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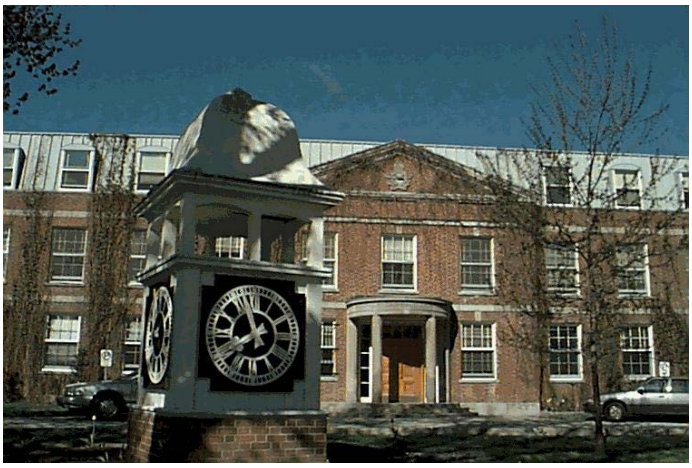

THE EFFECTS OF INCREASED PROLIFERATION OF SPACE ACTORS ON CANADA'S SECURITY

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AIM

As technology and the cost of space exploration become more affordable to a wider audience than just certain governments and national space agencies, the prevalence of other nations and non-state actors penetrating space in close confines to critical satellites poses a great risk to Canadian national security. The aim of this service paper is to examine the effects that declining access costs and increased proliferation of space actors have on Canada's security and Canadian Armed Forces (CAF) joint operations in space. This informative piece will first discuss prevalent issues that pose a potential risk to Canada's security, and will continue by examining considerations specific to future CAF joint operations in pace.

INTRODUCTION

1. The "space race" in the late 1950's saw tension between two great nations that led to the eventual launching of the first man-made object to orbit Earth and the first moon-landing.[1] But even with such great powers in play, the players and their objectives were known, and limited technology and access to funding eliminated the majority of other players from joining in the race. Today, with space becoming more accessible and less costly for both state and non-state actors across the globe, the National Aeronautics and Space Administration (NASA) and US policymakers have begun to cede their centralized control of economic activity in space to commercial companies in addition to other leading nations; actions which will affect Canadian security.[2]

2. It should be noted that increased accessibility has many positive outcomes, such as opening doors for better cooperation between civil and military organizations for greater national advancements in space. However, it is only prudent to consider the potential areas of concern to Canada's security given the important role that our space platforms play in its national security. This paper will begin by outlining some of the changes that increased accessibility brings with it and will identify how these changes imbed inherent risks to Canada's security. The paper will continue to identify changes in global joint operations in space and will identify their relevance to future CAF joint operations in space. A recommendation will follow on actions to be taken in order to mitigate the effects that widespread space exploration will soon bring.

DISCUSSION

3. Although only a seemingly limited number of governments and associated space agencies have had the success of sending systems beyond earth's atmosphere, it is not due to any law, rule, or other authority as existing international space treaties have nothing within them prohibiting the private use of resources in space. Although first signed in 1967, the Outer Space Treaty continues to be the main framework for international cooperation today and strikes an ambiguous middle ground on the development and use of resources in space. The Treaty

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[1] "Space Exploration," Wikipedia, last visited October 12, 2018. https://en.wikipedia.org/wiki/Space_exploration

[2] Matthew Weinzierl, "Space, the Final Economic Frontier," *The Journal of Economic Perspectives* 32, no. 2 (2018), 173-192, https://search.proquest.com/docview/2033734265?pq-origsite=summon

encourages - but does not require - cooperation on responsible use in that states bear international responsibility of all national activities in space.[3,4]

4. With $300 billion in annual revenue, private innovative space firms like SpaceX and Orbital ATK are now actively taking on the shared risks and potential returns inherent in space exploration, with recent individual valuations of firms ranging up to $21 billion.[5,6] For the first time since space exploration began, a multitude of non-state entities are joining foreign governments in the enhancement of space technologies that could greatly enhance Canada's military effectiveness in obtaining information from more than just the few "power countries" that have thus far had the upper hand in this sector.[7] This opportunity of widened exploration also leads to some potential risks to Canada's security due to effects relating to increased space debris, Intelligence, Surveillance and Reconnaissance (ISR) platforms, and space weaponization. It also puts into question the robustness of CAF joint operations in space when examining our effectiveness at denying interruption to systems, sharing information with allies, and being prepared for Counter-space Operations.

Risks to Canada's Security

Debris

5. The past ten years has seen a large increase in orbital and space debris, which includes such items as inoperative satellites, spacecraft parts, and pieces created by debris collisions. This is alarming as even small debris can inflict major damage. As Weinzierl explains, "a piece of metal the size of a cherry carries the explosive power of a grenade when in orbit" and estimates show that there are currently 500,000 "cherry-sized" and over 100 million smaller particles flying through low Earth orbit.[8] Although international agreements address the problem of space debris by requiring that objects put into space in the future have automatic de-orbiting capabilities, the ability to enforce such a provision becomes increasingly difficult with increased proliferation.[9] With continued demand in and for space, the rise of both accidental and intentional collisions will increase, ultimately leading to a runaway chain reaction of collisions that threatens the integrity of many important orbits.[10] This causes great alarm for Canada, "a world leader in satellite communications, Earth observation, space robotics, space science, optics

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[3] Matthew Weinzierl, "Space, the Final Economic Frontier," *The Journal of Economic Perspectives* 32, no. 2 (2018), 173-192, https://search.proquest.com/docview/2033734265?pq-origsite=summon

[4] Francis Lyall and Paul B. Larsen (Eds.), *Space Law – A Treatise, 2nd Edition* (Burlington: Ashgate, 2009), 532.

[5] Matthew Weinzierl, "Space, the Final Economic Frontier," *The Journal of Economic Perspectives* 32, no. 2 (2018), 173-192, https://search.proquest.com/docview/2033734265?pq-origsite=summon

[6] Editorial, "SpaceX Ignites Big Dreams." *Nature Research Journal* 554, no.7692 (February 2018): 275.

[7] Steven Lambakis, "Foreign Space Capabilities: Implications for U.S. National Security," *Comparative Strategy* 37, no. 2 (2018), 87-154, https://www.tandfonline.com/doi/full/10.1080/01495933.2018.1459144?scroll=top&needAccess=true

[8] Matthew Weinzierl, "Space, the Final Economic Frontier," *The Journal of Economic Perspectives* 32, no. 2 (2018), 173-192, https://search.proquest.com/docview/2033734265?pq-origsite=summon

[9] Ibid.

[10] Joint Chiefs of Staff, *Joint Operating Environment: The Joint Force in a Contested and Disordered World*. (Maxwell Air Force Base, Alabama, USA: Headquarters Air Force Doctrine Center, 2016), 33. http://www.dtic.mil/doctrine/concepts/joe/joe_2035_july16.pdf

and sensors"[11] due to the many satellites that the country depends on for both information and day-to-day activities.[12] As Canada remains just as vulnerable as other countries to either intentional or accidental collisions that could jeopardize Canada's security both at a National level as well as the individual well-being of its citizens, it must ensure that it continues to create redundancies in its space systems as well as in the robust nature of future satellites. Canada must also, in cooperation with other nations, ensure the enforcement of provisions of international agreements pertaining to diminishing the surplus of space debris, as well as ensure adequate over-watch of those who fail to comply by tapping in to their enhanced ISR capabilities.

Intelligence, Surveillance and Reconnaissance (ISR)

6. The area in which space-based ISR systems operate is so high above the Earth's surface, they are usually able to provide global coverage, including in areas that are out of reach for airborne or ground-based ISR platforms. With easier reach to this distance into space, an opportunity for redundancy of ISR resources through agreements with allies and organizations presents itself, allowing for the communication of to the most up-to-date and accurate information at all times. The predictable schedules of these systems, however, leave them vulnerable to denial and deception from any adversary wanting to block this critical information. With increased ease of access into space, the control and protection of these ISR platforms becomes increasingly worrisome, given that their high-orbit nature makes them difficult to repair. If an adversary (even a small non-state actor) can reach out and affect the entire basis upon which a country relies to be able to "see" the battle space and the enemy within it, then they can have great strategic effect with a relatively small tactical output. This ease of access will also lead to these same adversaries controlling their own ISR systems in space, maintaining an ability to obtain detailed information of our domestic infrastructure, training patterns, as well as our battle space during operations. As such, Canada must ensure to remain vigilant to respond to any space or other based threat, knowing that the enemy likely has detailed information on domestic movements, training and capabilities. This increased ISR ability leads to a subsequent requirement of ensuring that Canada has access to space-based or space-reaching weapons if the need to eliminate an enemy ISR system is required.

Weaponization

7. The accessibility of space has opened up a new battle space to adversaries seeking to limit America's war-fighting advantages. These adversaries see space as a key enabler of leveling the playing field of war and have been investing in ISR and counter-space weapons at an increasingly faster pace.[13] Although 130 countries, including Russia and China, have signed the 1967 Outer Space Treaty agreeing not to place weapons of mass destruction in outer space, [14]

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[11] "The Opening of the Final Frontier." Greater Saskatoon Chamber of Commerce, last accessed October 12, 2018. http://members.saskatoonchamber.com/events/details/the-opening-of-the-final-frontier-4159

[12] "Home: Satellites." Canadian Space Agency (CSA). Last accessed October 12, 2018, http://www.asc-csa.gc.ca/eng/satellites/science-and-spacecraft/default.asp

[13] Albert "AC" Harris III, "Preparing for Multidomain Warfare: Lessons from Space/Cyber Operations," *Air & Space Power Journal* 32, no. 3 (2018), 45-61, https://search.proquest.com/docview/2099884315?pq-origsite=summon

[14] Michael Krepon and Michael Katz-Hyman, "Space Weapons and Proliferation," *The Nonproliferation Review* 12, no. 2 (2005): 323-341. https://www.tandfonline.com/doi/abs/10.1080/10736700500378950

there currently is no specific prohibition on the placement of conventional weapons in space.[15] As not all countries rely equally on space systems for their economy and security, [16] and with a lack of control mechanism for space access and use, a nation with a presence in space must be prepared for a potential attack on their systems. As technological advances enhance even non-state actors' ability to attack a satellite or other space systems with greatly improved long-range precision strike weapons, a nation must have at their access both reversible countermeasures (such as jammers or dazzlers) as well as precision-strike measures that could thwart off an Anti-Satellite weapons (ASAT) attack or an attempt at a kinetic bombardment that would cause excessive damage due to orbital debris.[17] As Canada's security could be greatly hindered by one swift action by a weaponized space system, Canada must ensure that CAF joint operations in space are preparing for the denial of such a potential attack.

CAF Joint Operations in Space

Denial

8. Former Commander of U.S. Air Force Space Command General Hyten said: "Space is not just an enabler for the other operational domains, it directly impacts the calculus of national security."[18] This is referring to the fact that we use space assets for everything that we do – from banking systems and air traffic management to our classified systems on which we share information pertaining directly to national security. It is also referring to the way that we rely upon space capabilities in order to reach back to Canada from a multitude of deployed locations across the globe. This reliance therefore creates an important vulnerability in the realm of space denial in order to ensure that all space-dependent capabilities continue without interruption. The ability to deny interruption of services and capabilities is especially important with adversaries capable of deploying equipment and ASAT from the ground as well as from other satellites.

9. In evaluating approaches to address vulnerabilities in space pertinent to the US National Security, Lambakis suggests that redundancies or alternatives to space capabilities are essential in order to be prepared for a diminishment or loss in space access; notably by a nation that is not (as) dependent on space capabilities. In the same line of thought, in order to adequately deter others from attacking space assets, a nation "needs a credible and effective deterrence-by-punishment approach that will convince a potential attacker that the attack source will be held accountable for provocations or acts."[19] In order to be effective in these realms, it is imperative that Canada train in the identification and denial of space threats, as well as in identifying the

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[15] "Outer Space Treaty," Wikipedia, last visited October 12, 2018. https://en.wikipedia.org/wiki/Outer_Space_Treaty

[16] Steven Lambakis, "Foreign Space Capabilities: Implications for U.S. National Security," *Comparative Strategy* 37, no. 2 (2018), 87-154, https://www.tandfonline.com/doi/full/10.1080/01495933.2018.1459144?scroll=top&needAccess=true

[17] Ibid.

[18] Hyten, General John E., "National Security Space Budget for FY17: Presentation to the Subcommittee on Strategic Forces," *115th U.S. Congress*, House Armed Services Committee, March 15, 2016, p. 2 quoted in Lambakis, Steven. "Foreign Space Capabilities: Implications for U.S. National Security." *Comparative Strategy* 37, no. 2 (2018): 87-154, https://www.tandfonline.com/doi/full/10.1080/01495933.2018.1459144?scroll=top&needAccess=true

[19] Steven Lambakis, "Foreign Space Capabilities: Implications for U.S. National Security," *Comparative Strategy* 37, no. 2 (2018), 87-154, https://www.tandfonline.com/doi/full/10.1080/01495933.2018.1459144?scroll=top&needAccess=true.

alternatives to space capabilities that would be relied upon in the event that denial is unsuccessful. Ideally, this type of training would be held between at least a "5 eyes" or NATO community.

Information Sharing

10. With approximately 1,400 active military, civil, commercial and research satellites currently in space, more than 170 countries have access to information gathered via various space capabilities. Some claim that the measure of space power is not in the number or variety of space capabilities that a country has, but rather in its ability to integrate these with other national activities by extrapolating and processing big data via information management.[20] The Canadian Space Operations Center's (CANSpOC) relationship with the US-established Combined Space Operations Center (CSpOC) helps with greater integrated space operations and a push for a more unified understanding of the battle space and potential actors within it. The standing up of the Commercial Integration Cell (CIC) within the CSpOC that involves commercial satellite operators will become increasingly important in the maintenance of Space Situational Awareness (SSA) and the drive towards leveraging commercial advances for military means.[21] This type of process is convergent with Network Centric Warfare (NCW), where data taken from several available sources is made available to all those who need it.[22] NCW with a multitude of countries and commercial partners will become increasingly important to understand and have in place prior to a conflict arising in space. Canada's involvement in obtaining, extrapolating and sharing information will become more important as the complexity of systems, relationships and vulnerabilities in space continue to rise. In order to better understand how Canada can take on more of a contributing role in these relationships, Canada needs to ensure continual involvement in joint training and information symposiums across the globe in order to maintain SSA.

Counter-space Operations (CSO) and Space Situational Awareness (SSA)

11. US doctrine defines Counter-space Operations (CSO) as "the mission carried out to achieve space control objectives by gaining and maintaining control of activities conducted in or through the space environment."[23] Being prepared to gain and maintain "space superiority" via CSO will become increasingly important as more (and more unknown) civilian and non-state-led players enter into space. In order to avoid escalating into a "space (and potentially arms) race", CSO should not be conducted in peacetime. That being said, the ability during wartime to quickly react and adapt to CSO requires a high degree of continual SSA. Maintaining SSA allows for quick CSO implementation via defensive means, such as the dispersal and maneuverability of systems, or offensive means with intent to disrupt degrade or destroy enemy assets. [24] Given the potentially devastating outcome that even the perception of a country trying to conduct CSO could have, a robust joint training program with trusted international partners is

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[20] Ibid.

[21] Amy Butler, "Space Control Finally Gets a Boost," *Aviation Week & Space Technology*, May, 2015, http://aviationweek.com/defense/space-control-finally-gets-boost.

[22] Anthony Bagnall, "Space as an Enabler in Modern Military Operations," RUSI Journal 148, no. 4 (2003).

[23] United States Air Force, *Space Operations - Air Force Doctrine Document 2-2.* (Maxwell Air Force Base, Alabama, USA: Headquarters Air Force Doctrine Center, 1998), 8. https://www.globalsecurity.org/military/library/policy/usaf/afdd/2-2/afdd2-2.pdf

[24] Zaeem Shabbir and Ali Sarosh, "Counterspace Operations and Nascent Space Powers," *Astropolitics* 16, no. 2 (2018), 119-140, https://www.tandfonline.com/doi/full/10.1080/14777622.2018.1486792?scroll=top&needAccess=true

essential for Canada in order to understand how to maintain SSA whilst being prepared for a quick turnaround to CSO if required.

CONCLUSION

12. Prior to space becoming oversaturated with satellites, debris and other space systems from foreign governments and private corporations, Canada must ensure to conduct adequate planning and training specific to protecting space assets that can directly affect Canada's security. This paper has shown that Canada needs to play a part in external issues relating to space such as space debris agreement enforcement, having space-related ISR redundancy, as well as a way-forward regarding space weaponization in the event of an attack on space systems or platforms. The CAF must also continually look toward the future regarding joint operations in space to ensure that denial capabilities are being developed and then continually enhanced and that relationships with allies are being exploited in order to be able to extrapolate and share information with allies in all situations, including CSO.

RECOMMENDATION

13. Based on the information presented during this service paper, the following are recommendations concerning Canada's security and Canadian Armed Forces (CAF) joint operations in space:

a. Consider joining other nations in enforcing the provisions of international agreements pertaining to space debris diminishment, as well as ensuring adequate sanctions for those who fail to comply;

b. Take an active role in seeking out relationships with allies in order to ensure a robust network in information sharing is established in preparation for NCW;

c. Take an active role in developing a robust joint training program with trusted international partners in order to enhance and practice the identification and denial of space threats, the identification and use of alternative space capabilities, and the maintenance of SSA in advance of CSO;

d. Ensure a robust CSO contingency plan is drafted with identification of shortfalls in capabilities in areas of both precision-strike and reversible countermeasures; and

e. Ensure continual involvement in information symposiums across the globe in order to maintain SSA.

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