



Revitalizing Canada's Vision for Space



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“Imagine waking up to find that the everyday technologies we take for granted have gone dark. No Internet. No smartphones. No weather forecasts in the palm of your hand. No access to banking or payment systems. Nightmarish flight delays thanks to a hobbled air traffic management system. A military that’s literally fighting in the blind: No satellite imagery. No reliable global communications. No precision-guided anything.”¹

Introduction

Most Canadians have little appreciation of our profound daily dependence on space systems. As a nation, we are ill-prepared to meet the challenges and seize the opportunities presented by today’s complex space domain, and without nationally focused space governance, the essential opportunities for Canada to be a valued contributor might never be fully realized.

Canada’s space capabilities, although strong in a number of niche areas, are siloed by a lack of synergy between departmental objectives. An overarching national vision for the future of Canada’s use of space-based capabilities that encompasses civil, commercial, and national security/defence needs has never been articulated. Canada needs a nationally focused framework for space governance, and equally as importantly, a fully supported plan that enables the vision. Canada’s allies and competitors are seizing the space agenda with new national space policies and strategies, while Canadian government departments compete to fund their own internally focused mandates, absent a unifying vision.

This paper explores Canada’s critical dependencies on space-based systems and highlights the lack of a comprehensive, coordinated and fully supported national plan for advancing Canadian space capabilities. It considers that for a large part of society, space-based systems might appear as pure magic, and most are blissfully unaware of how much of what they depend on each day has a critical space nexus. In effect, as a nation, we lack space-mindedness. There are real risks to such a lack of understanding, and as access to space becomes easier, the threats to how we use space systems grow at a correspondingly rapid pace.

Space has long been recognized as an increasingly congested, contested, and competitive domain. Over the past 15 years, the revolution in space technology has enabled an order of magnitude increase in operational satellites, and the pace is increasing exponentially.² From a military perspective, space is often considered the ultimate high ground and as such space-based systems are highly coveted. Although “new” space systems use a design philosophy more akin to either the aerospace or automotive industry, this is not true for national security space systems. The reliability, resilience and competitive advantage that national security space systems offer make them complex and expensive. National security space is hard. The competitive advantage provided by national security systems also makes them a target. As a result, a number of countries have developed counter-space capabilities, including anti-satellite systems, putting

¹ Space News, <https://spacenews.com/commentary-a-day-without-space/>

² The Rise and Fall of Space Sanctuary in U.S. Policy, [Updated_Dickey_SpaceSanctuary_20200901_0.pdf](#) (aerospace.org)

regular and routine exploitation of the space domain at significant risk. This threat requires some re-thinking of Canada's strategy for safeguarding our investments in space. Although it may seem a dire situation, it's not all doom and gloom – Canada has an incredible space pedigree including a strong industrial backbone with an intense desire to do more. To help ensure a bright Canadian future in space, we need to focus and harness that capacity and desire.

The Problem

Without a coordinated national vision for space, including a fully funded strategic plan derived from a national space policy, Canada's role in space will be inefficient and ineffective. In our current state, the Canadian space enterprise is siloed, disjointed, and internally competitive. Canada has limited sovereign capability in space, and without nationally focused niche contributions, our future as a valued global contributor is at risk.

Space – Out of sight and out of mind

Space is fully integrated into the modern lives of Canadians, without many of them knowing it. As a society, Canada is wholly reliant on space-based systems for a wide range of critical daily activities. Space connects us, enables business to function and helps move people, goods and information, all on a global scale. The internet, cell phones, and navigation, to name just a few, are all enabled by space-based technologies, yet that fact is obscure to most.

What would happen if Canada lost its access to, or use of, satellites? GPS navigation systems would be unavailable, leaving aircraft grounded and ships stranded at sea or in ports. Clocks would not synchronize to a universal standard time bringing down global financial systems. Cell phones would lose signal and internet connections would instantly drop. Bank cards would no longer function, while debit payments and access to cash would be impacted as ATMs went offline. Banks would close. Stores could no longer conduct financial transactions, and individuals would be unable to purchase items. Businesses would close. Traffic lights, reliant on GPS timing signal synchronization for proper functioning, would falter, causing chaos on the roads. Electrical grids would lose timing synchronization resulting in widespread rolling blackouts. Security systems would fail as a result of power loss and many critical national defence communications and operational systems would cease to function. Imagine if this were to happen just for one day? Imagine a week? Imagine the chaos and panic.³

Going forward, Canadians need to be better informed about the prominence of space-based technologies in their lives and the importance of accessible space infrastructure and a viable space industry in Canada. Typically, when something is out of sight, it is also out of mind, and there is no more striking example than satellites in space. An absence of space-mindedness by the general public results in a significant lack of awareness about the critical importance of

³ [Modern civilization would be lost without GPS - SpaceNews](#). "This 2019 report sponsored by the National Institute of Standards and Technology estimated the loss of GPS would cost the U.S. economy \$1 billion a day, or \$1.5 billion if the technology failed in the April-May planting season for farmers. "

space-based systems to modern life. Such lack of understanding is dangerous as we continue to increase our space dependencies without consideration of the vulnerabilities surrounding these systems, and the various actors that have capabilities to disrupt them. When one connects the importance of public awareness to public support for government spending, it becomes evident that the government of Canada should take steps to better inform the Canadian public on the benefits and critical importance of space-based systems. A well-informed public often leads to better understanding, increased support and greater acceptance for government spending on expensive investments.

Current Assessment - Risks, Threats, Seams and Gaps

Canada is a proponent of the use of space as one of five internationally agreed global commons (high seas, deep sea bed, atmosphere, Antarctica and space), treating it as a shared environment with freedom of access for all. The global commons are defined by the United Nations (UN) as those areas that fall outside of national jurisdictions and to which all have access.⁴ Yet, access to and freedom of use of space has changed dramatically in the past 20 years. Near-earth space is clearly contested. Our adversaries, and many of our allies, have accepted that space is no longer a sanctuary. India, China, Russia and the United States have all developed the capacity to attack space systems, while many other nations have developed the capacity to interfere with ground elements of space systems, through cyber/electronic means or kinetic attack.⁵ Space has the potential of becoming a future combat environment, putting the civil, commercial and national security advantages we enjoy from it at risk.

Understanding the fundamental importance of space for Canada, we must ask: how well is Canada organized as a nation to meet the challenges and seize the opportunities that space presents? As a middle space power, Canada relies very heavily on military allies, civil and commercial partnerships, and multi-use systems to achieve the required space effects. The awkward reality is that we own and operate very little of what we actually need and use on a daily basis. We are dependant on others for critical capabilities. Those capabilities we do own and operate, such as the Canadian multi-use Radarsat series of satellites, provide critical government, commercial, and military space effects. But across the range of national security, civil, and commercial space activities, all closely interlocked at the working level, Canada has no all-encompassing national space policy, strategy or plan to ensure those activities are aligned in a whole-of-government effort, or that they represent the best overall collection of capabilities for Canada.

⁴ UN System Task Team on the post-2013 Development Agenda (2013). [Global governance and governance of the global commons in the global partnership for development beyond 2015](#).

⁵ [Global Counterspace Capabilities Report | Secure World \(swfound.org\)](#)

Instead, as depicted in figure 1, Canada has an incomplete collection of defence, civil and commercial space policies, strategies and initiatives. What should be a focused approach to space

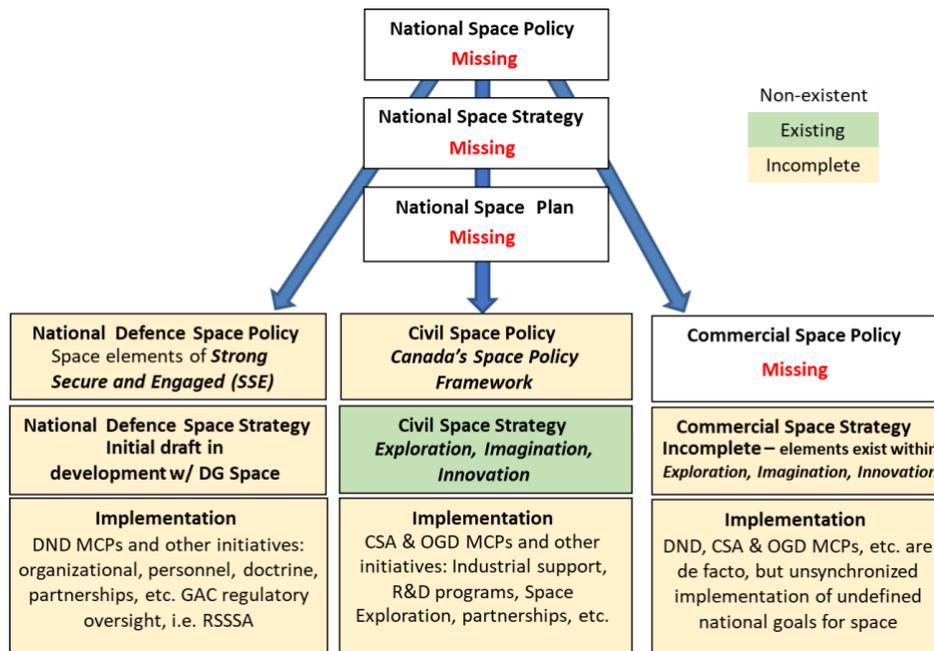


Figure 1- State of Canadian Space Governance

has been severely limited by a lack of national coordination, exposing serious gaps and seams in policy and planning.

For example:

1. The Radarsat series of capabilities have evolved through a variety of ownership models (public-private partnership, commercial ownership, government ownership). Such ownership arrangements may be normal for civil/commercial space programs, but regarding RADARSAT-2, such changes had serious problematic impacts on the defence crown jewel of Canada-US intelligence sharing;
2. Overlapping and competing projects such as DND's Defence Enhanced Surveillance from Space project (DESSP) and CSA's Synthetic Aperture Radar Data Continuity (SAR DC) project, both designed to replace existing Radarsat systems, lack national guidance to harmonize competing goals, leading to wasted resources and duplicated costs (e.g. pushing technology boundaries with new research and development versus operationalizing existing capability);
3. National security oversight of Canadian remote sensing space systems by Global Affairs Canada (GAC) via the Remote Sensing Space Systems Act (RSSSA)⁶ hinders the

⁶ Space Strategies Consulting Ltd. (SSCL). 2022 Independent Review of the Remote Sensing Space Systems Act (RSSSA). Parliament of Canada, House of Commons, Sessional Paper No. 8560-441-1062-01, Tabled 21 March 2022

development of the Canadian remote sensing space industry and limits their contributions to Canada's vision for space; and

4. Tensions between space as a military operational domain (e.g., military space doctrine) and diplomatic initiatives for international space governance (e.g., Canada's inputs to UN Resolution 75/36 on "Reducing space threats through norms, rules and principles of responsible behaviors" (2020)) require overarching guidance to work in harmony with one another and conform to a focused policy.

Such gaps and seams lead to inefficiencies, which will continue to impede the implementation of Canada's full range of space initiatives unless an overarching, harmonizing national vision for space is established - a national space policy, strategy and plan. Such a vision must include a viable, well considered and coordinated allocation of tasks and resources. Canada's vision for space should include:

1. Effective national leadership, including a cabinet committee for space, chaired by the Prime Minister, akin to those created by our UK and US allies (described later in this paper). This committee would ensure best allocation of funding for implementation of departments' desired projects;
2. A national space policy to identify and describe Canada's goals for space that considers, at a minimum, partnerships, niche contributions, economic opportunities, required sovereign capabilities, and leadership objectives in global space governance;
3. A national space strategy to describe how Canada's goals for space will be achieved, including the coordinated allocation of space activities to departments and agencies, and guidance for subordinate defence, civil and commercial space policies and strategies; and
4. Most critically, a fully considered and funded plan that enables the execution of the strategy. Without the necessary centralized funding, strategies become words without outcomes.

Desired Effects - Canada's Space Needs

So what space capabilities does Canada need? What are our strengths and weaknesses? How can we leverage specific opportunities to counter the future threats we face, while bringing the best capabilities we can achieve forward to bolster our status as a valued partner among our allies? It is clear that Canada continues to expand its use of and reliance on space, and we are certainly an active participant in the development of the increasingly congested, contested, and competitive environment. With a land mass of almost 10 million square kilometers and a coastline that stretches for 243,000 kilometers (covering three oceans), we have no choice but to capitalize on considerable space capabilities to monitor and defend our sovereignty.

To that end, the government of Canada has actively invested in world-leading space systems that provide earth observation (EO) capabilities (through the Radarsat series of satellites) facilitating the monitoring of Canada's land mass, maritime approaches, and global areas of interest.

Through an industry partner, MDA,⁷ Canada has developed cutting-edge space-based synthetic aperture radar (SAR) and opened the door to conducting maritime domain awareness missions from space on a global scale.

Furthermore, Canada regularly engages with its allies, international partners, and the commercial space sector, to ensure a collective ability to access and protect space-based capabilities that are critical to our safety, sovereignty and prosperity. The government has partnered with the United States to supply search and rescue repeaters for integration on U.S. GPS satellites. These repeaters are designed to receive transmission of distress from radio beacons and is part of the government Medium Earth Orbit Search and Rescue (MEOSAR) project. Additionally, Canada's access to global, resilient, satellite communications (SATCOM) through shared programs such as Mercury Global and Protected Military SATCOM project, provides high capacity, protected, and reliable communications for global operations, accessed through an agreement with the U.S.

Additionally, Canada contributes to the U.S. Space Surveillance Network (SSN), which is a comprehensive system of both space-based and ground-based optical and radar sensor systems that are dedicated to the persistent monitoring of space, providing space situational awareness (SSA). The primary mission of the SSN is to detect, track, identify and catalogue all man-made objects in space, akin to air traffic control on earth.

Canada's Space Niches

Canada's space industry has leaders in a number of niche fields: space-based SAR, robotics (the Canadarm), SATCOM (Telesat), and remote health care to name but a few – there is much more. It is clear that Canada has an excellent pedigree in space capability, and we have a number of options on where we can go next, and we should begin by looking at what we already do well for future investment, and then reassess, verify, and update our vision based on changes to the market and our current and future needs. Once we validate our plan, we can accelerate development in our niche areas in order to lead the pace of future global space capability development. We should strive to expand our expertise in our strengths, with the objective of developing these capabilities into world leading talents. For example, there are already some key areas where Canada can focus its developmental attention, effort and resources:

1. As one of a handful of 3-ocean nations, Canada should further develop and expand our space-based MDA capability to one that perhaps provides global coverage – in real time, without delay. This is a lofty goal and has never been achieved by any nation, but it is technically possible. It would create an incredible partner contribution that would be well received by our burden-sharing allies, and the envy of our adversaries. Canada should incentivize our industry to develop the SAR capability beyond its current state – integrate Artificial Intelligence and Machine Learning (AI/ML), and further expand development of

⁷ MacDonald, Dettwiler and Associates, Ltd., formerly Spar Aerospace founded in 1969, represents arguably Canada's largest and most successful space technology company, responsible for RADARSAT 1, 2 and RCM and the Canadarm development and operations

complimentary systems (i.e. Automated Identification System, LIDAR) and other nationally developed optical sensors.

2. Develop state-of-the art replacements for space-based situational awareness systems, which should leverage the excellence of our Sapphire (surveillance of space satellite) project to create similar yet advanced capabilities. Industries could be encouraged to create a constellation of affordable smallsats that would provide a depth of SSA capacity, providing strength in numbers and, through commercial partnership, to supplement national capabilities. This would lead to resilience and redundancy, and once again, would be yet another capability that allies would highly value.
3. Be an invested part of future space exploration activity. Invest in our civil space program, and our astronaut program. Support industry as they lean into the Lunar Gateway initiative – providing incentives for capability development, and invest in next generation space technologies to both accelerate broad commercial and niche national security applications.
4. Encourage and facilitate the merging of government, civil and commercial space operations to enable resource sharing. Develop a shared, secure and resilient national space capability that is interconnected, inclusive, and responsive.

Essential Next Steps

Space-based technologies are undergoing a global revolution in technological capabilities as well as an explosion in demand for space-derived services across all sectors of society. From accurate weather forecasting to agricultural management and national sovereignty operations, space systems provide all facets of government with accurate and timely information, which enables informed, timely and effective decision making. This evolution is being led by industry, who, in the absence of national direction, have boldly taken up the challenge, despite the significant risks, in an attempt to capture a piece of the space market.

Canada's small space sector has a global focus and has developed world-leading technologies. If Canada is to capitalize on a rapidly growing global space enterprise, the federal government needs to incentivize its space sector by providing a clear roadmap on the technologies in which it should invest. The Canadian space sector's reputation as world leaders in highly specialized capabilities risks being overtaken without a vision focused on the future. The roadmap must clearly articulate the vision, pointing to where the Canadian space sector should invest effort.

In 2019, a space strategy, primarily for civil applications, was released by the CSA. In it, the Minister of Innovation, Science and Economic Development (ISED) stated that the "government is committed to helping unlock the full potential of the space sector and respond to the realities of the new and evolving space environment."⁸ In order to do that, not only does the federal

⁸ Exploration, Imagination, Innovation: A New Space Strategy for Canada, Vision Statement, Pg 3

government need to publish a ‘whole of government’ national space policy and strategy, but a fully funded federal strategic plan for space must be developed.

Without a fully funded strategic plan, which is derived from a national space policy, Canada’s space strategy will be ineffective. Stable funding for government space programs will safeguard a healthy business environment for the Canadian space sector. It will provide a roadmap for industry to follow when determining what new technologies to invest in or develop, and where to focus its innovation efforts. In a sector “whose undertakings are innovation-dependent, long term, expensive, and complex, it is critical to have concrete national goals, predictable funding, and orderly implementation.”⁹

Comparative Approaches: Critical Internal and External Capability Linkages

In our current state, Canadian space capabilities are siloed and generally independent of each other. Within DND, the need to consolidate capabilities, force generate space expertise, develop effective, affordable, and timely systems, and employ those capabilities as a system of systems, has never been more important. As seen in figure 2, current direction and guidance is not

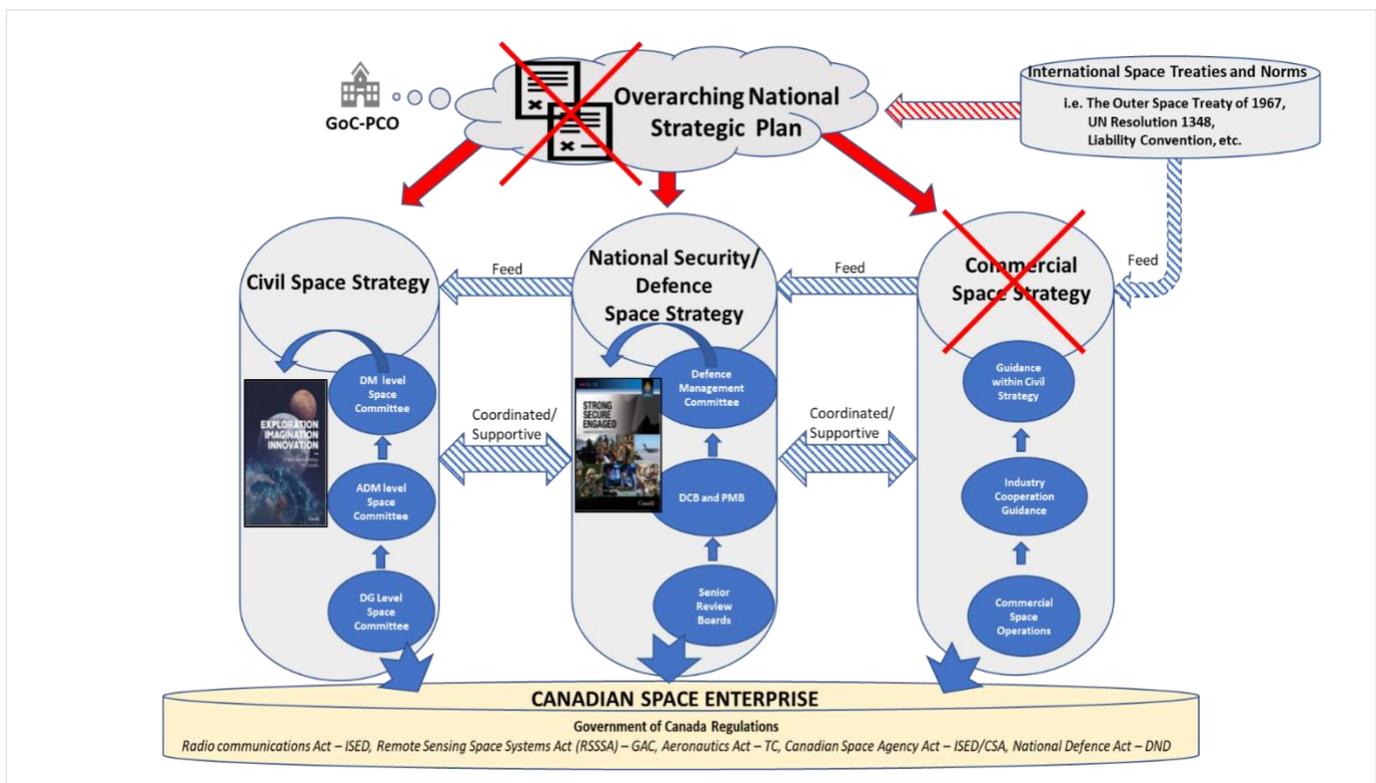


Figure 2 - Canada's Current Guidance for Space

harmonized and is moving forward without an overarching and collective vision. ISED focuses on shared and open architectures whereas security concerns within defence point more often to

⁹ Emerson 2012 Space Report Volume 2, Executive Summary, P1

classified requirements. Competing obligations are inevitable within departments. A national space strategy will enable a harmonized, resilient and mutually supportive Canadian space enterprise, with a shared understanding of need, shared operations (where appropriate) and shared situational awareness of what is happening in space. As depicted in figure 3, these

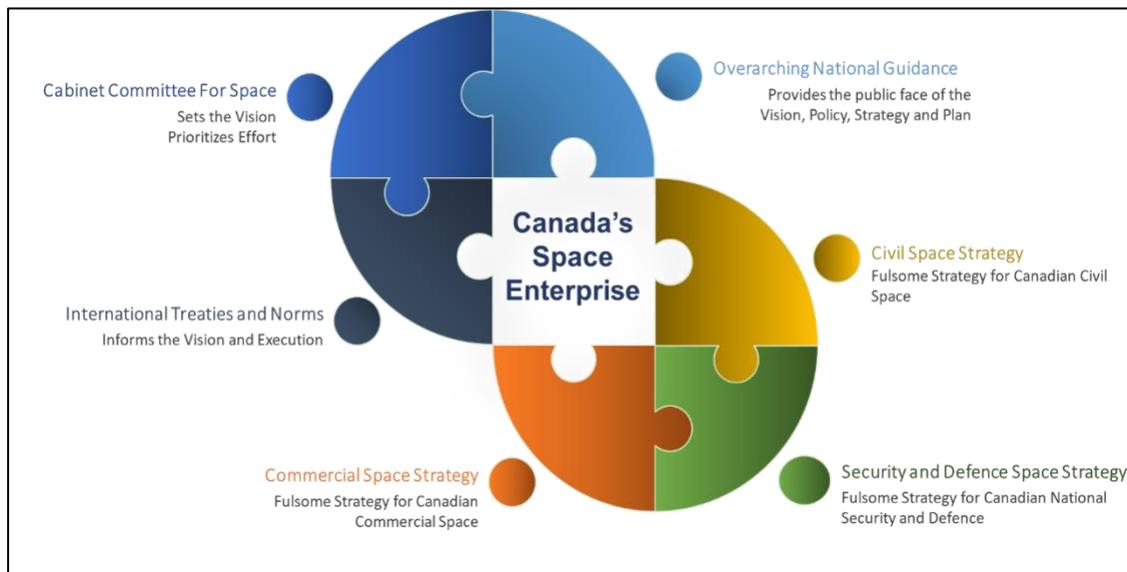


Figure 3 - Canada's Future Space Governance

realizations will only mature if they are born from a shared vision and a clear plan.

We are not the first nation to recognize the urgency of our situation. Some of Canada's close allies have recently addressed very similar issues.

United Kingdom

The 2021 *National Space Strategy* (NSS) outlines the UK government's civil and defence ambitions and goals in exploiting space and space systems. Featuring forewords from the Prime Minister and Secretaries of State, the NSS represents a centralized intergovernmental approach to achieving national objectives.¹⁰ It examines the benefits, strengths, opportunities, and threats to the UK's existing and emerging space sector and systems, referring to total employment, current and projected economic activity, and national security implications (e.g., missile warning and defence). Key points include the need for significant private sector investment in space activities, and the changing role of government from primarily a funder to an active customer of space systems and services. With regards to capability development and space system acquisition, the NSS refers to an 'own, collaborate or access' framework based on assessments of what capabilities must be owned on a sovereign basis, which can be secured via collaboration with partners and allies, and those that can be accessed through the commercial sector.¹¹ The

¹⁰ National space strategy - GOV.UK (www.gov.uk)

¹¹ Global Britain in a Competitive Age: the Integrated Review of Security, Defence, Development and Foreign Policy - GOV.UK (www.gov.uk)

strategy references and builds upon a broad swathe of national cross-policy linkages and government objectives, including the Plan for Growth, Innovation Strategy, Net Zero Strategy, Space Sector Export Academy initiative, Defence and Security Industrial Strategy, among others.

The UK's 2022 *Defence Space Strategy: Operationalising the Space Domain* (DSS) outlines a vision for how the MOD will fulfill the stated goal to protect and defend the UK's national interests in and through space.¹² It discusses the UK's reliance on space systems for critical civil, commercial, and national security services and speaks to the increasingly competitive, hazardous, and potentially threatening character of space as an operational domain. The DSS recognizes space as an operational domain and an enabler of defence operations, for example, via support for global command-and-control (C2), intelligence, surveillance, and reconnaissance (ISR), missile warning, and joint force operations. Significant emphasis is placed on the need to preserve strategic advantage in space through interoperability and burden-sharing in support of Allied efforts in space, including: preventing conflict, deterring escalation, optimizing resources usage, and enhancing mission assurance.

Australia

In 2018, the newly created Australian Space Agency (ASA) released a robust civil space strategy, *Advancing Space: Australian Civil Space Strategy 2019-2028*.¹³ The strategy outlines a staged plan of meeting the government's economic goals in the space sector. It aims to triple the size of the Australian space sector and create up to 20,000 jobs by 2030, while targeting dual-use capabilities that could be leveraged across government. While this may initially seem to parallel the Canadian experience, Australia has been more responsive in recognizing the problem. Despite the dual-use nature of the technologies listed in the National Civil Space Priorities, Australia's 2019 civil space strategy is predominantly focused on civil and commercial uses of space.

In mid-March of 2022 the Australian Department of Defence (DOD) released *Australia's Defence Space Strategy*, which describes the strategic context of the space environment and articulates a set of objectives to realize a vision of Australia as an integrated space power by 2040.¹⁴ The Strategy identifies five Lines of Effort (LOEs) broadly intended to: assure Joint Force access to space; integrate delivery of military effects across the whole of government and partners; increase national understanding of critical space dependencies; pursue sovereign space capabilities and develop a national space enterprise; and facilitate sustainable and effective use of the space domain.¹⁵

These developments represent a burgeoning yet promising shift to a more cohesive approach across civil and defence activities in space. Australia has recently announced the creation of a

¹² [Defence Space Strategy: Operationalising the Space Domain - GOV.UK \(www.gov.uk\)](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/106222/Defence_Space_Strategy_-_Operationalising_the_Space_Domain.pdf)

¹³ [Australian Civil Space Strategy 2019-2028 | Department of Industry, Science, Energy and Resources](https://www.industry.gov.au/publications/advancing-space-australian-civil-space-strategy-2019-2028)

¹⁴ [Defence Space Strategy | Royal Australian Air Force](https://www.defence.gov.au/DefenceSpaceStrategy)

¹⁵ *Ibid*, p. 15.

unified national strategy to shape Australia’s space sector for the next two decades.¹⁶ The Space Strategic Update (SSU) is intended to align national efforts across civil and defence space, and answer calls from industry to shape a coherent national space industry. Similar to Canada, Australia’s competitive advantage and sovereign capabilities in Space Domain Awareness (SDA) have the potential to contribute to burden-sharing in multilateral efforts, reducing dependence, retaining relevance, and ensuring interoperability.¹⁷

United States

The *2020 National Space Policy of the United States of America* presents a unified intergovernmental approach, including guiding principles, goals, cross-sector and sector-specific directives as they relate to U.S. space policy.¹⁸ Cross sector guidelines direct heads of all executive agencies and departments represented on the National Space Council to designate senior officials to oversee and report on their agency’s implementation of the National Space Policy. Sector-specific guidelines, meanwhile, categorize U.S. space activities into commercial, civil, and national security sectors, and provide accompanying definitions and directives. National security space guidelines call for a synchronized approach by the Department of Defense (DoD) and intelligence community to national security in space, and feature specific directives for the Secretary of Defense and Director of National Intelligence, respectively.

The *2020 U.S. Defense Space Strategy Summary*, building upon the aforementioned national security sector guidelines and in recognition of a global security environment characterized by renewed great power competition, seeks to enable the DoD to achieve desired conditions to maintain space as a secure, stable, and accessible domain; maintain military superiority in space; and provide support for national, joint and combined operations in space, with a clear emphasis on leveraging and improving interoperability with allied partners.¹⁹ While the U.S. case represents ambitions and efforts beyond Canada’s reach, it does provide an effective template of a comprehensive nation-wide approach to articulating and realizing the importance of space and access to it.

Conclusion

It is undeniable that Canadian society is critically dependent on space-based systems for an increasingly wide range of daily activities. It is also clear that space-based systems are vulnerable to disruption, degradation, and destruction, whether by an accidental collision in space between satellites and space debris, or by deliberate targeting of space-based systems. The chaos and disruption to the Canadian economy of just one day without space would be

¹⁶ [Address to the Australian Space Forum | Ministers for the Department of Industry, Science, Energy and Resources](#)

¹⁷ [Keep looking up: Australia’s next steps in space surveillance | The Strategist \(aspistrategist.org.au\)](#)

¹⁸ [National-Space-Policy.pdf \(archives.gov\)](#)

¹⁹ [2020 Defense Space Strategy Summary](#)

substantial. Yet the federal government has still to develop an overarching national strategic plan that addresses its growing dependency on space and take steps to ensure uninterrupted access.

Space-based systems are expensive – too expensive for most nations to go it alone. However, interoperability and burden-sharing initiatives among partners and allies enable nations to concentrate investment on niche capabilities while collectively leveraging the benefit of multiple capabilities shared by contributing nations. Canada is known today for excellence in certain technologies of space-based systems (SAR is but one example), but new niche competencies may be identified when the Canadian space enterprise, consisting of defence, civil, and commercial activities, are finally harmonized. That harmonization will occur with the development of an overarching national strategic plan for space, signed off by the Prime Minister.

Creating a carefully considered and well-connected Canadian space enterprise requires overarching national governance and direction. A funded strategic plan for space will breathe life into the words of *Strong Secure Engaged* for defence and *Exploration, Imagination, Innovation* for civil space. It will, for the first time, provide focus for the Canadian space industry and result in a much more coordinated approach to achieving the initiatives currently identified in departmentally focused space strategies. It will serve to enable our national strategic vision for space, provide confidence to Canadians, allies and industry alike, and instill a sense that Canada is committed to fulfilling its stated goals for space. To that end, the federal government should commission the development of a fully funded national strategic plan for space, without delay.