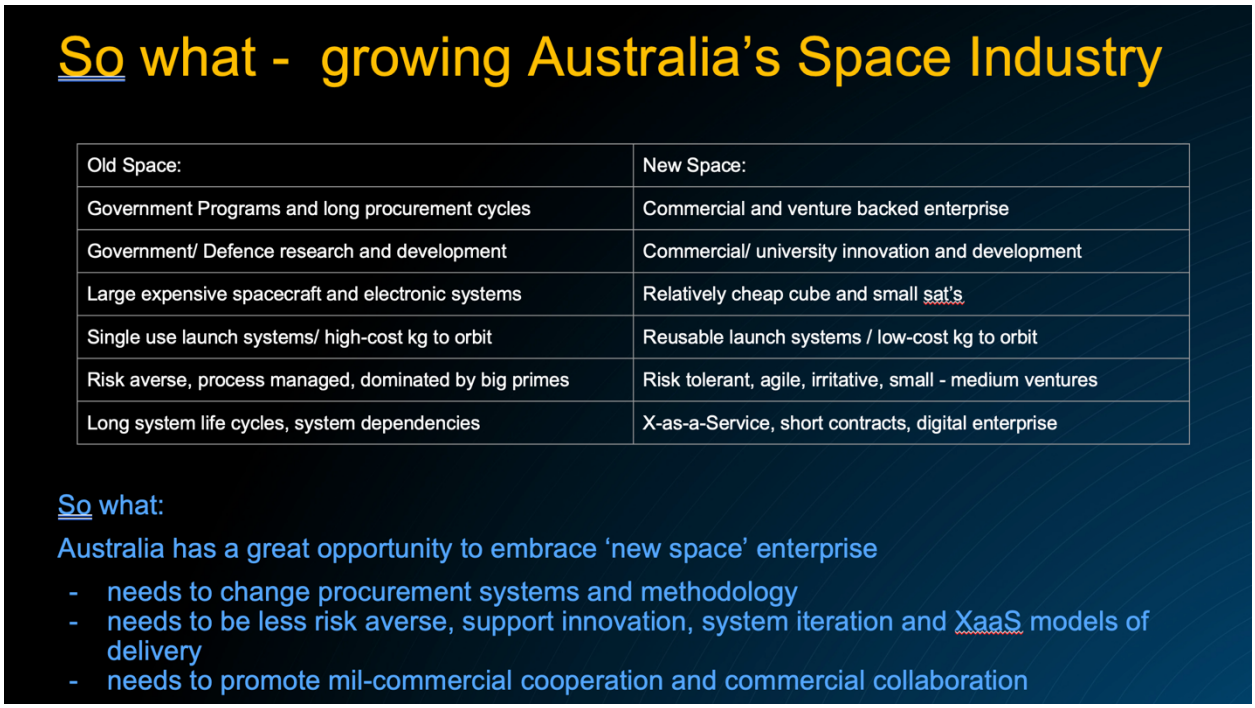


FIGURE 13 SLIDE FROM VAN HAREN PRESENTATION TO THE WILLIAMS FOUNDATION SPACE SEMINAR

As he put it at the seminar: "There is a significant opportunity for Australia with the emergence of new space. At the delivery level, there are now a lot of options now available as a service launch, as a service, for example. Data has become a service; software has become a service. It means that government now could be a customer, and they can move with the speed of the industry."

The major presentation at the seminar which provided answers to shaping a way ahead for defence regarding the space sector was provided by Professor Tanya Monro, the Chief Defence Scientist. Notably, Defence is investing in space to improve the resilience and self-reliance of Defence's space capabilities. Space has been recognised by the government as a Defence Sovereign Industry Capability Priority (SICP) in its own right.

She argued along the lines of van Haren that space is being disrupted by rapid technological change with the emergence of 'New Space.' This development has lowered the barriers to entry for all, including Australia companies. The Government's goal is to substantially increase the size and scope of the Australian national space economy. And they are doing so in part by supporting a comprehensive policy for Innovation, science, and technology (IS&T) and with the space focus as a subset of this more comprehensive effort.

She argued that Defence space IS&T is a key Defence enabler for building a sovereign Defence space capability. "We are seeking to help create a sovereign industrial capability to provide increased space capability for Australia. To do that, we need to partner with great minds across our nation."

She highlighted the importance of the defence innovation hub which can provide a way ahead for mission-directed research. And in the space domain by partnering with the national space sector can "deliver impacts through streamlined, agile and secure innovation pathways for our future space capabilities."

In her presentation, she highlighted how she saw the way ahead regarding Defence IS and T programs in the space domain area.

FIGURE 14 SLIDE FROM PRESENTATION BY PROFESSOR MONRO TO THE WILLIAMS FOUNDATION SPACE SEMINAR

She noted that the "Defence Innovation Hub undertakes collaborative innovation activities with the potential to enhance Defence capabilities, including for space." In other words, the re-set of how defence is looking to tap into Australian industry to generate greater defence capability is to be leveraged to provide for specific space capabilities, rather than the other way around.

Second Line of Defence

She underscored the importance of the "Defence Rapid Prototyping Initiative (RPI) aims to increase use of innovative technologies to solve critical Defence problems with a Defence Capability Assurance Fund (CAF) to be introduced in the middle of the decade."

FIGURE 15 PROFESSOR MONRO AT THE WILLIAMS FOUNDATION SPACE SEMINAR

In this effort, she highlighted the STaR Shots approach. This is how the DS and T web page describes this approach:

"STaR Shots will be established to focus strategic research and drive the development of leap-ahead Defence capabilities. This strategy introduces a new concept – STaR Shots – that will concentrate strategic research efforts on a smaller number of bigger, specific, and challenging problems of the scale and impact of JORN. An ambitious schedule will be set, with the aim of demonstrating leap-ahead capability within 10 years.

'STaR Shots will be challenging, inspirational and aspirational, and will generate competitive capability best achieved through Australian investment. They will align with Defence strategic guidance, address future Force Structure priorities and be sponsored by at least one Defence 3-star leader. Crucially, they will have clearly defined transition pathways to take innovative ideas out of the laboratory and deliver real impact into the hands of the warfighter.

"STaR Shots will focus the strategic research investment program but with an increase in scale and intensity that will be supported by investment from other innovation initiatives and partner co-investment.

"The initial eight STaR Shots will be established to collectively support Defence's ability to prevail in contested environments. Aligning with capability needs across each of the warfighting domains, they will enable Defence to get to the fight, shape how the ADF operates and generate new military effects.

"STaR Shots will be supported though investment in modelling and simulation, wargaming, prototyping, experimentation and trials. They will culminate in technology demonstrations during ADF exercises.

"The STaR Shots are deliberately ambitious and reflect Defence's enduring commitment to invest in science and technology. As our strategic context evolves, new STaR Shots could be established to ensure that leap-ahead capabilities which align with Defence's needs continue to be delivered."[8]

The space-focused Star Shot program within the overall effort is to focus on "resilient multi-mission space." The DS and T web page identifies this effort as follows:

[8] https://www.dst.defence.gov.au/strategy/defence-science-and-technology-strategy-2030/science-technology-and-research-star-shots.

"Providing resilient space-based services direct to the warfighter to enable the Australian Defence Force to prevail in increasingly contested operating environments.

"Context:

"Space-based systems play a vital role in all ADF and coalition operations, wherever they occur around the world. From providing precise location information and situational understanding of the operating environment to enabling personnel and platforms to stay connected, assured access to satellite services and the freedom to operate in space are critical to the ADF's ability to protect and defend Australia's national interests.

"Space is now a warfighting domain. Some countries are developing anti-satellite systems and denial-of-service measures that threaten space-based capabilities. Satellites and space systems used by Defence are becoming more vulnerable as the space domain changes from a benign environment into one that is increasingly congested and contested, where adversaries seek to limit the military advantage provided by space.

"An agile and potent future force will rely on assured access to resilient and responsive space services. Seamless interoperability with coalition partners will also be necessary to support diverse missions across multiple locations around the globe.

"Opportunities:

- Advanced space-based surveillance capabilities to provide comprehensive situational awareness for superior decision-making.
- Secure and resilient communications delivered from space for a highly networked force.
- Resilient satellite services providing accurate position and timing information to enable precision effects in contested environments.
- Advanced space domain awareness and control for sovereign space operations.
- Autonomous space systems and processing capabilities to dynamically reconfigure and deliver space cloud services at speed and scale direct to the warfighter.
- Space systems hardened against anti-satellite and denial-of-service measures."[9]

Professor Monro provided a slide in her presentation which captured some of the key elements of the space-focuses STaR shot effort:

[9] https://www.dst.defence.gov.au/strategy/star-shots/resilient-multi-mission-space.

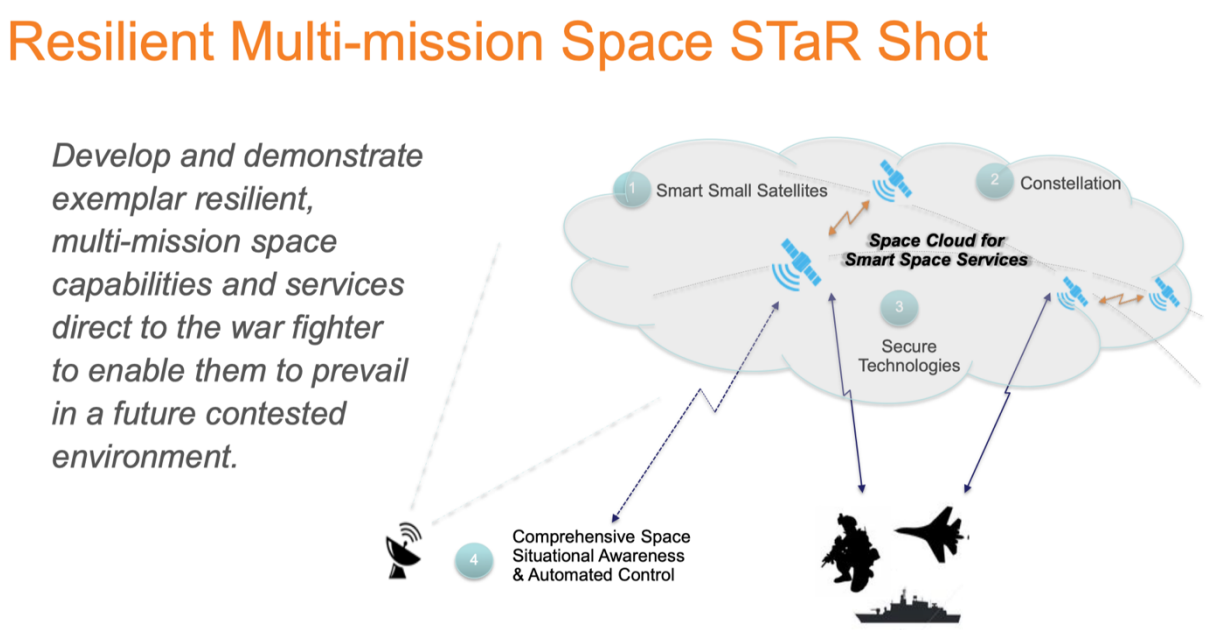


FIGURE 16 SLIDE FROM PRESENTATION BY PROFESSOR MONRO TO THE WILLIAMS FOUNDATION SPACE SEMINAR

There is also a very helpful video which was released on 3 May 2020 which highlights key elements of this effort as well. [10] According to the narrator of the video, the heart of the effort is to shape a small satellite network that can deliver various data to ADF warfighters operating worldwide. The focus is to leverage the innovations in LEO systems to be able to do so. Communications, imagery, position, navigation, and timing capabilities are envisaged for the ADF user. To do this, a focus is upon developing and testing new technologies and capabilities with SmartSat CR and to work small satellite integration.

In the interview which she did with the Williams Foundation she summarized how she saw the target goals and the way ahead:

"I don't think it's ever reasonable to expect that Australia will have a purely sovereign space capability, but we certainly need a much more sovereign one than we have now. We're very dependent on access to foreign space assets. I don't think Australia will ever have a purely independent sovereign space capability. And I don't think we need one, but I do think we need a much more sovereign space capability than we have now. We need to know that when push comes a shove, we can rely on space assets to support our nation and its protection of its own interests, that our ADF can rely on having access to space when needed.

"We need to build very significant Australian sovereign industry capability to support that. And I think that that helps us be a better international partner. What we absolutely must do is work with our allies to make really clear where Australia has niche advantage, so that we can create opportunities for our companies to export to the world in those areas and that we can buy other complimentary areas of capability and technology from allies.

"For me, a future Australian sovereign space capability means assured access to the things we need when we need them under pressure. But it doesn't mean every space asset that we use is sovereign. Defence has a range of innovation programs that are designed to help foster, support, and invest in new space technologies

[10] https://www.youtube.com/watch?v=hrr_URDhH4g.

and capabilities. This includes the Defence Innovation Hub, which can accept great ideas from industry and really pull them up the technology readiness levels to the point where they could be demonstrated and tested in a defence context and then pulled through to acquisition programs.

“And it's really exciting to see how many of these projects are now maturing to the point where they are serious acquisition prospects, and indeed a number are pulling through into capability. We also have things like The Next Generation Technologies Fund which can take earlier staged ideas to get them to the point where we could put them through that innovation pipeline. There are increasingly a range of different ways that companies, big and small can interact with defence. I think what we're increasingly focusing on over the next couple of years is getting engaged with industry earlier. Hearing your good ideas and working out how we can reduce the barriers for you to be able to develop new technologies in a defence context.”

THE ADF AND THE AUSTRALIAN SPACE ENTERPRISE

AIRCDRE Nick Hogan, Director General Space Domain Review, provided on overview on the emerging approach to how the RAAF and Defence are addressing military space. In an interview which he provided to the Williams Foundation separate from the presentation at the seminar itself, he highlighted the way ahead.

“The space organization that we're starting up in January 2022 is a whole of defence organization. While Air Force will host space, it certainly does not own it. Space is a multi-domain capability, so certainly not owned by anybody in particular…

“The space organization we are setting up will be a flat structure by necessity. And when I say by necessity, we will have a two-star lead with three, one star or band one equivalents that sit underneath her and then underneath that it's a pretty skeleton like structure.

“We will also bring in other organizations like the Australian Space Operation Center inside the organization…We are literally quite lean by design so that not only do we have a requirement to keep it lean so that we don't have as much of a resource burden across the services because of course we're doing this within our resources right now, as well as doing everything else that we normally do.

FIGURE 17AIRCDRE HOGAN

“But also, we want to be able to get the lower ranks engaged who have more experience in space. We're in an unusual situation here where we are standing up an organization where the person who leads it isn't the most experienced person in the organization. We are standing up an organization where the lead of the organization doesn't know as much about space as some of the junior people who have been in it for a long time. Having those junior people come into the headquarters provides us with that experience. It's a great

opportunity to be a lean and agile organization and I think that's what you'll see at the organization next year."

As the ADF shapes and interacts with the evolving Australian space enterprise, they are doing so in the context of a broader set of space developments affecting their partners and allies as well. This means that they can take account of broader allied efforts as they shape their own as well.

He highlighted that a key focus of their space effort was upon supporting the joint warfighter. This is also part of shaping a broader national security strategy for whole of government. "We need to understand the effects of space on our security."

The defence workforce needs to have the flexibility to get full value from the evolving space work force, inside and outside of government. "What does that mean in the defence context? It means allowing people to go into industry, come out of industry, work back inside the fence. That will allow us better understanding as we move forward, truly moving forward."

He underscored the need for new training regimes, including the formation of a space warfighter course. And it is important to ensure that such a perspective fits into the evolving integrated force approach or concept.

Indeed, even though leveraging commercial space is a key aspect of the way ahead, military applications do have the specialized requirements. As David Ball, regional director, Australia/New Zealand for Lockheed Martin Space put it: "We need to make sure that it's military-grade and it does provide the resilience that we need to have in such an important system. We see increasing counterspace activities by adversaries in this region, we've seen anti-satellite attacks recently, we've seen co-orbital attacks from another spacecraft. Those technologies are advancing rapidly, and we need to be very cognizant of those changes as we build up our network. It's something the satellite industry needs to take care of in all facets in the space segment as well as the ground segment and the control segment."

And in Ball's assessment this means that space although a distinctive domain is embedded in a wider information warfighting environment facing the ADF. "In addition to the physical risk I just talked about, there's always a cyber risk, and we've seen government recently make announcements in this regard about critical infrastructure in this country. That applies to civilian networks as well as to military networks, so industry, as a whole, needs to respond and be aware of these as cyber risks and make sure that we have bulletproofed our systems to ensure that people can't get in to attack."

FIGURE 18 DAVID BALL, LOCKHEED MARTIN

When one focuses on defence, it is always crucial to remember that it is an entity which is engaged in the ongoing defence of the nation. And as the major authoritarian powers are engaged in my view in ongoing limited war with the liberal democracies to seek to gain escalation control dominance, the focus is upon the

future is now. It is important to have long-term objectives, but one must just think back to 2019 to look at how good the forecasts were for the world in 2020 to understand the need for modesty when making long-term projections.

The presentation by the commander of the Air Warfare Centre, AIRCDRE Ross Bender provided an assessment of the way forward grounded in this reality. "If we need to go and conduct an operation in the next 12 months to two years, what do we know of the environment? What do we know of the options we have available? What are our vulnerabilities? What are our key support requirements from our coalition partners to enable us to provide options to the joint force?

"That's the focus that I have in my current role. We need to work with industry, academia, and the coalition partners to identify those options and then explore them, so that day zero, I can be prepared to fight. Rather than day one, trying to make it up on the fly while we understand what we can and can't do."

AIRCDRE Bender underscored a core point for today's operating force: "Space domain awareness is critical for today's fighting force. The reason can be reduced to one word and that is dependency. Dependency in joint operations translates to military vulnerability, which in turn may identify opportunities for an adversary.

"Australian defence-based capabilities and operations are significantly dependent on the U.S. for access to space-based capabilities, along with the provision of accurate and validated observations of objects in space….

FIGURE 19 AIRCDRE BENDER

"The U.S. operates and maintains a space surveillance network that consistently collects observations on all observable space objects from multiple sensors, spreading around the globe, to extrapolate and validate orbital elements, which then form a space object catalog. The U.S. space catalog is maintained at different classification levels, and one of the primary contributors to developing space domain awareness.

"Therefore, continued access to these catalogs is a critical vulnerability that the government plans to mitigate through the development of a sovereign space domain awareness capability. It is important to note that with the focus on developing sovereign defence space capability, it might be perceived that defence may be disconnecting somewhat from our allies and partners. This could not be further from the truth. Australia holds a unique geographical position to contribute significantly to collective space domain awareness with our allies and partners, as evidenced by Defence currently hosting a U.S. ground space-based surveillance sensor.

"Defence space capability delivers desired effects in supportive joint operations through the use of space as an operational domain. The desired effects are provided through space battle management, missile warning operations, access to and management of space services, including SATCOM and GPS, and access to space-

based intelligence, surveillance, and reconnaissance systems. And underpinning all of this is developing and maintaining consistent and comprehensive space domain awareness."

When considering a realistic and effective way ahead for the ADF in space, Malcolm Davis sensibly focused on how Australia can work the high-low mix or focus really on the new space approach to satellite build and launch, and craft capabilities to work in effect ISR constellations. He argued at the seminar that by using small satellite systems Australia could shape sovereign space-based targeting for strike capabilities. Combined with innovations in reusable launch, small sats can provide the ADF with significant new capabilities.

Such capabilities are part of the kind of resilience which the ADF is broadly seeking. As Davis put it: "Why should we do this? Why should we invest in sovereign capabilities? It's all about resilience. It's all about having the ability to maintain operations and maintain capability in a contested environment. We are responsible for this, not the Americans, not anyone else, it's down to us to deliver this capability.

"At the same time as we develop these resilience capabilities, we need to expand our ability to contribute towards deterrence, because that allows us to contributed to the common good of preventing a Pearl Harbor in space."

A Navy perspective on space was provided by CDRE Matthew Doornbos, RAN Director General Navy Intelligence and Information Warfare. He argued that "The ability to access services and benefit from space related war fighting effects and synchronizing and coordinating them with other kinetic, non-kinetic effects and physical maneuver is critical to vitality and survivability of a deployed maritime task group. Controlling the seas and projecting power from the sea complicates the strategic situation for adversaries and competitors.

"As Director General Navy Intelligence and Information Warfare, I have responsibility for the oversight over the Maritime Commander Control Communications, Computers, Cyber, Intelligence, Surveillance, Electronic warfare program, or more simply the MC5ISR program, which include Navy's endeavors in the space domain.

"The creation of the program was approved by government late last year and brings together all of Navy information warfare projects under one overarching program. It includes several projects that are already delivering and several projects which deliver over the next 20 to 30 years.

"A notable endorsement by government of the program is the adoption of a continuous capability development system that enables defence the ability to maintain tactically relevant, technically advanced, in fit for purpose systems that enable the maritime force to maneuver within the electromagnetic spectrum in a degraded, denied, intermittent or limited environment. At the same time, it allows us to the capability for degrading or denying adversaries freedom maneuver.

"The requirement for the program was driven out of a growing realization that the current rate of technology advancements, and our contrasting inability to deliver new capability at a similar rate. It was realized that our limitations for providing rapid responses to emerging threats was derived from our process of implementation and not necessarily our capacity to develop the technology.

"The future of warfare is being shaped by the world advancements in technology. And we must stay at the forefront. The rapid pace of technology development means that Navy's mission is now only achievable through the nexus of maritime, air, land, cyber, and space domains. Navy gains several critical information advantages through space, position, navigation, and timing….

FIGURE 20 CDRE MATTHEW DOORNBOS

"This network provides the central warning for counter advanced ballistic missile capabilities. Intelligence surveillance reconnaissance, space based optical radar and RF sensors have been long used to support military operations. As soon as we leave the wharf, these space-based communications are being placed at risk in a congested and contested spectrum environment."

Operating within the dynamic war fighting environment relies on access to space and doing so requires in his view the ability to shape, support, and leverage the wider evolving Australian space eco-system.

"We cannot rely on our major primes and institutions alone. Therefore, we must identify the importance of implementing the smaller players within the industry to contribute and develop our key resource, and that is our people. My goal is to develop and build and nurture the relationships between defence industry and academia. In doing so, I seek to build that academic base and give depth and breadth to support Navy's, C5ISR needs. This partnership, where we're all able to understand each other's needs and pressures, will lead to a better outcome for all of us collectively.

He then added that: "Navy may need to leverage commercial capabilities that reduce the cost of access to space and increase the utility and the availability of space-based systems. Navy needs to establish processes for developing and managing space expertise for our sailors. In information warfare related work groups, current career streams do not provide a path to upscale individuals, who would form the core of professional workforce in our Navy to stay abreast of rapid developments in tactics, techniques, procedures, and capability. Concurrently, Navy needs to train its officers with specialist space effects and information warfare knowledge to generate, integrate and synchronize space capabilities into maritime task group operations."

He added: "In order for us to predicatively move forward with the necessary research and development and basic science and technology to meet our capability needs, there needs to be a level of funding behind the research. It's a simple fact. That's why we need to fully utilize the funding opportunities available to us through the defence innovation hub."[11]

An Army perspective on military space was provided by BRIG Ian Langford, Director General Future Land Warfare. "As part of the joint force, the Australian Army must contribute to orchestrating effects across all domains, to include space with our like-minded partners and allies. The more cohesive, integrated, and network force that we generate as part of the joint force, the more effective we will be in leveraging this domain.

[11] https://www.dst.defence.gov.au/nextgentechfund

Second Line of Defence

"Army's contribution to space power is obviously not new. And as the ADF recapitalizes, to include its diverse space workforce, it'll require expertise to be drawn from across army, navy, air force, the public service, contractors, academics, and industry, if we are to realize this ambition and the responsibilities that we have towards safeguarding the nation.

"For our army, they exist inside our sixth brigade, which is that part of army which raise, trains, and sustains our air defence, our ISR electronic warfare, and our long-range fires community. That organization and those people within will need to be skilled, and in some cases re-skilled, across the decade as the ADF space strategy becomes realizable….

"The generation of space power for army will require more than just the employment of space systems. It will demand a coherent joint and integrated culture in space domain, increasing the awareness of space power within army and across defence. We must understand how each of the constituent parts of military power are enabled by the other. And this prepares our people for roles across the department, outside of this service, expands our thinking, and ultimately contribute to our ability to be successful both in single, unified, and multi-domain operations. Army's access to terrestrial and orbit satellite assets, for example, provide a spectrum of offensive and defensive capabilities to protect and defend the space domain."

FINAL THOUGHTS

One way to look at the discussion at the space seminar is to place into the context of the evolution of the Australian defence strategy since 2014. In my book *Joint by Design*, I brought together the Williams Foundation seminars since 2014 to shape a comprehensive narrative with regard to the evolution of Australian defence strategy.[12] Since 2018, there has been enhanced focused on crafting a longer reach for the ADF but at the same time enhanced capability for the direct defence of Australia within its region.

Given resource limitations, including significant manpower challenges, this has meant that there is an enhanced focus as well on man-machine systems, longer range strike missiles, rethinking how the Australian defence geography interests with extended Australian defence, and how to shape longer range ISR systems which can provide for earlier warning and enhanced decision making.

The presentations by AIRCDRE Phil Gordon at an earlier Williams Foundation Seminar when brought together with his presentation at the space seminar highlight some of the dynamics. At the October 24, 2019, seminar which focused on the requirements for fifth generation manoeuvre, Gordon highlighted the importance of evolving C^2 and ISR capabilities to delivering effective capabilities for manoeuvre in the contested battlespace. In a piece I wrote after the seminar, this is how I discussed his presentation:

How to shape information dominance is a key part of the evolving approach to maneouver warfare.

WGCDR Brick cited the Australian Army's doctrine of accelerated warfare: "Accelerated warfare means owning the speed of initiative to outpace, out-manoeuvre and out-think conventional and unconventional threats. It requires excellence in the art and science of decision making…."

A key element of shaping such a capability revolves around the kind of Command and Control which the force can exercise in multi-domain operations.

[12] https://www.amazon.com.au/Joint-Design-Evolution-Australian-Strategy-ebook/dp/B08R6JVWFQ/ref=sr_1_2?crid=17EZMBKWN6BA9&keywords=Joint+by+design&qid=1641468207&sprefix=joint+by+design+%2Caps%2C112&sr=8-2

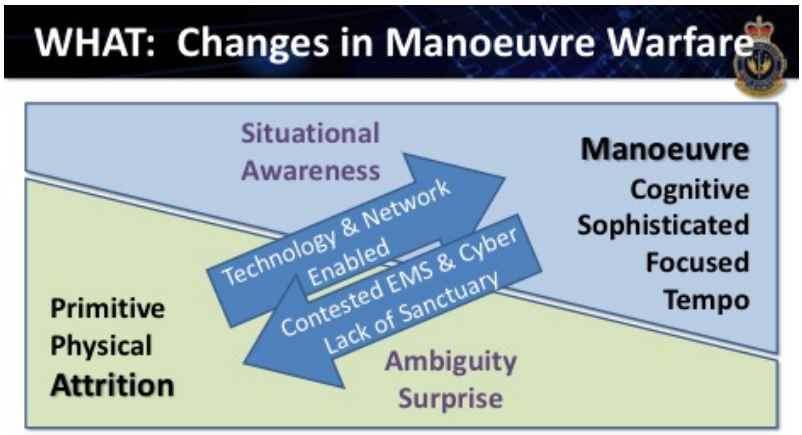
This was the topic of the presentation of the Commander of the RAAF's Air Warfare Centre, AIRCDRE Phil Gordon.

This is how he defined fifth generation manoeuvre:

"The ability of our forces to dynamically adapt and respond in a contested environment to achieve the desired effect through multiple redundant paths. Remove one vector of attack and we rapidly manoeuvre to bring other capabilities to bear through agile control."

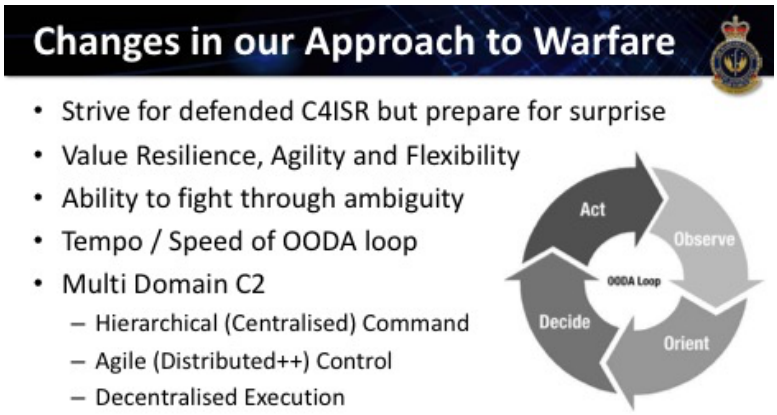
In his presentation, he started by discussing what is new and what is not in terms of 21st century manoeuvre warfare.

This slide captured how he addressed this issue.



He then addressed how he saw the C² piece of this as a crucial glue holding together mission success.

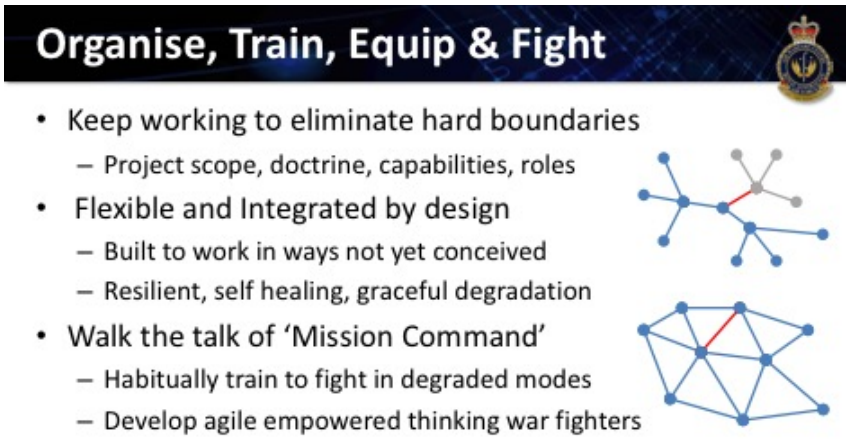
The following slide captured how he conceptualized this dynamic.



He argued as did Air Marshal Hupfeld in his presentation later in the day that this was not a static achievement, but fluid and dynamic and required mastering the art of transient advantage against the adversaries we are confronting today.

This is how he highlighted the dynamic learning curve which the force and its technology needs to go through to achieve this outcome or capability:

Second Line of Defence



With his presentation at the space seminar, in effect, Gordon was now discussing the same thing but in terms of an extended battlespace with space as the high end for ISR and C^2 systems. And given the criticality of such systems for national decision making in the limited wars ongoing with the authoritarian powers, for escalation control and resilience when conflict ramps up, Gordon naturally highlighted the importance of enhanced sovereignty for Australia within space.

FIGURE 21 AIRCDRE PHIL GORDON

Gordon underscored regarding the Australian space effort: "We are on a journey, but we've got a long way to go to achieve professional mastery. We need at all levels of defence, leadership, and government to be informed and understand what it means when someone cozies up to one of our satellites, starts fiddling around, well, what does that mean? What should we do about that? We need to take an integrated commander control approach. This is a key part of the joint force. We're not just making space versus space decisions. Space is not just a special domain but one which impacts on all other warfighting domains."

Certainly, as Australia looks to add long-range strike, space capabilities are a key part of such a system. And that really is the point. Shaping sovereign space capabilities is a key part of the ability of Australia to have the kind of decision making appropriate to the gray zone, hybrid war or what I prefer to call it limited war and escalation control challenges.

As Gordon put it: "If we are going to make a decision to go to war, we probably shouldn't just take someone else's word for it. What happened? You could look back to the decisions around the invasion of Iraq and the

fallout of that and weapons of mass destruction. Do we want to just rely on other people's assessments of why our satellite just stopped communicating with us? Or do we want to have a way to independently collaborate and corroborate that information."

We put it this way regarding defence in our book on European defence: "But it is clear this is not the 19th century in that no Western state can directly defend itself and its interests by itself. We are in a situation where even powerful Western states can only pursue defence and security strategies from a position of semi-sovereignty.

"The fundamental reality is that defence is national but executed in a situation of semi-sovereignty. It is not only shaped by semi-sovereign relations with other liberal democratic states but also in terms of sorting through the kind of relationships liberal democratic states will have with 21st century authoritarians which now operate both internally and externally regarding the liberal democracies themselves.

"Alliances are crucial but not definitive in solving the direct defence challenges facing today's liberal democratic states. National goals and objectives need to be clearly identified, stated, and pursued but done so with regard as well to ensuring ensuring that those liberal democratic states most willing to act in support of your nation's more enlightened objectives are on the same page with regard to how best to handle full spectrum crisis management.

"Nations remain the focus for defence and security, even though what has emerged is clearly semi-sovereignty even for larger nations. Part of shaping the way ahead for a nation is to have tool sets which not only can defend its interests but also trigger collaboration with core partners to ensure that the overall result is more capability on the basis of "enlightened" nationalism to act, rather than on simply more agreement to discuss, but with little ability to be able to act during a crisis."[13]

CONCLUSION: THE PERSPECTIVE OF AIR MARSHAL (RETD.) GEOFF BROWN, CHAIRMAN OF THE WILLIAMS FOUNDATION

After drafting the report on the conference, I had a chance to discuss with the Williams Foundation his takeaways from the seminar and his perspective with regard to the way ahead.

Question: What was the purpose of the seminar and was that purpose achieved?

Air Marshal (Retired) Geoff Brown: The purpose of the seminar was to look at space from a defence perspective. How do we apply developments in the commercial sector, notably with what is labelled new space, to the defence sector?

The ADF has clearly recognized that it needs to own space-based capabilities, but how best to do so?

As Phil Gordon noted, we have significant experience with space operations, but more like frequent flyers on the U.S. systems, than being operators ourselves. We're very experienced in using other people's space assets. In the competitive era we are now in with authoritarian regimes around the world, it's important that we actually operate our own sovereign capabilities to supplement the access that we've have with U.S. capabilities.

Question: Australia has a unique geography which is relevant to the space effort. How do you see this factor?

[13] Robbin Laird and Murielle Delaporte, *The Return of Direct Defence in Europe: Meeting the Challenge of XXIst Century Authoritarian Powers* (2020), chapter five.

Air Marshal (Retired) Geoff Brown: We sit fundamentally on the line of a polar orbit shared with our chief competitor and there are a lot of things that we can do down here building out from that geographically reality. But to do so, we don't need to duplicate US capabilities; there's less expensive sovereign methods of achieving the aim of leveraging our geography.

Question: Clearly, the United States has recognized the importance of Australian geography for space operations. If we think of Australian engagement in this approach as a sunk capital cost, how best for Australia now to leverage this capital investment?

Air Marshal (Retired) Geoff Brown: A key aspect is what is referred to as the new space. The cost to launch has gone down dramatically over the past three decades. Building satellites has changed with the launching and operating of new constellations. For Australia, going down this new space path is crucial.

One aspect of which is working ways to shape LEO constellations combined with MEO satellites. That combination can give you data and communications capabilities of the kind which the ADF clearly wants and needs.

A lot of the things we really wanted to bring out in the conference was as Australia looks to invest in space capabilities, we shouldn't necessarily follow the U.S. model blindly and just put up a big geo communication birds because that may not be the best path forward. We need to look at the opportunities of what I term new space and see whether we can't leverage those capabilities to get us a more cost effective and a possibly more enduring capability for Australia.

Question: Looking back at the evolution of the ADF, clearly significant ISR capabilities have been added, such as Wedgetail. The F-35, the Triton, and the P-8. Space gives a longer-range reach, but should it not be viewed with this lens of shaping a more integrated ISR enterprise with longer reach?

Air Marshal (Retired) Geoff Brown: That is a good way to put it. Because we have not had a dominant space effort like the United States, we can think of space precisely in the terms of how what we can do enhances our overall ISR capabilities. It is not about feeding legacy space or a big intelligence community. It is about relevant space capabilities that can work effectively with our other terrestrial capabilities, including innovative new ground-based radar and laser optical systems as well.

It is similar to my experience with Wedgetail. The USAF has been so heavily invested in AWACS that they have resisted what we have done with Wedgetail. We took a different approach and did so because we saw it as a better fit for where we needed to go as a force, rather than we owned this a particular capability and needed to keep it alive.

I see this as analogous to how we are approaching space. We are looking for the capabilities that take us forward towards the warfighting capabilities we need, as opposed to keeping the legacy systems fed.

Question: To the warfighting question. My friend and colleague, Dr. Paul Bracken, has made the point in a recent interview I did with him, that in effect we are in a new historical era. We are some ways in the situation which the West found itself in 1949 exploring how to deal with the global Soviet threat. We are exploring now how to adjust and how to move forward.

In that context, information war is a staple of the transition for sure. And shaping how to share information with allies and partners is a major challenge. How do you see an Australian space approach helping in this regard?

Air Marshal (Retired) Geoff Brown: As you mentioned in the report, commercial space capabilities are delivering unclassified data for situational awareness. We can actually share such data with the Solomon Islands government or Papua New Guinea or Indonesia. We can share data with partners and the public in the information domain in dealing with the information being generated by authoritarian regimes for our or foreign publics.

This is part of the new warfighting domain for sure.

It is also the case that commercial firms have a capability for agility and integration that government intelligence agencies simply cannot do or certainly have not demonstrated. They provide alternative paths to avoid a threat of tyranny of domination by any allied intelligence services as well.

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APPENDIX 1: THE PROGRAM FOR THE WILLIAMS SEMINAR, 1 DECEMBER 2021

Conference: *The Requirements of a Sovereign Defence Space Capability*
1 December 2021, National Gallery of Australia

Program
(updated 29 November 2021)

Time	Topic	Speakers
0800-0830	**Registration and light breakfast**	
0830-0835	Welcoming Remarks	AIRMSHL Geoff Brown AO (Retd) Sir Richard Williams Foundation
0835-0850	Introduction and MC	Darin Lovett, Director Space, South Australian Space Industry Centre
0850-0900	Australian Space Capability - Historical Perspective	Amy Hestermann-Crane, The Central Blue
0900-0910	Threats to Space Operations	Dougal Robertson, Sir Richard Williams Foundation
0910-0930	Sovereign Defence Capability and Space	Dr Malcolm Davis, Australian Strategic Policy Institute
0930-0950	Space Domain Research & Development	Prof Tanya Monro, Chief Defence Scientist, DST Group
0950-1010	Commercial Space-based ISR	AIRCDRE Richard Keir AM, CSC (Retd), Sir Richard Williams Foundation
1010-1040	**Break – Morning Tea**	
1040-1055	Sovereign and Resilient Space Battle Management	AVM Chris Deeble AO, CSC (Retd), Executive Director, Strategy, Northrop Grumman Australia
1055-1110	Space Domain Awareness	Nick Leake, Head of Satellite and Space Systems, Optus
1110-1130	Space Control	AIRCDRE Phil Gordon, Director General Air Defence and Space
1130-1145	Resilient Satcom in a Counterspace Age	David Ball, Regional Director Australia New Zealand, Lockheed Martin Space
1145-1205	Sovereign Defence Space Considerations	Terry Van Haren, former Air Attaché Washington
1205-1230	Panel	Panel members
1230-1330	**Lunch**	
1330-1345	The Requirements of a Sovereign Defence Space Capability	AIRCDRE Ross Bender, Commander Air Warfare Centre
1345-1405	Australia's Civil Space Industry – Now and into the Future	Anthony Murfett, Deputy Head of the Australian Space Agency
1405-1420	Pre-recorded video	AVM Cath Roberts AM, CSC, Head of Air Force Capability
1420-1435	Navy Perspective	CDRE Matthew Doornbos, RAN Director General Navy Intelligence and Information Warfare (representing Chief of Navy)
1435-1450	Army Perspective	BRIG Ian Langford DSC and Bars Director General Future Land Warfare (representing Chief of Army)
1450-1505	Defence's Vision for Space Capability	AIRCDRE Nicholas Hogan, Director General Space Domain Review (representing Chief of Air Force)
1505-1515	Formal Close	AIRMSHL Geoff Brown AO (Retd), Sir Richard Williams Foundation

APPENDIX II: "AUSTRALIA NEEDS NEW EARLY WARNING CAPABILITY TO COUNTER THREAT FROM CHINA'S NEW MISSILES" BY MALCOLM DAVIS

Australia has a new opportunity to contribute to countering Chinese long-range missile threats by establishing a sovereign space-based early warning and tracking capability. A first step would be to invest in new types of sensors that can be deployed on Australian satellites. Ultimately, we should deploy additional satellites dedicated to the surveillance mission. This would enhance Australia's ability to detect and respond to long-range missile threats under Defence's AIR 6500 program and expand our regional role through the Quad and AUKUS to burden-share with and support key allies.

There's a strong case for Australia to undertake this role now. The Chinese missile threat is growing rapidly, as their strategic and regional nuclear forces expand. The US Department of Defence's recently released report on China's military power notes: 'The accelerating pace of the PRC's nuclear expansion may enable the PRC to have up to 700 deliverable nuclear warheads by 2027. The PRC likely intends to have at least 1,000 warheads by 2030, exceeding the pace and size the DoD projected in 2020.'

These warheads are to be delivered through an increasingly sophisticated triad comprising an expanded intercontinental ballistic missile force, a modernised submarine-based ballistic missile force, and a bomber component employing air-launched ballistic missiles. A report by the US–China Economic and Security Review Commission suggests that China's nuclear build-up 'could also be intended to support a new strategy of limited nuclear first use … [which] would enable Chinese leaders to leverage their nuclear forces to accomplish Chinese political objectives beyond survival, such as coercing another state or deterring US intervention in a war over Taiwan'.

To this growing nuclear challenge must be added the threat posed by advanced long-range conventional missiles and the looming threat of submarine-launched hypersonic missiles.

The emerging threat posed by China's hypersonic weapons capabilities—notably, the DF-17 and the recently tested 'FOBS–HGV' (fractional orbital bombardment system – hypersonic glide vehicle)—will add to the challenge of defending Australia against missile threats. China has deployed the DF-17 and is testing a hypersonic glide vehicle for the DF-26 intermediate-range ballistic missile. It has also successfully tested Xing Kong-2, a nuclear-capable hypersonic vehicle prototype.

In July and August, China reportedly tested a nuclear-capable FOBS–HGV over the South Pole, releasing what might have been a submunition over the South China Sea at speeds above Mach 5. These tests have placed China well ahead of the US in developing and deploying hypersonic weapons, demanding greater investment in space-based missile early warning.

Space-based missile early warning is not new. The US initially employed Missile Defence Alarm System, or MIDAS, satellites in the mid-1960s and now employs the space-based infrared system (SBIRS), which it's set to replace in a program known as 'Next Gen OPIR' (overhead persistent infrared), with the first of five satellites due for launch in 2025.

The US is also pursuing more advanced solutions for countering hypersonic threats. The DoD's Space Development Agency is pursuing a wide-field-of-view solution which, if placed in geostationary earth orbit (GEO), will provide the persistence needed to handle the hypersonic threat.

Australia currently relies on SBIRS, and one option would be to continue that dependency with the Next Gen OPIR satellites. But the recent signing of the AUKUS agreement, and Australia's rapidly growing space sector, opens up an opportunity for Australian to build a sovereign early warning and tracking capability. A new

sovereign capability could provide the true persistence needed to handle the emerging manoeuvrable, short time-of-flight threats being developed and deployed by China.

Developing such a capability should be a basis for the AIR 6500 project. Australia needs to be able to detect, track and ultimately intercept long-range ballistic and cruise missile systems, as well as hypersonic glide vehicles.

The quickest and cheapest path to achieving that goal involves developing persistent overhead imaging sensors to be deployed on satellites. Solutions are already available; Leidos (which recently briefed the author) has proposed a low-cost wide-field-of-view sensor that could be hosted on future satellites, such as the four to be deployed in GEO for Joint Project 9102B. Costing around $300 million for four sensors, plus the associated ground segment, the proposed 'commercially hosted infra-red payload' would provide enable the Australian Defence Force to rapidly detect, assess and track a target and would complement the tracking provided by SBIRS.

Speed is of the essence in successful missile early warning, and a sovereign capability that has a persistent wide field of view would maximise coverage of likely missile threat arcs from the north as well as along Australia's east and west coasts. Whether it's Leidos's proposed capability or one from an alternative bidder, the case for Defence supporting the acquisition of sovereign missile early warning is strong, given the looming threat and the importance of countering growing adversary missile capabilities.

Deploying a sovereign capability aboard JP 9102B satellites would mean it's available when the first of these satellites is delivered from 2027. That capability could later be complemented by additional satellites deployed in low earth orbit (LEO) or medium earth orbit (MEO).

A LEO- or MEO-based constellation, operating alongside GEO-based sensors, should be centered around locally developed small satellites, which could be launched from Australia. Orbital dynamics mean that a LEO layer have more satellites than the four GEO-based sensors. However, going to LEO or MEO for a future phase would open up new opportunities for Australia to directly participate in the Next Gen OPIR program and more fully develop the technology being used on GEO-based sensors.

The key rationale for going to a distributed and disaggregated missile early warning capability is that it makes it more difficult for an adversary to use counterspace capabilities against it. This approach may also offer advantages in detecting hypersonic weapons. Developing sovereign missile defence would enable Australia to play an even more vital role in ensuring credible nuclear deterrence and enhancing regional defence and security against a rising challenge from China.

This article was published by the ASPI Strategist on 21 December 2021

https://www.aspistrategist.org.au/australia-needs-new-early-warning-capability-to-counter-threat-from-chinas-new-missiles/

APPENDIX III: DEFENCE ANNOUNCES SPACE DIVISION

On 19 May 2021, the Australian Department of Defence announced that they were creating a new space division.

Defence will establish a Space Division headquarters within the Royal Australian Air Force in early 2022, with personnel from all areas within Defence reflecting the importance of the Space domain.

Chief of Air Force, Air Marshal Mel Hupfeld AO, DSC, said assured access to Space was critical to enabling Defence's multi-domain operations.

"We use Space daily for understanding the weather, navigating, access to geospatial information and sharing information across Australia or across the world," Air Marshal Hupfeld said.

"Defence is delivering capabilities including Space domain awareness, sovereign controlled satellite communications and Space-based Earth observation, and navigation.

"The Government has committed to significantly increasing investment in Defence's Space capabilities by investing around $7 billion this decade to ensure our access to Space, Space services and geospatial information.

"Defence will need capabilities that directly contribute to outcomes in Space as a contested domain, however this does not mean that Defence encourages the militarisation of Space.

"All Space operations are conducted consistent with international and domestic legal obligations."

As the Defence Space Domain lead, Air Marshal Hupfeld is conducting a Space Domain Review to improve how Space capabilities are managed, acquired, and operated.

"I congratulate Air Vice-Marshal Cath Roberts selected as the inaugural Head of Defence Space Division – there is no person better suited for the job," Air Marshal Hupfeld said.

Air Vice-Marshal Roberts said the position was a dream come true.

"To reach for the stars and actually get there is a phenomenal feeling," said Air Vice-Marshal Roberts.

"As an aero-space engineer I have always been fascinated by space – the ultimate high-ground."

https://news.defence.gov.au/media/media-releases/defence-announces-space-division

APPENDIX IV: INTRODUCTION TO "THE NOW FRONTIER: DEVELOPING AUSTRALIA'S SPACE INDUSTRY."

In November 2021, the House of Representatives Standing Committee on Industry. Innovation, Science and Resources, issued a report entitled "The Now Frontier: Developing Australia's Space Industry." A selection from the introduction to the report is below:

Space is an industry that inspires, fascinates, and excites people. Generally, rockets and astronauts come to mind when we think about the space industry, but its technology and equipment are very much a part of our day-to-day lives. There are enormous opportunities for individuals, organisations, and communities to take advantage of this growing sector, particularly in rural and regional areas.

Australians are most familiar with our nation's involvement in the moon landing. In 1969, tracking stations at Honeysuckle Creek and Parkes in New South Wales, relayed images back to Earth of Neil Armstrong and Buzz Aldren walking on the moon. This followed the rocket testing program in the late 1950's at Woomera in South Australia as part of the Australian Government's Weapons Research Establishment.

Perhaps less familiar to Australians is the continued use of space-based technologies and applications in our daily life. Mobile phones, the internet, weather forecasting, GPS technology and banking services all rely on data derived from space. Space related technologies were once considered those of the future – robots,

drones, remote sensors, and artificial intelligence – but are very much where we are now. For Australia to be competitive, we need to not only foster these technologies and their applications but ensure we have people with the right skills and expertise to make it happen.

The pace at which space-based technologies and innovation are developing is set to revolutionise the way we live. Space 2.0 refers to utilising and accessing space here on Earth. It includes a range of new technologies such as artificial intelligence, remote sensing, smart sensors, nanotechnology, microelectronics, big data, robotics, drones, autonomous systems, quantum computing and the internet of things. The significance of Space 2.0 is that it will create the jobs of the future.

In addition to improving our lives, this transformation will present real opportunities for Australia to be part of a growing and lucrative global space industry. Australia needs to position itself to capitalise on these opportunities.

Australia enjoys natural and structured advantages that can be leveraged to benefit socially and economically. Our geography and landscape, education and training system, technical expertise and international partnerships and agreements all combine to form an important foundation for access to the global space industry supply chains and the development of sustainable commercial activities. Furthermore, Australia is renowned for its innovation, research, and development.

The Australia' space industry is enjoying a renewed focus and interest. The establishment of the Australian Space Agency in 2018 has helped to galvanise an industry and signal Australia's commitment to a globally competitive industry. It is fair to say it has invigorated the domestic space industry. However, more can be done.

The Australian Government has a set a goal to grow the domestic space sector by $12 billion and create an additional 20,000 jobs. This report makes recommendations designed to support this growth and beyond. It has identified key reforms that the Committee hopes will help the Australian space sector to be more globally competitive while preserving and protecting the space environment. Some of these reforms include the call for an overarching vision for the industry in Australia, to inspire confidence and investment in our space capabilities, and an increased visibility of space across the Government and the Parliament.

The report acknowledges the importance of the Australian Space Agency, its dedicated staff, and the role it has played in strengthening the Australian space industry. At the same time, the Committee believes it is timely that important consideration be given to the agency's funding, operations, and status, including whether it be a made a statuary authority. This is to ensure it can even better support the industry and hold its own with other international space agencies.

Importantly, this inquiry helped to uncover that space is an accessible industry to those wishing to pursue a career in this field. The sector presents a lot of opportunity for Australia and the need to grow a workforce to support it is paramount. Beyond rockets and astronauts, there are many and varied jobs that can be undertaken. The Committee heard that there are a range of professions – not generally associated with space – such as law, medicine, project management, communications and business that will all be required to support Australia's space industry and facilitated to grow an internationally competitive sector. The report recommends that community education and outreach programs to promote these opportunities are developed, and that diversity is sought across the sector.

Further, there is so much potential for our rural and regional areas to benefit from and get involved in Australia's space sector. This includes the links between our regional industries and the space sector, the application of space related technology and infrastructure to agriculture, health, and telecommunications; and

of course, the uptake of regional education and training to better equip young people to build their careers in this industry. The report calls for an examination of ways to maximize these benefits.

https://www.aph.gov.au/Parliamentary_Business/Committees/House/Industry_Innovation_Science_and_Resources/SpaceIndustry/Report

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