Monitoring and Surveillance Systems in the Canadian Arctic

Credit: Whitney Lackenbauer

Although Canadian Rangers are often visualized as being on foot and on snowmobiles, they also employ a variety of small watercraft in the summer months. Here, Rangers patrol near Clyde River in August 2018.

Credit: Irving Shipbuilding

A rendering of the Arctic Offshore Patrol Vessel in Canadian Coast Guard (CCG) colours. The Trudeau government announced in May 2019 that two ***Harry DeWolf****-class ships will be procured for the CCG in addition to six being built for the Royal Canadian Navy. The CCG variants will be used for offshore fisheries patrols.*

I. Canadian Arctic Surveillance Systems/Existing or Underdevelopment – 2020

1. Radarsat Constellation

Three satellites were launched in Polar Orbit in June 2019, costing $1 billion.

Each satellite is equipped with synthetic aperture radar that can provide high-resolution images of the Earth's surface through darkness and clouds. This system will provide near constant coverage in Canada's Arctic Ocean for tracking ships, measuring sea ice and SAR recovery missions. The system was developed by the company MDA; [1]

2. Enhanced Satellite Communications Project (ESCP)

This system consists of a pair of elliptical orbiting satellites at medium earth orbit that spin 90 degrees to conventional satellites, passing over both poles. It will provide communications and surveillance in the Arctic. Bidders for the RFP in 2018 consisted of the companies MUA and VIA SAT. As of November 2019, the RFP has still not been issued. The project is in the "Industry Engagement" phase. An RFI was issued at the end of August 2018. The E1 period has been extended to March 31, 2020.

3. VIA SAT – 3 Satellites

These are three satellites due to enter service in 2019/2020, which are planned to enter into geostationary orbit to provide communications bandwidth in the north exceeding 1000 GBPS.

4. Sigma 56 Ice Navigator

This system is high definition for detecting ice ridges, icebergs embedded in pack ice, open water leads and coastlines. The system overages 32 scans and tracks 1000 targets simultaneously. The system is built by SME/RUTTER.

5. Autonomous Underwater Vehicle (AUV)

International Submarine Engineering (ISE) in 1985 laid fibreoptic cables on the arctic seabed for 200k at a depth of up to 600 metres. Advancements have been made for such vehicles to operate at greater depths and ranges, and allow for the AUV to pair wit moving beacons and to recharge, upload data and receive travelling instructions at the same time. ISE is based in Vancouver.

6. JSK Naval Support will be collaborating with marine technology company Kraken Robotic Systems to develop an enhanced autonomous underwater sonar solution utilizing an underwater vehicle (AUV). [2]

II. Unmanned Aerial Vehicles (UAV's) In the Arctic

Drones in Canada's Arctic will assist in the surveillance and monitoring of ship traffic, ice conditions, the detection of pollution and oil spills, Search and Rescue, and marine and fisheries regulation.

These vehicles will augment aircraft assigned by Transport Canada under the National Aerial Surveillance Program (NASP) which currently carries out periodic surveillance flights in the Arctic. The aircraft are equipped with state-of-the art remote sensing gear, including side-looking airborne radar, ultraviolet scanners and a Canadian-made electro-optical infrared camera system. The RCAF also send CP-140 Aurora long-range patrol aircraft on patrols to monitor activity in the Arctic, from bases in Greenwood Nova Scotia and Comox British Columbia.

When pollution spills occur, (MART) Marine Aerial Reconnaissance Team personnel confirm the location, record the spill, communicate with the vessel and report the incident to the Canadian Coast Guard regional operations center.

In 2015, the Treasury Board of Canada Secretariat approved $39.5 million in funding for a technical assessment of acquiring drones to boost its' National Aerial Surveillance Program to detect oil spills, survey ice and monitor shipping activity in the Canadian Arctic Ocean. [3] Hopefully such drones would be located in the NorthWest Territories or Nunavut.

The development in Canada of "Unmanned Aerial Vehicles" (UAV's) and "Remotely Piloted Aircraft Systems" (RPAS) is with the federal government primarily under the control and development of the Department of Defence and Transport Canada. As noted in this paper, private industry is also taking a significant step in the research of such vehicles for use in Canada's north.

Prof. Rob Huebert of the University of Calgary states that:

"The Arctic region poses significant challenges in regards to the control of UAV's given issues pertaining to satellite control line-of-sight and the general lack of existing ground infrastructure. Extreme weather with high winds and low temperatures, limited and unreliable satellite communication and navigation, and continuous darkness during the winter months are significant hurdles in the operation of drones in the Arctic. [4]

Russia are building UAV's which are being adapted to navigating without the use of global satellite-based navigation systems which are unreliable in the polar regions, called a GIRSAM system when GPS and GLOWASS are unavailable. [5] The drones are capable of identifying and gathering information on ships 100 kilometers away. The Russian drones will contain a 24 megapixel photo camera, infrared imagining technology and a zoom video camera. The batteries and electronics will be specifically shielded against Arctic temperatures.

A) Department of Defence (DND)

DND recently announced that Canada is in the midst of a five year $133 million upgrade to its' Arctic monitoring system. The existing system covers 75 percent of the country's coastline, which will require significant upgrades and replacements by 2025.

In the spring of 2019, DND announced that it has submitted an official bid to acquire a high-altitude surveillance UAV prototype from Germany. [6] In 2018 the German government confirmed they were working with Canada to purchase a second-hand "Euro Hawk", which cost the Germans $823 million to build. The concern at the time was that most of the important components of the drone would have to be removed at the time of the sale. [7] It has been reported that the Canadian Forces intends to establish a fleet of new armed drones by 2021 and operational by 2023. The cost of such a purchase would likely be more than a billion dollars. [8] The military at the time expressed interest in purchasing the US built Predator.

It has recently been reported that the Canadian government is in the Definition Stage of the "Remotely Piloted Aircraft System" (RPAS) unmanned aerial system (UAS) procurement, with an RFP due to be issued sometime in 2020/2021. [9] According to the Canada DND procurement website:

"This project will acquire a medium altitude and armed Remotely Piloted Aircraft System along with associated equipment, weapons, infrastructure and in-service sustainment capability that will support up to three concurrent lines of operation; domestic and international."

If all goes to plan, DND will award the RPAS contract in 2022/23; with the first delivery in 2024/25 and the first operational deployment in 2025/26.

The two bidders in the running for the project are Team Artemis (L3 MAS and 1A1); and Team Sky Guardian (General Atomics Aeronautical Systems, Inc., CAE, MDA and L3 WESCAM). Team Artemis is promoting the "Heron TP"; while Team Sky Guardian is proposing its' "MQ-9B Sky Guardian".

The "Heron" is a MALE (Medium Altitude Long Endurance) system with the capability to fly more than 30 hours at altitudes of up to 45,000 feet. Three Heron's were leased and flown by the Canadian Armed Forces (CAF) during the deployment in Afghanistan. [10]

The Sky Guardian's MQ-9B is a variant of the Predator B, which is widely used by the USAF. In May 2017 it logged a flight of more than 48 consecutive hours and became the first MALE RPA to perform a trans-Atlantic flight in July 2018.

One of the significant issues addressed by Craig Martin of CGAI is the role and rules for armed drones for DND. [11] There has to date, been very little information from DND on how armed drones will be utilized and how they would be used. Other countries have established laws and policy frameworks governing the used of armed drones.

North American aircraft companies are working in developing "Unmanned Combat Air Vehicles" (UCAV's). Although greatly advanced in the last ten years, to date there does not exist feasible and credible UCAV's optimized for air combat. Boeing is currently testing its' X-45 for high-risk combat missions. [12]

B) Transport Canada

A company called "Arctic UAV" was initially supposed to be conducting research and development trials with Transport Canada using a "Sea Hunter" drone with the first tests due to take place in June 2017 [13], with trials lasting until March 31, 2019. The drone was made by Griffen aerospace in Madison Alabama. It was later reported that the project was to be delayed up to at least two years because the drones was so large they were considered a

"missile" under the international arms-control agreement, known as the "Missile Technology Control Regime" or MTCR, which Canada and 34 other countries have adopted. [14]

The drone for Transport Canada was expected to fly about 500 hours per year and planned to acquire a medium-altitude between 10,000 and 30,000 feet for as long as two days straight. [15]

Arctic UAV is no longer a partner in the "Sea Hunter" project. A tender notice was later released on April 1, 2019 by Transport Canada for a "Beyond Visual Line of Sight" (BVLOS) "Remotely Piloted Aircraft System" (RPAS) for the Arctic.

III. Sky Sensus Project (BVLOS)

In October 2019 Ottawa announced the Sky Sensus project in developing unmanned aerial systems operating out of Foremost Alberta.

Defence contractor Peraton Canada is working with two Alberta companies Aerium Analytics, and Canadian UAV's. The project will focus on "Beyond Visual Line of Sight" (BVLOS), an important component of the UAV industry. [16] The contract is for a term of five years and is expected to stimulate growth and create 50 jobs in Calgary.

Also a Calgary company, FLYHT, with headquarters in Calgary since 1998 have developed an enhanced global flight tracking system for aircraft that exceeds CAO's Global Aeronautical Distress and Safety System (GADSS).

Specific features include built-in visual and audible alerts, email notifications, access to historical data as well as fully-automated distress tracking capability down to a minimum resolution of 20 seconds.

FLYHTASD is a fully integrated and enhanced global flight tracking solution which allows airline companies to track and monitor commercial aircraft overflying the polar route and indicate precisely their location in the High Arctic in the event of having to ditch as a result of an accident.

IV. Airships in the Arctic

The Canadian Forces Aerospace Warfare Centre (CFAWC) located in Trenton Ontario, under the "Emerging Skies Initiative" is looking into the "RCAF Arctic Airships Concept" which explores the potential for airships to provide Canada with airlift capacity in the Arctic. [17]

As noted in the above article, the US-based firm Airship Manufacturing has introduced an experimental Unmanned Autonomous Blimp (UAB) known as the "Sky Sentinal". Lockheed Martin has also been working on a "High Altitude Airship" (HAA) and has already received a $480 million order from a British company Straightline Aviation for a dozen of its' hybrid airship; the LMH-1. [18] The LMH-1 would carry 21.3 tonnes of cargo, 19 passengers and a crew of 2. The cargo bay of the LMH-1 would measure 10 feet by 10 feet by 60 feet.

The Lockheed Martin LMH-1 has developed technology that enables the ships to load without any moving structure. Called the air cushion landing system (ACLS), it employs large pads containing fans like those on a hovercraft to land. The low-power fans reverse, creating enough suction to stick the craft to the ground.

The Province of Quebec is spending $30 million to back the blimp maker "Flying Whales". [19] Flying Whales is a Chinese airship company that has received support from the government of France. [20] The design of the LCA 60T airship has a capacity of 60 tonnes. The deal proposed would include building airships at a plant in Montreal which could employ up to 400 people. North American operations for a "Flying Whales" unit, which would operate the airships, would also be based in Quebec. The LCA 60T is expected to include a 60 tonne payload and a cruising speed of 100K/hour. According to the company, it is anticipated that the first flight will occur in 2022 with certification and operation by 2023.

It is anticipated that the operation of airships in Canada's High Arctic, could operate out of such bases as Inuvik or Iqaluit, and be equipped with various sensor and monitoring equipment. In many cases, airships would be operationally dependent on the Arctic's extreme weather conditions.

V. Underwater Surveillance

During the Cold War, the US Navy established a Sound Surveillance System (SOSUS) to track Soviet submarines coming out of their ports in the north. [21] It consisted of a network of passive hydrophone acoustic arrays on the seafloor connected to shore stations called NAVFAC's, where acoustic data was analyzed.

In the 1980's this system was augmented by naval ships deploying "Surveillance Towed Array Sensor System" (SURTASS) which consists of a low frequency array towed behind a ship up to 8000 feet long.

These two systems became part of the comprehensive "Integrated Undersea Surveillance System" (IUSS).

The problem in establishing NAVFAC's too far in northern waters is that the arrays on the seafloor could be severely damaged due to the scouring of ice travelling though such waters during certain times of the year.

Recognizing that SOSUS could not relied upon in the High Arctic, because of ice conditions, researchers began testing acoustic and magnetic sensors at certain chokepoints in northern waters. During the 1980's, it has been reported that hydrophones were laid on the edge of the continental shelf in the Lincoln Sea that covered the majority of the Arctic Basin. [22] In future, Canada will have to renew its effort to conduct under-ice research and knowledge in the Arctic Ocean and the NorthWest Passage.

VI. Conclusion

With increased development in Canada's Arctic, and the increased ship traffic in the NorthWest Passage as a result of the receding multi-year ice, the National Aerial Surveillance Program (NASP) could be enhanced by the following mix of monitoring assets:

1. Aircraft with greater endurances and surveillance equipment;
2. Satellites with effective communication systems and synthetic aperture radar;
3. New RPA's and UAV's;
4. Airships;

5. Underwater tracking systems;
6. Improved communication systems in the three Canadian territories and with other international Arctic countries;
7. Upgrades to the North Warning System (NWS) to include over-the-horizon (OTH) radar to detect targets beyond the radar foreign;
8. Increased patrols by RCN ships in Canada's Arctic Ocean, such as the tasking of the new Arctic Offshore Patrol Ships (AOPS). The first of these ships should be operational in 2020; and
9. Ensuring indigenous "Ranger" militia units located in communities throughout the three territories, are adequately trained and equipped by the Department of National Defence, with headquarters in Yellowknife, NWT.

Such monitoring and surveillance operations could ensure that Canada can effectively monitor the activities in our Arctic waters, in compliance with our legislation and regulations, and the 1982 UN Law of the Sea Convention (UNCLOS).

Such continuous monitoring and surveillance year round of our Arctic Ocean will track foreign shipping, detect potential oil spills and changing ice conditions in these waters.

A recent paper also suggested that increased search and rescue infrastructure, by several Arctic experts, could be used for policing non-state threats in the North. [23] SAR equipment, based in the North, it was argued, could improve Canada's search and rescue ability in the region and such equipment might also be used for security duties to assist RCMP and fisheries officers. It is envisioned such helicopters designated for SAR duties would be located on a regular basis in Inuvik and Iqaluit.

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