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A SURVEILLANCE PLATFORM FOR CANADA'S ARCTIC PLAYGROUND

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JCSP 40

Exercise *Solo Flight*

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Introduction

The Arctic is now an accessible region and is taking form as an area of global political interest. In the past, ice prevented access and passage. Given the immense size, no single modern navy could patrol the expanse of untapped resource-rich territory known as the Canadian Arctic Archipelago. Canada has but one financially viable option to actively patrol the Arctic; utilize a fleet of unmanned aerial vehicles (UAV)[1], in particular the high-altitude long-endurance (HALE) variety, to closely survey activities within its northern sovereign territory.

Arctic Playground

As stated by Levon Bond (2011), "Canadians have historically relied upon extreme cold and vast distances to defend its massive and sparsely populated Arctic territories."[2] The Arctic Ocean is exhibiting a trend towards larger losses of summer ice per annum, opening shipping routes on all sides of the North Pole. Access to previously inaccessible regions implies economic opportunities for companies to commence resource extraction[3] and to lower shipping costs when transporting between the Pacific and Atlantic Oceans. This area is already becoming more hospitable to scientific research and eco-tourism.[4] Given their geographical encapsulation of the entire Arctic region, the

[1] UAVs are also commonly known as RPA (remotely piloted aircraft), UAS (unmanned aircraft systems) or simply as'drones'

[2] Bond, Levon. "JUSTAS and Project Epsilon: Integrated Intelligence, Surveillance, and Reconnaissance of the Canadian Arctic." Canadian Military Journal 11.4, 2011, p24. Hereafter: Bond

[3] Kilisek, Roman. "Why is the Arctic at the Center of World Politics?" 07 Oct 2014

[4] Spears, Joseph. "Northern Exposure: The Future of Unmanned Systems in the Arctic" Unmanned Tech Solutions, Nov 2014, p22. Hereafter: Spears

two countries most likely to be approached (or encroached) by commercial and private operations are Russia and Canada.

Russia's growing national interests are largely based on securing and exploiting the resources in the region and establishing the North East Passage (NEP)[5] as a unified national transport corridor between the Pacific and Atlantic Oceans. On top of extensive oil and natural gas reserves, which up until very recently[6] account for 20-25 percent of Russia's GDP[7], the region holds abundant deposits of gold, uranium, nickel, copper, coal, tungsten, and diamonds.[8] The Russian Arctic shoreline measures 24,140km[9] and is the staging ground for resource extraction and international shipping.

A commercially navigable North West Passage (NWP) through Canadian waters would reduce 7,000kms from the current Panama Canal shipping route.[10] The Government of Canada (GoC) considers the seven potential navigable routes of NWP as part of its internal waters.[11,12] The Canadian Arctic Archipelago shoreline measures 162,000km and, due to increased summer ice melt, is an increasingly interesting avenue for international shipping. The 36,563 islands have a combined land mass of 1,424,500km^2. They remain quite undeveloped and it has been assessed that the Arctic may contain up to 25 percent of the world's untapped hydrocarbons.[13] A 2011 Monk School of Global Affairs poll reports most Canadians consider the Canadian Arctic part

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[5] NEP is also referred to as the NSR – Northern Sea Route

[6] The 2014 end-quarter oil price per barrel took a nose dive to less than half the average 2013/2014 price; exact percentages for the time of this paper (2015) have yet to be analysed in depth.

[7] Käpylä, Juha and Mikkola, Harri. "The Global Arctic: The Growing Arctic Interests of Russia, China, the United States and the European Union." *Finnish Institute of International Affairs*, Aug 2013

[8] The Calibre. "Russia to reopen Arctic naval base" 22 Sept 2013

[9] Bonikowsky, Laura Neilson. "The Arctic, country by country " 04 Oct 2012

[10] www.thecanadianencyclopedia.com/en/article/northwest-passage/ Accessed 23 May 2015

[11] Parliament of Canada, Law and Government Division "Controversial Canadian Claims over Arctic Waters and Maritime Zones"10 Jan 2008

[12] Byers, Michael. "Does Canada Need Submarines?" Canadian Military Journal, Vol. 14, No. 3, Summer 2014, p10

[13] Borgerson, Scott. "The Great Game Moves North" 25 Mar 2009

of their national identity and support efforts to retain sovereignty over the region.[14] Exercising policing responsibilities is considered a principle means of ensuring sovereignty is retained.[15] The GoC's ability to monitor and control what happens in the Arctic speaks to stewardship while addressing the issue of sovereignty.[16] Although it is unlikely a hostile force would mount a sea or land-based attack from the North, one can easily imagine reprehensible activities occurring within open Arctic waters such as drugs, weapons or human trafficking or even illegal fishing. Illegal bilge water discharging of sea vessels in such a fragile ecosystem is also a valid concern.

Canada's Shortcoming

The GoC introduced the 'Canada's Northern Strategy' in 2007 and continues to actively invest in four priority areas: Arctic sovereignty, protection of economic heritage, promoting social and economic development, and improving and devolving Northern governance.[17]

If Canada wishes to maintain sovereign claims to the legal status of the NWP, then Canada must actively monitor the number of maritime vessels transiting. The NWP connects two bodies of water, but does not yet constitute a route for international shipping and is therefore not considered an international straight.[18,19] Should international shipping routinely transit the NWP without seeking permission, there would be a

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[14] Ekos Research Associates Inc. "Rethinking the Top of the World: Arctic Security Public Opinion Survey" Munk-Gordon Arctic Security Program, 25 Jan 2011

[15] Lytvynenko, Anneta. "Arctic Sovereignty Policy Review." 05 Apr 2011, p3. Hereafter: Lytvynenko

[16] Huebert, Robert. "Canadian Arctic Sovereignty and Security in a Transforming Circumpolar World" Canadian International Council, July 2009, p5. Hereafter: Huebert

[17] www.northernstrategy.gc.ca/index-eng.asp Accessed 23 May 2015

[18] Lytvynenko, p5

[19] Huebert, p3

perception that the passage constitutes an international strait.[20] If Canada loses the ability to control these waters, control of environmental issues and shipping practices could slip from the GoC's hands.

Although efforts are being made to bolster support, Canada does not retain any level of permanent Search and Rescue (S&R) aircraft in the Arctic. Should assistance be needed, it is often deployed from up to ten hours away in Southern Canada.[21]

Current Surveillance Capabilities

A fundamental requirement for successful maritime surveillance is achieved by maintaining continuous coverage for a range of activities. Active monitoring is currently undertaken[22] using a layered approach by:

- the Canadian Coast Guard (CCG), to include support of a shore-based shipping Automatic Identification System (AIS);[23]
- the National Aerial Surveillance Program supported by:
    - Transport Canada;
    - RCAF long range patrol (LRP) aircraft;[24]
- the RCN; and
- satellite coverage; specifically by RADARSAT-2 which uses synthetic aperture radar (SAR) and is incorporated into the AIS network.[25]

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[20] Charron, Andrea. "The Northwest Passage: Is Canada's Sovereignty Floating Away?" International Journal, Vol.60, No.3, Summer 2005, p832

[21] Spears, p23

[22] Hoy, Laura. "Making Waves – Maritime Surveillance in the North" Canadian Naval Review Vol.6, No.1, Spring 2012, pp27-28. Hereafter: Hoy

[23] AIS is a tracking system required by the International Maritime Organization (IMO) whereby ships broadcast information about their identity, position, course and speed, to other ships, ground stations and satellites; http://en.wikipedia.org/wiki/Automatic_Identification_System Accessed 25 May 2015

[24] RCAF - Royal Canadian Air Force; RCN - Royal Canadian Navy

Naval vessels and manned aircraft pose logistical problems. Human resources, operating costs combined with limited and diminishing manned platforms are a significant concern for the Canadian Forces (CF).[26] The current orbit and configuration of the Canadian-owned and operated RADARSAT-2 allows for 14 orbits of the earth per day. The SAR has a nominal swath of 500nm while over an area of interest (AOI) and an imaging resolution of 100m. While there is an upgrade project under development (Polar Epsilon)[27,28] to increase the number and frequency of Canadian satellite polar crossings, the current satellite situation leaves large areas unmonitored for lengthy periods. As aptly stated by Laura Hoy (2012), "[a]lthough much has been done to improve maritime surveillance in Canada's north, more work remains."[29]

UAV Solution

UAVs are entering an era of their own and give the GoC the opportunity to maintain constant over watch of sovereign territories at all times of the year. A multitude of providers have developed a plethora of UAVs ranging from palm-size to medium-category-sized aircraft.[30] Established military UAVs come with a variety of sensor packages and are used to carry electro-optical (EO) sensors, infra-red (IR) sensors, SAR, laser designators, cameras and video recorders and even precision guided weapons.[31]

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[25] SAR is a form of radar which is used to create images of an object, such as a landscape – these images can be 2D or 3D representations of the object; http://en.wikipedia.org/wiki/Synthetic_aperture_radar Accessed 25 May 2015

[26] Canada. Department of National Defence. "UAV Campaign Plan" Ed. 1, UAV Joint Projects Office, Ottawa, ON: Chief of Force Development, 2007, p11. Hereafter: DND "UAV Campaign Plan"

[27] Bond, p25

[28] DND "UAV Campaign Plan", p39

[29] Hoy, p28

[30] Medium category aircraft are 15,500-300,000lb weight range; www.skybrary.aero/index.php/ICAO_Wake_Turbulence_Category Accessed 24 May 2015

[31] Recent COPA Flight 8 Events, "Canadian Forces Briefing on UAVs" 24 Jun 2009

The long-endurance variety is of particular note for this paper, and there are several commercial ventures underway to corner a niche market. This type is divided into medium- and high-altitude long-endurance (MALE and HALE), each having unique design capabilities. MALE UAVs (MUs) typically operate in the 10-30 thousand foot altitude zones and are generally propeller driven. They are primarily used for aerial reconnaissance and forward observation roles (such as the MQ-1 'Predator'[32]), with some capable of carrying several thousand pounds of ordinance (MQ-9 'Reaper'[33]). HALE UAVs (HUs) are generally jet powered and operate in higher altitude zones. They too are primarily used for reconnaissance and observation (RQ-4 'Global Hawk'[34]) with some being designed to be low observable or 'stealthy' (RQ-170 'Sentinel'[35]) or armed ('Avenger').[36] Armed UAVs are categorized as unmanned combat aerial vehicles (UCAV).[37] HUs design shape, propulsion and operating envelopes allows for extended range, speed and loiter times over MUs.

UAVs for Canada

In 2000, the Joint Unmanned Surveillance Target Acquisition System (JUSTAS) program was initiated in a two phase approach: Phase 1 "providing a domestic and expeditionary overland capability" and Phase 2 "the implementation of a domestic maritime and Arctic UAS capability."[38,39]

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[32] http://en.wikipedia.org/wiki/MQ-1 Accessed 25 May 2015
[33] http://en.wikipedia.org/wiki/MQ-9 Accessed 25 May 2015
[34] http://en.wikipedia.org/wiki/RQ-4 Accessed 25 May 2015
[35] http://en.wikipedia.org/wiki/RQ-170 Accessed 25 May 2015
[36] http://en.wikipedia.org/wiki/General_Atomics_Avenger Accessed 25 May 2015
[37] http://en.wikipedia.org/wiki/Unmanned_combat_aerial_vehicle Accessed 25 May 2015
[38] Bond, p27
[39] DND "UAV Campaign Plan", pp22 and 33

In 2004, the Commander of the Canadian Army published "Intelligence, Surveillance, Target Acquisition and Reconnaissance (ISTAR)[40] Vol. 1 – The Enduring Doctrine," where the contents detail the flexibility and vulnerabilities of airborne surveillance platforms.[41]

> UASs can offer extensive loiter times and are ideally employed on tasks that are too deep for assets on hand, too dangerous for ground recce troops or in areas where terrain or weather prevents ingress from the ground. UASs provide a bird's-eye view of the battlefield and are capable of employing a variety of sensor packages; as a result, UASs can provide deep or persistent coverage while maintaining flexibility during operations.[42]

The nuance of Arctic UAV surveillance is captured in the text describing deep, persistent coverage over terrain that is considered inaccessible due to the polar clime.

In 2007, the UAV Joint Projects Office published the "UAV Campaign Plan" providing a "blueprint for the development of this innovative aerospace capability." Descriptions of expected challenges that are relevant to the Arctic arena are:

- unlike manned aircraft, UAVs lack freedom of navigation; and
- most UAVs available on the market have not been designed for Canadian operating environments.[43]

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[40] ISTAR is defined as "a grouping of information collection, processing, dissemination and communication assets designed, structured, linked and disciplined to provide situational awareness, support to targeting and support to commanders in decision making." The term ISTAR is used to refer to both the operational process and the personnel, assets and architecture involved in the process. (*from B-GL-352-001/FP-001*)

[41] Canada. Department of National Defence. B-GL-352-001/FP-001, "Intelligence, Surveillance, Target Acquisition and Reconnaissance (ISTAR) Vol. 1 – The Enduring Doctrine", Kingston, ON: Chief of the Land Staff, 2004

[42] Ibid., p 4-18, para 47

[43] DND "UAV Campaign Plan", pp5-6

This document specifically mentions the Arctic region as part of the 'Canada First' mentality to ensure sovereignty and security of airspace and maritime approaches.[44]

In 2012 the Defence Minister announced to the media that several contenders were being considered for aerial surveillance of the Arctic.[45]

In 2013, in front of the Standing Senate Committee on National Security and Defence, Lieutenant-General (LGen) Blondin, Commander (Comd) of the RCAF answered questions regarding surveillance in the Arctic. "[UAVs] have got the range and endurance to be able to go on long patrols and be our eyes in the sky in the Arctic. It is a Canadian requirement."[46]

In 2015, the Comd of the Canadian Army published "Surveillance and Target Acquisition (STA) in Land Operations" that detailed how UAV assets provide persistent battlespace surveillance and target acquisition capabilities to the task force, and how it is expected the task force will deploy with, and incorporate these assets.[47]

UAVs over the Arctic would also allow for quicker location and communications with persons in distress, decreasing S&R response times in the austere environment.

Constraints of MUs

MUs pose certain constraints for Arctic operations (AO). Given the operating altitude band, MUs are subject to Transport Canada (TC) regulations and the vagaries of the jet stream. Below 60,000 feet altitude in Canada, all air traffic is governed by air traffic control (ATC). Aircraft that can operate above this altitude are virtually

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[44] Ibid., p20

[45] Leithen, Francis. "Canada Outlines Arctic UAV Requirement" Aviation Week, 05 Jun 2012

[46] www.parl.gc.ca/content/sen/committee/411%5CSECD/50054-e.HTM Accessed 25 May 2015

[47] Canada. Department of National Defence. B-GL-373-001/FP-001, "Surveillance and Target Acquisition (STA) in Land Operations", Kingston, ON: Chief of the Land Staff, 2015

unregulated - they need contact no one, nor are subject to direction or area restrictions. The strongest jet streams (narrow air currents circumnavigating the earth) are the polar jets which are located between 23,000-39,000 feet.[48] Flight time between destinations and distance covered can be significantly affected by winds. Additionally, severe structural stress can be inflicted on aircraft in and around the jet stream due to clear air turbulence (CAT).

MUs still-air range is limited when compared to LRP aircraft and HUs. The MQ-1 touts a 675nm range with endurance up to 24hours,[49] and the MQ-9 advertises an 1150nm range with endurance up to 14hours.[50] Using either of these most prolific UAVs would require multiple Arctic operating bases to support complete area coverage, significantly increasing operating costs.

CF UAV Trials

A series of trials with a medium-to-high altitude UAV was held by the CF in 2004 and was dubbed the Atlantic Littoral ISR[51] Experiment (ALIX).[52] The airframe was a General Atomics (GA) variant of the MQ-9 boasting a larger wingspan and wing area akin to the models used by NASA for scientific research.[53] It was conducted solely in Canadian airspace and was "the first CF employment of a UAV in Canada's Arctic airspace."[49] The three CF exercise scenarios included:

- a domestic emergency in southern Baffin Island (Arctic scenario);

[48] http://en.wikipedia.org/wiki/Jet_stream Accessed 23 May 2015
[49] http://en.wikipedia.org/wiki/MQ-1 Accessed 25 May 2015
[50] http://en.wikipedia.org/wiki/MQ-9 Accessed 25 May 2015
[51] ISR - intelligence surveillance and reconnaissance
[52] DND and CAF, "Atlantic Littoral ISR Experiment", Project number: BG–04.027, 18 Aug 2004
[53] http://en.wikipedia.org/wiki/MQ-9 Accessed 25 May 2015

- a peace-support operation in the Gulf of St. Lawrence and New Brunswick; and
- a domestic security and defense of Canada operation in the Grand Banks fishing area east of Newfoundland.[49]

Specific to the Arctic scenario, a 19 hour flight covering a 900nm range from the launch and recovery equipment (LRE), numerous shortcomings were documented:[54]

- significant manoeuvring was required to minimize the occurrence of a lost satellite link due to the low satellite look-angle;
- miscommunication between controlling agencies resulted in ATC directions to alter course (vectoring) by 200km away from polar air traffic prior to destination;
- the maximum cruise speed at the top of the operating envelope of 42,000 feet was 313km/h;[55]
- the deviation from course combined with strong headwinds and poor satellite look angle resulted in a 4 hours delay in mission execution over the AOI;
- the delay in arrival over the AOI precipitated a reduction of loiter time to a mere 15 minutes to allow for return to base (RTB);

[54] Canada. Department of National Defence. "Atlantic Littoral ISR Experiment", Project number: BG–04.027, Final Report Part 5.2-6(a) "Experiment Observations/Outcomes: Scenario One", pp135-136 – via Access to Information

[55] Wind velocity is highest in the core of the polar jet stream where speeds can be as high as 300 km/h. The jet stream core is surrounded by slower moving air that has an average velocity of 130 km/h in winter and 65 km/h in summer. www.physicalgeography.net/fundamentals/7q.html

- the risk of icing in clouds precluded the UAV from descending into the operating altitudes, which was required for the onboard radar to map ground activities (system maximum operating altitude of 25,000 feet);
- restrictions to working above the clouds, the onboard radar was not used to navigate laterally between vertical cloud formations for the transit portion of the mission, lengthening transit times; and
- the onboard video recording device only recorded cloud tops vice ground activities due to the amount of cloud cover and an inability to loiter to wait for a change in cloud coverage;

Of particular concern was the link with the geostationary satellites (GEOS). GEOS are located in orbit over the equator and, due to the curvature of the earth in the Polar Regions, a UAV needs to be at an appropriately high altitude in order to maintain line of sight to a directing satellite. The further north the UAV, the higher it must be to maintain a satellite link.

The ALIX trial highlighted that MALE UAV and GEOS become less and less compatible the further north the operating area. If Canada is to use MUs for AO, it must devise an alternate means of linked communications such as a series of ground stations across the operating area.

MALE for Canada

The ALIX trial encountered numerous issues under its controlled scenario. GEOS lose their ability to effectively communicate with ground-based stations above 66 degrees

north.[56] The trial navigated as far north as 66 degrees latitude and, given the altitude above the surface, it had a seven degree look angle at the controlling GEOS. The main AOI for the GoC is the NWP and, as defined by the International Hydrographic Organization (IHO, is bounded as far north as 76 degrees latitude.[57]

In addition to the procurement cost of the UAVs and their LRE, establishing and maintaining Arctic operating ground-based infrastructure would exponentially increase the operating and life cycle costs. LGen Devlin wrote in 2014 that, based on his military experiences in the north, operating costs in the Arctic "can cost from five to seven times more than if they were conducted in southern Canada." [58] It is clear that due to limitations in both communication links and flight range, MUs cannot monitor Arctic activities without a significant investment in northern support infrastructure. Even in 2014, Byer's and Franks continue to assert that "currently available UAVs are ill suited to the high latitudes and extreme weather conditions."[59, 60] To be noted, when special use or special purpose aircraft are operated in CA, a publically announced Notice to Airmen (NOTAM) is issued. Nefarious activities (e.g. bilge water discharge) could be coordinated to occur outside of publically available NOTAM specified times (or areas) to avoid being caught red-handed.

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[56] Spears, p22

[57] Limits of Oceans and Seas 3rd Edition, International Hydrographic Organization, 1953, p10

[58] Pugliese David, "Polar Challenge: Extreme Conditions Put High Cost on Arctic Operations" 10 Jun 2014. Hereafter: Pugliese

[59] Byers, Michael, and Franks, Kelsey. "Unmanned and unnecessary: Canada's proposed procurement of UAVs" Canadian Foreign Policy Journal, 2014, p272. Hereafter: Byers and Franks

[60] This author would disagree that all UAVs are incompatible; HALE UAVs are a viable option.

HALE for Canada

In contrast to MUs, HUs can operate above controlled airspace (CA),[61] above the jet stream, above the weather-induced icing zones and they have significantly longer range and endurance. HUs also travel at near twice the speed of MUs, allowing for more rapid re-routings. The operating concept would have an HU depart and climb within military airspace to a point where it could then transit the full length of the Arctic clear of the jet stream winds and CAT. Working above the numerous polar air routes would negate ATC conflicts.[62]

Northrop Grumman Polar Hawk

In 2012, Canadian military-aircraft support provider L-3 MAS teamed up with Northrop Grumman to submit a proposal to the GoC to deliver modified RQ-4B 'Global Hawks' to provide surveillance of the Arctic.[63,64] The proposal was dubbed 'Polar Hawk' with a specific aim and modifications to meet the needs of a HU designed for AO .

When compared to typical MU range and endurance, the RQ-4B touts a 7,560nm range and endurance up to 28hours.[65] As such, the RQ-4B is able to complete 2 full trips across the Arctic per flight - supporting the full length of the NWP up to four times per mission. The turbo-fan powered RQ-4B would operate at a significantly higher altitude than MUs (60,000 feet and above) and at a cruise speed of 575km/h. The operating envelope would translate into a requirement for only one operating base on either end of

[61] Operating above CA is negates requirement for NOTAMs.
[62] Spears, p22
[63] Aviation Week. "Northrop Pitches Polar Hawk for Canada Arctic Role" 31 May 2012
[64] Canadian American Strategic Review. "DND's JUSTAS Project Candidates – Northrop Grumman Polar Hawk" July 2013
[65] http://en.wikipedia.org/wiki/RQ-4 Accessed 25 May 2015

the country and the proposal was to utilize the already established CF military base in Goose Bay, Newfoundland.[66]

The integrated sensor suite of the proposed 'Polar Hawk' is very robust and combined with the sensor standoff ranges up to 200km, it could be considered an early-warning detection system for hostile entities approaching sovereign territory.[67] The proposed communication suite would also eliminate concerns over high-latitude signal blanking.[68,69]

Finally, the RQ-4B 'Global Hawk' is operated by the USAF,[70] but another version is under development with the USN – the MQ-4C 'Triton' with an added low altitude capability.[71]

GA Avenger

Another contender for the CF in the HALE UAV category is the GA 'Avenger.'[72] Similar in nature to the RQ-4B, this platform is turbo-fan powered, operates at the 60,000 foot altitude, and has SAR and wide-area surveillance sensors. Additionally and perhaps

[66] Canadian American Strategic Review. "DND's JUSTAS Project: HALE (High-Altitude, Long-Endurance) UAVs" July 2013

[67] While over the AOI, the SAR has a swath of 9.3nm and an imaging resolution of 1.0m (compared to 100m for RADARSAT-2) with a standoff range up to 200km. When used in Spot mode, the resolution increases to 0.3m. The EO/IR Wide Area search camera can record up to 137,000km^2/day with a framing camera running at 30FPS with an imaging resolution of less than 1.0m. The sensor suite also includes a ground moving target indicator (GMTI), with detection rates as low as 4knots and range resolution of 10m.

[68] The 'Polar Hawk' proposal introduced the opportunity to use civilian low-orbit satellites owned by Iridium Communications rather than the previously trialed GEOS.

[69] Canadian American Strategic Review. "DND's JUSTAS Project Candidates – Northrop Grumman Polar Hawk" July 2013

[70] USAF – United States Air Force; USN – United States Navy

[71] http://en.wikipedia.org/wiki/Northrop_Grumman_MQ-4C_Triton Accessed 25 May 2015

[72] Canadian American Strategic Review. "JUSTAS Project Candidates: General Atomics Avenger / Predator C" July 2013

more controversially for Canadians, it has the ability to carry up to 3,000lbs of internal armament – from smart bombs to air-to-ground missiles.

For Canadians, a valid concern is that an armed capability could lead to mission creep, where surveillance missions lead to missions devoid of ground troops, wading into to the highly controversial 'targeted killings'.[73] As Major General Holman aptly stated in 2013 regarding the U.S. use of UCAVs in Yemen or Pakistan, "Canada has no such aspirations" and "Canadian policy has eschewed such involvement."[74]

Finally, one might assess the 'Avenger' program as relatively embryonic given the first flight was in 2009, and to date only three have been built.[75] In contrast, the 'Global Hawk' program took first flight in 1998 and to date has 42 airframes built and flying around the world.[76]

International Players

As part of a comprehensive approach to the Arctic, Russia has steadily expanded its military component in the region. An excerpt from the 2008 Arctic policy document[77] translates as follows, "It cannot be ruled out that the battle for raw materials will be waged with military means."[78] Russia is reported to be deploying a UAV fleet to overfly its northern coast conducting surveillance and reconnaissance.[79] A 2012 RT.com news article announces "It is time to recognize Russia's overwhelming presence in the Arctic

[73] Byers and Franks. p272

[74] Holman, D. Fraser. "The Future of Drones in Canada: Perspectives from a Former RCAF Fighter Pilot" Canadian International Council, 2013, p7. Hereafter: Holman

[75] http://en.wikipedia.org/wiki/General_Atomics_Avenger Accessed 24 May 2015

[76] http://en.wikipedia.org/wiki/RQ-4 Accessed 25 May 2015

[77] The Kremlin. "Fundamentals of state policy of the Russian Federation in the Arctic for the period up to 2020 and beyond." 2008

[78] Schepp, Matthias. "Riches at the North Pole: Russia Unveils Aggressive Arctic Plans" 29 Jan 2009

[79] Bender, Jeremy. "Russia is Deploying a Drone Fleet to the Arctic" 29 Dec 2014

and rename the Arctic Ocean the 'Russian Ocean.'"[80] Russia's only aircraft carrier is assigned to the Northern Fleet, a floating Arctic home to fighters and anti-submarine helicopters.[81]

Conclusion

> *Canada has a choice when it comes to defending our sovereignty over the Arctic — we either use it or lose it.*[82]
>
> - Prime Minister Stephen Harper, July 2007

As the permanent polar ice recedes, the Arctic is emerging as a geopolitically significant region. Prospects in mineral, energy and maritime transport offer significant economic opportunities for the Arctic states – not least of all for Canada. The NWP offers world markets significant savings in shipping costs and transit fees and the NWP could become an ever-increasing source of revenue – in the order of $2-4 billion per annum.[83]

The Canadian Arctic is an immense and austere region and operating costs for complete surveillance and monitoring is beyond the GoC's current capability. "Satellite sensors have lower resolution, lower revisit frequency"[84] and are not designed to be re-tasked to loiter over a specific AOI. Technological advances in UAVs offer real-time data on a cost-effective basis. They afford the opportunity to actively monitor shipping lanes, be the initial S&R platform and provide a means for early warning of unfavourable or hostile entities. HUs as surveillance platforms would meet Canada's need for a

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[80] RT News. "Polarizing proposal: Bye-bye 'Arctic' Ocean, welcome 'Russian'" 26 Jul 2012
[81] Konyshev, Valery and Sergunin, Alexander. "Is Russia a revisionist military power in the Arctic?" Defense & Security Analysis, 2014, p9
[82] Pugliese, 10 Jun 2014
[83] Lytvynenko, p13
[84] Holman, p7

comprehensive layered approach to Arctic sovereignty, without stirring controversy regarding employment of a fleet of UCAV.

Demonstration of military efficacy in terms of UAV monitoring in the Arctic environment would show that Canada actively polices its slice of the Arctic pie.

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