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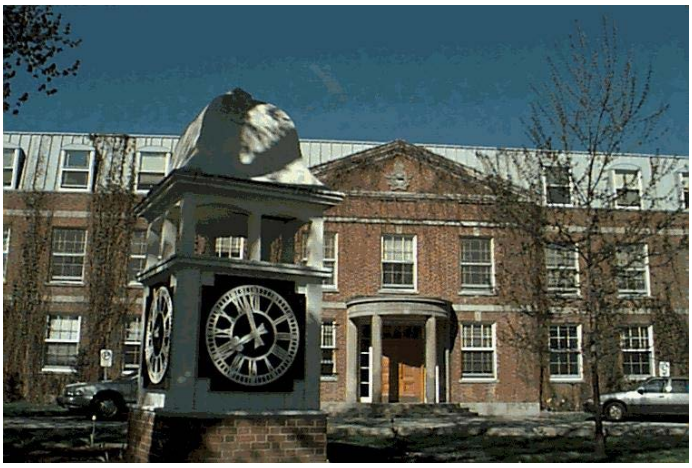

COMMERCIAL SPACE LAUNCH

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JCSP 45

Service Paper

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COMMERCIAL SPACE LAUNCH

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COMMERCIAL SPACE LAUNCH

AIM

1. The aim of this service paper is to explore opportunities and threats of the upsurge in commercial space launch actors. The fundamental issue at stake is the role the Canadian Armed Forces (CAF) in the ever-growing space launch industry; notably what implications on CAF operations and the security of Canada. We present opportunities to bolster Canadian space power and areas of threats to Canadian space assets. The intended audience for this service paper is the Director General (DG) Space/Space Component Commander (SCC) and staff.

INTRODUCTION

2. Space launch capabilities have historically been reserved to nation states.[1] During this period of expansion, the majority of space assets were dedicated to defence, earth monitoring, communications and scientific adventures; driven by the Cold War and nuclear armament. The Second Space Age is in full swing, characterized by the slew of commercial space launch organizations fully integrated within governmental frameworks and priorities.[2] A nation's investment cost to become a space power is substantively lower, creating a pool of nascent space powers; Canada being one of them.[3] A nascent space power lacks launch capabilities at home.[4] Commercial actors can supplement or replace public space launch capabilities.

3. Strong, Secure, Engaged tasks the CAF with protecting Canadian national space power which includes civilian, governmental and military space assets, access to space and part of the EM spectrum.[5] The space domain continues to become more competitive, congested and contested, leading to CAF involvement in the security field.[6,7] Canadian industry is well placed to take advantage of the commercial space launch boom, increasing the responsibility to protect as satellites are poised to become targets in future conflicts.[8] Canadian space power is set to grow with decreased costs of space launch as industry, government, and the CAF are able to afford to develop and launch more space assets.

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[1] Great Britain. Ministry of Defence. Directorate of Air Staff and Great Britain. Royal Air Force. British Air and Space Power Doctrine. London: Air Staff, Ministry of Defence, 2009. 58-60

[2] Ibid

[3] Shabbir, Zaeem and Ali Sarosh. "Counterspace Operations and Nascent Space Powers." Astropolitics 16, no. 2 (2018): 122.

[4] Shabbir, Zaeem and Ali Sarosh. "Counterspace Operations and Nascent Space Powers." Astropolitics 16, no. 2 (2018): 121.

[5] Canada. Dept. of National Defence and Canada. Strong, Secure, Engaged: Canada's Defence Policy. Ottawa, Ont.: National Defence, 2017. 72

[6] Ibid, 56

[7] United States. Joint Chiefs of Staff. Joint Doctrine for Space Operations. Washington, D.C: Joint Chiefs of Staff, 2017. viii

[8] Canada. Dept. of National Defence and Canada. Strong, Secure, Engaged: Canada's Defence Policy. Ottawa, Ont.: National Defence, 2017. 57

DISCUSSION

4. The first commercial launch actor was Space Services of America, in 1982 with Conestoga 1.[9] Since then multiple companies have fielded, started or invested in space launch capabilities. In 2014, 23 commercial space launches were successful; the majority from US, European and Russian companies; one company is a multinational called Sea Launch.[10] The Outer Space Treaty (OST) and subsequent space laws until the 2010s have emphasized the role of the states as the primary responsibilities for regulating and monitoring their space objects.[11] A satellite built and launched by a country is the sole responsibility of that nation if it collides with another, lands on foreign soil or the launch does not occur as planned and causes damage.[12] The onset of commercial space launch capabilities is challenging this half-century old concept as now multiple nations states can be involved in the process.[13] The perfect storm is a conglomerate like the EU, using a transnational commercial launch provider from a sea barge in the open ocean. Spaceflight industries have a single planned launch of 71 different satellites belonging to 18 different countries in a single launch.[14] Attribution of responsibility is extremely complex in this case if the mission is unsuccessful. A robust national Space Situational Awareness (SSA) capability is the cornerstone in the attribution process; one that Canada has started to field.

5. The legal ambiguities within the military sphere have pushed the space community writ large to undertake a massive consolidation of space laws under the MILAMOS concept, led by McGill University.[15] The primary objective of MILAMOS is to create a single authoritative legal text to guide military space use in the future.[16] This legal framework set to become customary law in the 2020s will provide the arcs of fire for the CAF, informing future decision-makers on options at the strategic, operational and tactical levels. The CAF has a vested interest in participating, at a minimum as an observer, seeing as a majority of major and nascent space powers are already involved in the development of MILAMOS.[17] Understanding such an agreement is one of the foundational steps in describing the battle space of the future and is crucial to framing blue, red and grey force legal boundaries in the future. Waiting for text to become treaty is similar to being outpaced by technology, risking our sovereignty.[18] The CAF should be linked in the development of the MILAMOS proceedings as this will provide the legal framework for the foreseeable future. The MILAMOS agreements are vital to future concept development in the CAF as our employment of capabilities in the future need to be within the legal agreements.

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[9] Abell, John C. "Sept. 9, 1982: 3-2-1 ... Liftoff! The First Private Rocket Launch." Wired (Sep 9, 2009).

[10] Federal Aviation Administration. Commercial Space Transportation 2014 Year in Review. Washington, DC: FAA. 2014a. 5

[11] Federal Aviation Administration. 2014 Commercial Space Transportation Forecasts. Washington, DC: FAA. 2014b. 8

[12] Nevala, Emily M. "Waste in Space: Remediating Space Debris through the Doctrine of Abandonment and the Law of Capture." American University Law Review 66, no. 6 (2017): 1513.

[13] DiMaria, Stephen. "Starships and Enterprise: Private Spaceflight Companies' Property Rights and the U.S. Commercial Space Launch Competitiveness Act." St.John's Law Review 90, no. 2 (2016): 416.

[14] Spaceflight Industries. "Introducing SSO-A: The Smallsat Express." 2018. http://spaceflight.com/sso-a/

[15] McGill University. "About MILAMOS.". https://www.mcgill.ca/milamos/about.

[16] Ibid

[17] McGill University. "About MILAMOS.". https://www.mcgill.ca/milamos/about.

[18] Hayden, Dale L. "The Search for Space Doctrine's War-Fighting Icon." Air & Space Power Journal 28, no. 6 (2014): 61

6. One of the current issues with the current legal agreements is attribution. When nation's states controlled the manufacturing, launch and control of their space assets, they held the entirety of the responsibilities for those assets.[19] Another nation state with the capabilities to detect and track the space asset would be able to attribute responsibility in the case of a catastrophe or incident. One of the best defences against damages in space is a robust national attribution capability.[20] The attribution process starts with a strong intelligence capability, capable of determining the basic requirement such as manufacturing country, initial launch orbits, launch windows and basic on-obit movement capabilities. The next step in an attribution network is the capability to model the information collected into a coherent decision-making tool. The next step is to confirm the information and model through tracking data. This intently acts as active tracking of others' assets and provides the basic information for court cases in case of damages. The cycle continues between modelling and confirmation of the model as long as the asset is in space. A nation state that advertises that it has an attribution process can use this as a deterrent to others who wish to hide in the mist. Canada has been developing its ability for SSA and is able to field a nascent ability to attribute; an overall emerging capability within the Five Eyes (FVEY) and NATO construct where Canada has shown leadership in the past.[21] The CAF has an opportunity to continue building its SSA capabilities and advertising it as a deterrent.

7. The attribution of damages was more straightforward when nation states controlled the whole spectrum of manufacturing to control operations. During the First Space Age satellites tended to be large, complex and had a long lead time to complete.[22] The long lead time enabled intelligence to be collected, and the sheer size of the satellite enabled easier tracking of the space system. The latest trends are that satellites are reducing in size.[23] The size of satellites is challenging the current space tracking infrastructure, initially designed to monitor large satellites and ballistic missiles. This challenges the attribution process and requires nations to modify tracking systems. Unfortunately, the long lead time to modify tracking systems is outpaced by the satellite creation cycle as smaller more capable space systems are fielded faster than the tracking systems can be modified. A contributing factor for the slow speed at which the space tracking systems are modified is their ties to the Integrated Threat and Warning Attack Assessment (IT&WAA) network, part of the US nuclear defence capabilities requiring quasi-perfection in the missile domain. Systems created for space tracking only are more flexible and reactive as long as they are purchased as such. One such example of CAF expertise and excellence in the matter is the Sapphire project. The CAF satellite was developed at significantly lower cost of a similar US project, filled a critical gap in the US Space Surveillance Network (SSN) and provided the CAF access into additional space control capabilities. Leveraging Canadian industry, the CAF has an opportunity to develop SSA capabilities that are agile and

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[19] Dempsey, Paul Stephen and Ram S. Jakhu. Routledge Handbook of Space Law. London: Routledge Ltd, 2016. doi:10.4324/9781315750965. 14-16

[20] Shabbir, Zaeem and Ali Sarosh. "Counterspace Operations and Nascent Space Powers." Astropolitics 16, no. 2 (2018): 123-124.

[21] Thompson, M. S. and Canadian Forces College. Separating "Space" from Aerospace: A Case for Canadian Forces Space Doctrine. Toronto, Ont.: Canadian Forces College, 2016. 4

[22] Great Britain. Ministry of Defence. Directorate of Air Staff and Great Britain. Royal Air Force. British Air and Space Power Doctrine. London: Air Staff, Ministry of Defence, 2009. 58

[23] Federal Aviation Administration. Commercial Space Transportation 2014 Year in Review. Washington, DC: FAA. 2014a.

flexible, becoming a niche contributor to the SSN as many of the US capabilities are tied into IT&WAA.

8. Another main advantage of the influx of commercial space launch actors is the lower overall cost of space projects. A combination of lower cost of launch with the lower cost of manufacturing smaller satellites makes space an affordable venture for anyone with approximately $100,000 USD.[24] potential adversaries including non-state actors are able to afford to send objects in space. These new space actors have the potential to affect major and nascent space powers at a cost that is much lower than the original space system, causing a strategic imbalance.[25] An example is that a $50,000 USD cubesat[26] has the potential to disrupt the entire $2.9B USD Iridium Next communications system.[27] This strategic imbalance pushes new states and non-state actors into space, increasing the "contestedness" of the domain.[28] During the Cold War, large complex systems were being developed to shape the space domain.[29] The effects of a kinetic strike in space are vast and quasi-permanent. A case is point, the Fenyung 1C ASAT test from the Chinese in 2007 affected the entirety of the Low Earth Orbits (LEO) and the space debris caused are still causing massive congestion.[30] The growing commercial launch sector will lower the costs of space projects and has the potential to attract nefarious actors if ill monitored and controlled. Major and nascent space powers strategically understand the role of their space assets within their national framework. Newer powers may not have the same appreciation or may assume that the disruption is an advantage strategically for their means. The reduced cost of developing and launching these potential disparate weapons should concern the CAF. The pervasiveness and the strategic disparity of lowering access cost to space, primarily stemming from lowering launch costs, is a threat to Canadian Space power requiring dedicated counter space capabilities.[31]

9. The lowering of launch costs enables Canadian space power and is also an opportunity to exploit from a counter space perspective. There two main methods to defend space assets are offensive and defensive counter space methods.[32] An assumption here is that defensive counter space is the primary politically acceptable means with which the CAF is able to protect space assets outside of the deterrence realm. Defensive counter space is comprised of four main

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[24] Antunes, Sandy. Surviving Orbit the DIY Way. Maker Press. O'Reilly Media Inc. Sebastopol, CA. 2012. 77

[25] United States. Joint Chiefs of Staff. Joint Doctrine for Space Operations. Washington, D.C: Joint Chiefs of Staff, 2017.

[26] Antunes, Sandy. Surviving Orbit the DIY Way. Maker Press. O'Reilly Media Inc. Sebastopol, CA. 2012. 77

[27] Gunter Space Page. "Iridium-NEXT." 2018. https://space.skyrocket.de/doc_sdat/iridium-next.htm.

[28] Great Britain. Ministry of Defence. Directorate of Air Staff and Great Britain. Royal Air Force. British Air and Space Power Doctrine. London: Air Staff, Ministry of Defence, 2009. 58

[29] United States. Defense Intelligence Agency. Soviet Military Space Doctrine. Washington, D.C: The Agency, 1984. 1-2

[30] Shabbir, Zaeem and Ali Sarosh. "Counterspace Operations and Nascent Space Powers." Astropolitics 16, no. 2 (2018): 125-128.

[31] Canada. Dept. of National Defence and Canada. Strong, Secure, Engaged: Canada's Defence Policy. Ottawa, Ont.: National Defence, 2017. 71-72

[32] Shabbir, Zaeem and Ali Sarosh. "Counterspace Operations and Nascent Space Powers." Astropolitics 16, no. 2 (2018). 123

methods; two of these defensive counter space measures are directly linked to launching satellites in space are passive measures and recovery actions.[33]

10. Passive measures are another aspect of defensive counter space that are being reinvigorated by the commercial launch sector. Through a concerted effort in launching multiple payloads at once, a nation is able to dissimilate the active or sensitive satellite within a number of other assets. This is especially easy to undertake with the combination of smaller satellites and more robust launchers, as seen in the projected Falcon 9 launch of 71 satellites concurrently[34] and the non-commercial but still relevant launch of 104 satellites from and Indian Space Research Organisation rocket.[35] These techniques have become the cornerstone of Russian and Chinese counter space doctrines when pieces of supposed debris started rendezvous proximity operations (RPO) in space as early as 2014 on.[36] Although the Russian and Chinese examples are not commercial launch in nature, the offset of lower priority launches has the potential to free up national capabilities to testing more dangerous RPO like experiments in the future. The CAF has the responsibility to promote the peaceful use of outer space[37] and as such should bolster its SSA capabilities to deal with the increased adversary counter space measures.

11. Recovery actions include reconstitution and redundancy; both focused on replacing lost assets.[38] In either case, the ability to either launch on-orbit spares or have the capability to quickly launch another asset is the key. The growth of commercial space launch capabilities is an opportunity for nations to have a responsive and flexible reconstitution plan by contracting assured launches. The US already employs this flexibility through the contracted agreements with the United Launch Alliance, a commercial entity. The strategic importance of these launch capabilities forces foreign nations outside the US in contracting similar agreements. SSE pushes the CAF in defending military assets[39], most of which are whole of government or civilian owned. The CAF and civilian sectors are growing more dependent on space effects[40] and thus require flexible recovery actions. The introduction of Canadian commercial launch companies would open the possibility for a CAF flexible arrangement, further bolstering the Canadian counter space capabilities. Laws such as the 2015 US Commercial Space Launch Competitiveness Act (CSLCA 1) lead to explosive increases in the US[41] and could be emulated in Canada.

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[33] Ibid

[34] Spaceflight Industries. "Introducing SSO-A: The Smallsat Express." 2018. http://spaceflight.com/sso-a/

[35] Department of Space Indian Space Research Organization. "PSLV-C37 Successfully Launches 104 Satellites in a Single Flight." . https://www.isro.gov.in/update/15-feb-2017/pslv-c37-successfully-launches-104-satellites-single-flight.

[36] Secure World Foundation. Global Counterspace Capabilities: An Open Source Assessment. SWF Inc. 2018

[37] Canada. Dept. of National Defence and Canada. *Strong, Secure, Engaged: Canada's Defence Policy*. Ottawa, Ont.: National Defence, 2017. 71-72

[38] Shabbir, Zaeem and Ali Sarosh. "Counterspace Operations and Nascent Space Powers." *Astropolitics* 16, no. 2 (2018). 121-124

[39] Canada. Dept. of National Defence and Canada. *Strong, Secure, Engaged: Canada's Defence Policy*. Ottawa, Ont.: National Defence, 2017. 71-72

[40] North Atlantic Treaty Organization. Joint Air and Space Operations Doctrine. May 2002 6 at Change 1. ed. Brussels: North Atlantic Treaty Organization, Military Agency for Standardization, 2002. 5-3

[41] Dodge, Michael. "The U.S. Commercial Space Launch Competitiveness Act of 2015: Moving U.S. Space Activities Forward." The Air and Space Lawyer 29, no. 3 (2016): 4.

12. The overall trends in commercial space launch capabilities is a steady year-on-year increase both in the deep space[42] and the near earth realm; forecasted to quadruple in the next 8 years.[43] The high risks of starting a space launch business is still a large detractor and a hurdle to new actors, but is being challenged by regulations such as the CSLCA 1.[44] Another hurdle is the spaceport location as the facility has a set number of inclinations it is able to launch in a cost effective manner. The increase commercialization of spaceports and launch facilities is set to extend space access worldwide and may pose a threat as the basis of our attribution process and early warning networks is linked to launch locations and intelligence cueing. Potential adversarial actors would have the option to hide their assets within the midst of the vast amounts of commercial launch facilities, increasing the amount of time it takes to characterize a threat. Consistently updating the Canadian SSA capabilities via collaboration approach with industry is desirable to meet the threat.[45]

CONCLUSION

13. Overall, the increase in commercial space launch capabilities represents a golden opportunity for nascent space powers such as Canada to increase its capabilities in space. The lowering cost of placing space assets in orbits enables the CAF to develop counter space capabilities, increasing the resilience of Canadian space power. The space domain is set to become more congested, competitive and contested; increase in launch slots and a decrease in costs are a double-edged sword. The funding threshold for new including non-state funded actors is bound to be lowered, mixed with a complex legal framework has the potential to affect the ever more space dependant Canadian security landscape.

RECOMMENDATION

14. The increased numbers of commercial space launch actors have the potential to change the space domain significantly. The following recommendations stem from SSE CAF directed tasks and are supported in the discussion above. Overall, the CAF can directly contribute to shaping the future space domain via two main efforts. First, bolstering the budding SSA capabilities by fielding flexible and consistently updating the SSA capabilities. Vulnerabilities stemming from the increased commercial space launch sector would be reduced as deterrent power increases. Second, stronger links into industry and legislative organizations such as the MILAMOS proceedings would provide the CAF with a roadmap for future force development efforts such as a Canadian commercial launch enterprise. Canadian space power intrinsically links governments at all levels with industry and the CAF; there is no way forward but together in shaping the space domain of tomorrow.

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[42] Federal Aviation Administration. 2014 Commercial Space Transportation Forecasts. Washington, DC: FAA. 2014b. 5

[43] Analytical Research Cognizance. Global Space Launch Services Market Outlook (2017-2026). New York, NY: Statistics MRC, 2018.

[44] Dodge, Michael. "The U.S. Commercial Space Launch Competitiveness Act of 2015: Moving U.S. Space Activities Forward." *The Air and Space Lawyer* 29, no. 3 (2016): 4.

[45] Canada. Dept. of National Defence and Canada. *Strong, Secure, Engaged: Canada's Defence Policy*. Ottawa, Ont.: National Defence, 2017. 71-72

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Shabbir, Zaeem and Ali Sarosh. "Counterspace Operations and Nascent Space Powers." *Astropolitics* 16, no. 2 (2018): 119-140.

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