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DEFENSIVE COUNTER-SPACE: LAYING THE FOUNDATION FOR FUTURE CAF OPERATIONS

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AIM

1. As Canada increases its footprint in space over the next decade, there are certain actions the Canadian Armed Forces (CAF) needs to take to mitigate the risk associated with a space-faring nation. With respect to the growth in the Satellite Communications (SATCOM) program, it is critical for Canada and the CAF to protect the new capabilities to ensure they work when called upon. This paper proposes that Canada needs to develop a Defensive Counter-Space (DCS) capability to protect SATCOM links in a contested, degraded, and operationally limited (CDO) environment.

INTRODUCTION

2. Canada's new defense policy Strong, Secure, Engaged (SSE) places an increased importance on new and evolving domains; one such domain is space. Colin Wills, an expert in air power in the United Kingdom, advocates that integrating air and space assets creates an overall more capable force than would have been otherwise possible.[1] He goes on to say that "Space power should not be viewed as stand-alone tenant of military doctrine; rather it is an integral part of air, land, and sea power"[2]. The reason that SSE emphasizes an increased effort in the space domain is because space assets offer a huge force multiplying effect to CAF. The proper integration of space power will not only allow for increased air power within the Royal

[1] Colin Wills, "The Role of Air and Space Power and Control of the Air," in *Unmanned Combat Air Systems in Future Warfare: Gaining Control of the Air* (Basingstoke: Palgrave Macmillan, 2015).
[2] Ibid.

Canadian Air Force (RCAF), but also the increased survivability and lethality of the entire CAF as it grapples with the complex battleground of the future. With the increased importance of organic Canadian space capabilities, it is critical to ensure the continued use of the space domain. In order to meet those ends it is necessary for the RCAF to procure a DCS capability.

3. In order to provide the facts necessary to recommend procuring a DCS system, this paper will first define defensive counter-space to ensure a common understanding throughout the paper. Next, it is important to highlight the role of the space domain, and specifically satellite communications (SATCOM), with respect to SSE. Then, it is necessary to define the parameters of the SATCOM threat environment, to show why a DCS capability is necessary. Finally, this paper will use Canadian and United States (U.S.) doctrine to show how defending the space domain is in line with the needs of the CAF as well as the policy laid out by SSE.

DISCUSSION

4. United States Joint Publication 3-14 (JP 3-14) defines defensive space control (the U.S. term defensive space control is synonymous with the Canadian term defensive counter-space) as "Operations conducted to preserve the ability to exploit space capabilities via active and passive actions, while protecting friendly space capabilities from attack, interference, or unintentional hazards".[3] With respect to SATCOM this means protecting friendly space capabilities by taking measures to increase the survivability of the satellite and the SATCOM links. There are numerous ways to do this, to include both active and passive measures as outlined in Canadian

[3] United States, Joint Chiefs of Staff, *Space Operations*, (Washington, D.C.: Joint Chiefs of Staff, 2013), xi.

Space Power doctrine.[4] Due to cost and complexity involved with modifying satellite hardware for survivability, one of the most efficient and cost-effective ways to increasing link survivability is monitoring the satellite for interference. For that reason, this paper will focus on the active measures taken to increase the survivability of the SATCOM links.

5. These active measures specifically mean monitoring friendly SATCOM links to detect and characterize interference, assess the mission impact, and finally determine the location of the interference.[5] For the purposes of this paper, there are two types of interference, unintentional (resulting from accidental radiation in the wrong frequency) and intentional interference, or jamming.[6] It order to detect, characterize, assess, and geolocate interference it requires continuous monitoring of mission critical links. When a DCS asset detects interference, the operator can then determine if it was unintentional interference or jamming.[7] The reason it is important to differentiate between the two is because it will change how the SATCOM operators react to ensure link survivability. Overall, the purpose of this type of DCS asset is to give SATCOM operators and users situational awareness of their communications flowing over SATCOM links. *If* something is wrong with the links, either intentionally or not, it allows for everyone to take actions to ensure the consistent flow of information. DCS preserves the friendly ability to operate in the space domain.[8]

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[4] Canada, Department of National Defence, Royal Canadian Air Force, *Royal Canadian Air Force Doctrine Note 17/01: SPACE POWER* (Department of National Defense, 2017), 6.

[5] United States, Joint Chiefs of Staff, *Space Operations*, Annex: Defensive Space Control (Washington, D.C.: Joint Chiefs of Staff, 2012).

[6] "RF Interference Mitigation," RF Interference Mitigation | Kratos Technology & Training Solutions, , accessed February 04, 2018, http://www.kratostts.com/solutions/satellite-and-space/rf-interference-mitigation.

[7] United States, Joint Chiefs of Staff, *Space Operations*, Annex: Defensive Space Control

[8] Canada, Department of National Defence, Royal Canadian Air Force…, 6.

6. The space domain, and especially SATCOM, plays a key role in the policy of Strong at Home, Secure in North America, and Engaged Abroad. The development of an organic Canadian SATCOM capability is a critical enabler to several of the new mission areas highlighted for growth in the policy. The mission of Strong at Home emphasizes arctic operations in order to ensure security and sovereignty in the Canadian Arctic. While it is possible to operate in the high arctic using terrestrial communications, any operation requiring long distance communications back to a headquarters for command and command would have to use SATCOM. As Canada works to remain Secure in North America by defending, the CAF plans to enhance its satellite communications network as part of the commitment to NORAD.[9] The final part of SSE, where Canada remains Engaged in the World through the expeditionary operations, is largely enabled by SATCOM. The new RCAF Space Power Doctrine states that "[SATCOM] provide[s] the National Rear Link back to Canada, as well as all close signal support required in theatre for effective accomplishment of Defence missions".[10] Additionally, the Royal Canadian Navy (RCN) whose operations are inherently expeditionary, is almost completely reliant on SATCOM for intelligence and communications when at sea. Integrating the space domain into CAF operations is critical to executing the SSE plan. In order to make SSE a success, it is necessary to procure a DCS capability to ensure continued access to the space domain.

7. One of several areas of emphasis under SSE it the increased role of Remotely Piloted Systems (RPS) for Intelligence, Surveillance, and Reconnaissance (ISR) missions within the RCAF.[11] While there are numerous benefits to RPS due to low cost, real-time ISR, and long

[9] Canada, Department of National Defence, *Strong, Secure, Engaged: Canada's Defence Policy* (Copyright Her Majesty the Queen in Right of Canada, as Represented by the Minister of National Defence, 2017), 60-61 .

[10] Canada, Department of National Defence, Royal Canadian Air Force…, 7.

[11] Canada, Department of National Defence, *Strong, Secure, Engaged* …, 16.

loiter time, they are completely dependent on SATCOM for mission execution. Once an RPS is launched, it controlled exclusively by an operator via SATCCOM. If an RPS loses contact with the satellite for any reason, such as jamming, it goes into a "lost link" flight profile. This means that the aircraft flies in a circle trying to reacquire the SATCOM link. If the aircraft cannot find the signal after a set period of time it will follow a return to base flight profile. Therefore, a simple adversary tactic to keep RPS out of their area of responsibility would be jam the SATCOM link. In order to counter that tactic, Canada would need to have SA of their links to notice the jamming so the RPS pilot could switch to another frequency; this is not possible without a DCS capability.

8. In addition to the increased emphasis on the use of the space domain within SSE, there are also plans to expand Canadian SATCOM capabilities. As one of the investment initiatives with the RCAF the government is planning to acquire "space-based systems that will enhance and improve tactical narrow- and wide-band communications globally, including throughout Canada's arctic region".[12] This includes launching two new organic Canadian satellite constellations, ESC-P and GEO UHF, that will further enable the mission areas discussed above.

9. All of the new capabilities and efforts outlined in SSE without the ability to counter adversary threats are useless in a CDO environment. As Canada and the CAF make a significant transition into the space domain, it is critical to understand the threats that exist and how to counter them. Canada cannot afford to hold to the antiquated belief that space is a peaceful environment without threats from potential adversaries. In fact, space is a contested and

[12] Ibid., 109.

congested environment.[13] One that Canada's adversaries will soon recognize as critical to Canada for achieving their national interests. The SSE document states that, "space is an increasingly contested environment. While Canada remains fully committed to the peaceful use of space, our assets have become potential targets".[14] While it is difficult to discuss the full gamut of capabilities that hold SATCOM at risk due to the classification of this paper, it is important to understand that there are many.

10. At the most basic level, the largest risk to SATCOM is electromagnetic jamming that interferes with space system links.[15] Jamming is the most widely proliferated due to the ease and effectiveness with which it is done. An adversary can overwhelm a specific SATCOM link, by putting up more energy than the satellite, denying access to users.[16] While military satellites have some counter-measures built in, a relatively unsophisticated adversary can easily disrupt or degrade a SATCOM link, if no one is monitoring the link for interference. Anyone of the traditional Canadian adversaries down to the non-state actors could potentially disrupt or degrade Canadian satellite communications, and without the SA to understand what is happening it becomes very difficult to negate the enemy actions.[17] This is why it is critical to Canada to procure a DCS system.

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[13] Bryan M. Bell and Evan T. Rogers, "Space Resilience and the Contested, Degraded, and Operationally Limited Environment," *Air & Space Power Journal* 28, no. 3 (November/December 2014): , doi:10.21236/ada618128.

[14] Canada, Department of National Defence, *Strong, Secure, Engaged* …, 57.

[15] United States, Joint Chiefs of Staff, *Space Operations*, Annex: Defensive Space Control

[16] Amy Butler, "U.S. Air Force Kills Key Space Control Program," USAF Kills Key Space Control Program | Defense Content from Aviation Week, May 7, 2015, , http://aviationweek.com/defense/us-air-force-kills-key-space-control-program.

[17] Canada, Department of National Defence, Royal Canadian Air Force…, 9.

11. There are two options concerning DCS system procurement. While either option will provide roughly the same capability, there are pros and cons associated with each. The first option is paying for a commercial service that would detect, characterize, and geolocate the interference. The second is developing and fielding a DSC capability within Canada for the sole purpose of protecting Canadian military SATCOM links.

12. The surge in commercial use of space has given rise to commercial services that monitor SATCOM links for the purpose of protecting a company's multi-billion dollar investment. A SATCOM company that provides a poor service due to interference will have a hard time keeping its customers. In order to ensure a good product, satellite providers pay companies to monitor their links for interference. When the company finds interference, they alert the satellite provider so they can take the appropriate actions to mitigate the interference.

13. One such company that provides Radio Frequency Interference (RFI) Geolocation Capability services is Kratos. While the specific cost of using a company like Kratos to monitor Canadian SATCOM is dependent on the number of signals and the type of support desired, one could approximate the cost at around $10 million per year.[18] Cost is one of the primary benefits of using a commercial service when compared to acquiring and developing a purely Canadian system. These systems are not cheap to build as the U.S. showed recently when it cancelled a SATCOM monitoring system due cost and performance issues; it was priced at $214 million when the program was shut down.[19]

[18] "RF Interference Mitigation,"…
[19] Amy Butler, "U.S. Air Force Kills Key Space Control Program,"...

14. However, there are significant downsides as well when considering using a commercial service for military means. First and foremost, is the problem that companies like Kratos are built to look for accidental interference and not intentional jamming. Accidental interference would be one company accidentally transmitting in the wrong frequency resulting in disrupted service to another company. The largest difference between the two is how dynamic jamming can be when executed by a capable enemy. Intentionally jamming will change frequencies to maximize the effect, while accidental interference won't change because they don't know they are doing it. The service Kratos provides is not tailored to stopping a dynamic and thinking adversary.

15. The other option is for Canada to develop an organic capability that could be tailored to the needs of the military. The CAF would benefit from the ability to directly control the capability tasked with protecting their SATCOM links. Additionally, the fact that the CAF would not rely on commercial company for information on adversary jammers that could ultimately lead to a military strike, is a huge benefit to having an organic system. However, building a system like this is expensive, as proven by the U.S. and providing the personnel to operate it is also a burden.

16. Another benefit to building an organic Canadian system is providing a much-needed capability to the coalition. As mentioned earlier, the U.S. cancelled their last DCS capability and yet to find a replacement. Canada building a system to monitor SATCOM links would go a long ways to strengthen the coalition by reinforcing a capability gap.

17. Regardless of what the Government of Canada decides as the more appropriate option for the CAF, it is critical that they understand the need to protect their SATCOM capabilities with a DCS system.

CONCLUSION

18. The Canadian government and military have recognized the need to increase their presence in the space domain as highlighted by the new efforts in SSE. Canada must use SATCOM to enable missions in the arctic and abroad. The increased role of RPS in the defense plan is also reliant on SATCOM. In addition to the coalition SATCOM already used by the CAF, there are also plans to develop two purely Canadian satellite constellations in the near-term. This dramatic increase in SATCOM usage will not go unnoticed by potential adversaries and Canada must be prepared to defend their use of space. While there are many ways to defend assets in the space domain, monitoring SATCOM links for jamming or interference has the lowest cost for entry and the most immediate benefits; both are advantageous for the CAF as a new player in the military SATCOM arena. Additionally, monitoring SATCOM links will protect Canadian assets in the space domain while staying within the Government of Canada's policy of "promoting the military and civilian norms of responsible behaviour in space required to ensure the peaceful use of outer space".[20]

19. The bottom line is Canada has already stated their intent to increase their presence in the space domain; monitoring SATCOM links will help their success in that venture for relatively little investment while staying within the broader space policy of the Government of Canada.

[20] Canada, Department of National Defence, *Strong, Secure, Engaged* …, 57.

RECOMMENDATION

20. The RCAF should invest in a DCS capability capable of monitoring, detecting, characterizing, and geolocating interference on SATCOM links. This capability should ideally be developed organically by the Canadian military but a SATCOM monitoring service could also be purchased from a commercial company.

BIBLIOGRAPHY

Bell, Bryan M., and Evan T. Rogers. "Space Resilience and the Contested, Degraded, and Operationally Limited Environment." *Air & Space Power Journal* 28, no. 3 (November/December 2014): 130-48. doi:10.21236/ada618128.

Butler, Amy. "U.S. Air Force Kills Key Space Control Program." USAF Kills Key Space Control Program | Defense Content from Aviation Week. May 7, 2015. http://aviationweek.com/defense/us-air-force-kills-key-space-control-program.

Canada. Department of National Defence. Royal Canadian Air Force. *Royal Canadian Air Force Doctrine Note 17/01: SPACE POWER*. Department of National Defense, 2017. 1-43.

Canada. Department of National Defence. *Strong, Secure, Engaged: Canada's Defence Policy*. Copyright Her Majesty the Queen in Right of Canada, as Represented by the Minister of National Defence, 2017.

"RF Interference Mitigation." RF Interference Mitigation | Kratos Technology & Training Solutions. Accessed February 04, 2018. http://www.kratostts.com/solutions/satellite-and-space/rf-interference-mitigation.

United States. Joint Chiefs of Staff. *Space Operations*. Washington, D.C.: Joint Chiefs of Staff, 2013.

United States. Joint Chiefs of Staff. *Space Operations*. Annex: Defensive Space Control. Washington, D.C.: Joint Chiefs of Staff, 2012.

Wills, Colin. "The Role of Air and Space Power and Control of the Air." In *Unmanned Combat Air Systems in Future Warfare: Gaining Control of the Air*, 57-92. Basingstoke: Palgrave Macmillan, 2015.