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THE MISSING PIECE TO THE UMBRELLA PUZZLE: CANADIAN ISR IN THE MARITIME DOMAIN

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Canada

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As the world grows more complex and interconnected, what happens outside our borders has become increasingly important in the lives of Canadians. Our security, prosperity, and well-being will depend on how we navigate this period of global change. An important element of Canada's history – and our continued engagement with the world – is our military capabilities and contributions: to the defence of Canada, to the defence of North America, to United Nations peace operations, to disaster relief, and when necessary, to combat missions. Above all, the brave members of today's Canadian Armed Forces offer their service to protect Canada and its sovereignty.

-Justin Trudeau, Liberal Government website. Real Change.

As the Prime Minister Justin Trudeau and the Liberal government have stated, the Canadian Armed forces have the ultimate mission of protecting Canada and its sovereignty. Canada holds sovereignty as one of its closest values of national importance. The mission of ensuring national security and sovereignty has become increasingly difficult in a constantly changing world where asymmetric threats are becoming ever present. One of the first defenses to a threat either to security or sovereignty is to know of the threat before it can affect you. This vital information is what decision makers seek in order to ensure decisions can be made with the most current information possible. The CAF as well as their other government partners pursue and protect these values daily through Intelligence, Surveillance and Reconnaissance (ISR). Although members of the ISR community use air, land, naval and space based assets to achieve this advance threat warning, this paper will focus on Canada's air and space based ISR assets in the maritime domain both of the RCAF and Other Government Departments (OGDs) and agencies.

With coasts along three sides of Canada and a border shared with our closest ally to the south, the responsibility to ensure aerial maritime ISR coverage is massive. This paper will argue that with the size of the Canadian Area of Responsibility (AOR), the aerial ISR assets that currently exist are insufficient to protect Canada from external threats to both its citizens as well as its sovereignty. While an important factor is the stress the current expeditionary operations puts on domestic ISR assets, it will not be covered in detail during this paper. This paper will use established ISR metrics to examine the ISR capabilities and argue there are ISR gaps in domestic coverage. Finally, a solution of an integrated, overlapping, Canadian ISR umbrella system will be introduced that satisfies the ISR metrics and establishes an end state of a Canada confident that we see the threats before they can affect us.

WHY ISR IS SO IMPORTANT AND MEASURES OF PERFORMANCE

The Canada First Defence Strategy of the Harper government was a detailed road map for the modernization of the Canadian Forces. It very clearly laid out the missions that the CF would be responsible for and which ones they would maintain a capacity to support. The recently elected Liberal government has stated that, "The *Canada First Defence Strategy* is underfunded and out of date. We will immediately begin an open and transparent review process to create a new Defence White Paper that will replace Harper's failed *Canada First Defence Strategy*."[1] While Canadians wait for the defence review to be completed, the Liberal party has given key direction in the priorities it sees being necessary in the future of Canada. These are to include;

1) Developing the Canadian Armed Forces into an effective, agile, responsive, and well-equipped military force that can appropriately respond to a spectrum of operations within a whole of government context. These include: Defence

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[1] Liberal government. "Real change," Last accessed 05 May 2016, https://www.liberal.ca/files/2015/09/A-new-plan-to-strengthen-the-economy-and-create-jobs-with-navy-investment.pdf

of Canada, Defence of North America, support during natural disasters, international deterrence, humanitarian support missions, peace operations, and combat capability.
2) Renewing focus on surveillance and control of Canadian territory and approaches, particularly our Arctic regions, including an increase in the size of the Canadian Rangers.
3) Assisting in domestic security and natural disaster responses, both national and international.[2]

Although this is not all the priorities identified by PM Justin Trudeau, these three key priorities and the ability to satisfy them, is directly linked to the capabilities of Canadian ISR and more specifically aerial ISR in the maritime domain.

Before examining the tasks that ISR must accomplish in Canada, it is important to first define what one means by the term ISR. The definition of intelligence can be found in the Joint Publication 1-02, Department of Defense Dictionary of Military and Associated Terms. "The product resulting from the collection, processing, integration, evaluation, analysis, and interpretation of available information concerning foreign nations, hostile or potentially hostile forces or elements, or areas of actual or potential operations."[3] Information becomes key in this definition. How then does Surveillance and Reconnaissance fit into this definition and what is their relationship with the information gained? As Judy Chizek, a well known author on military ISR, explains in Military Transformation. Current Issues in Intelligence, Surveillance and Reconnaissance, "Surveillance and reconnaissance refer to the means by which the information is observed. Surveillance is systematic observation to collect whatever date is available while

reconnaissance is a specific mission performed to obtain specific data." [4] The goal then of

Canadian ISR is to obtain information so that senior decision makers have the ability to make

informed decisions. CF doctrine is an overarching guide for the proper application of air power.

Of the six RCAF functions, Command, Sense, Act, Shield, Sustain and Generate, the key

variable to the Sense function is the ISR aspect. The better the information and the better

informed the decision maker and the better is his situational awareness. As the Canadian Forces

Aerospace Sense Doctrine states,

> Situational awareness provides a combined picture of the operational
> environment. Decision superiority provides an operational advantage over an
> adversary though superior situational awareness. The Sense function is the
> capability that provides the commander with knowledge to achieve decision
> superiority. [5]

As Richard A. Best and Christopher Bolkcom go on to state in Military Transformation, "new

levels of effectiveness in joint warfighting specifically highlights the importance of achieving

information dominance. We must have information superiority…"[6] Information superiority gives

decision superiority. Canadian decision makers need to have an ability to gain information from

their ISR systems that provides decision and information superiority.

The counter argument to this idea is that Canada will never achieve information superiority.

The Canadian AOR is just too large. The maritime domain is an enormous task to ensure

information dominance. To understand the size of this one can look at Capt(N) Laurence

Hickey's background brief on The Recognized Maritime Picture,

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[4] Chizek, J., J. Elsea, R. Best and C. Bolkcom. *Military Transformation. Current Issues in Intelligence, Surveillance and Reconnaissance.* (New York: Novinka Books, 2003), 2.

[5] Canada. Department of National Defence..B-GA-402-000/FP-001. Canadian Forces Aerospace Sense Doctrine Manual (Ottawa: DND Canada, 2012), Key notes iv.

[6] Chizek, J., J. Elsea, R. Best and C. Bolkcom. *Military Transformation. Current Issues in Intelligence, Surveillance and Reconnaissance.* (New York: Novinka Books, 2003), 47

> With a coastline of 150,000 miles and an area of responsibility over 6.7 million miles, Canada has a formidable challenge in addressing maritime security. There are 250 ports in Canada and, on a typical day, there are some 1700 reported ships in our area of responsibility, with many more not self reporting, being further out from the major ports and beyond the vessel traffic management system coverage. [7]

Canada has attempted to break down this huge Area of Responsibility into more manageable portions called zones. As LCol Godefroy mentions in his paper, "the areas subject to maritime surveillance were defined in an internal 2002 CF ISR concept document produced by the Chief of the Maritime Staff and consist of a series of four maritime surveillance zones." [8] These zones are the Inner, Middle, Outer and Artic. The inner extends from shore to 50nm. The middle goes from 50nm to 250nm; the outer from 250 to 1000nm. The Artic zone is poorly defined and is consistently changing with the changing weather conditions.[9] The establishment of these zones makes the collaboration with OGDs easier and ensures that assets are directed to zones where they can be efficiently used.

With the total goal of maritime domain awareness as Transport Canada defines, "having true and timely information about everything on, under, related to, adjacent to, or bordering a sea, ocean or navigable waterway. For marine security, this means being aware of anything in the marine domain that could threaten Canada's national security." [10] Maritime domain awareness allows the security apparatus to better respond to threats to Canada with all the information possible both through the ISR route but also from all the other agencies and government partners.

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[7] Hickey, Laurence. "Background brief – The Recognized Maritime Picture". Last accessed 19 April 2016. http://www.parl.gc.ca/Content/SEN/Committee/372/defe/witn/hickey2-e.htm
[8] Godefroy, J.D. "The Future of US/Canadian Cooperation in the Surveillance of North America." Master of Defence Studies Paper, Canadian Forces College, 2013, 15.
[9] Author's experience as a CP140 pilot from 2003-2008.
[10] Transport Canada. "Maritime Domain Awareness,"Last accessed 25 April 2016, https://www.tc.gc.ca/eng/marinesecurity/operations-269.html

The need for information to not only be collected but integrated into the overall maritime domain awareness is important. What metrics can be used to ensure the Canadian ISR assets are actually doing the job? What exactly makes an ISR asset a good ISR asset? Y Gauthier and all answer these questions in Defining and Selecting Metrics for Intelligence, Surveillance and Reconnaissance (ISR). They mention 4 categories when examining ISR metrics but this paper will examine the two primary metrics for measuring ISR assets. They are;

> 1) Measure of sensor performance, which measure the ability of a sensor to collect and report potential target information. Things such as range, persistence, revisit time, reliability and availability.

> 2) Measure of fusion performance which measures the ability of a system to combine data received from multiple sources[11]

As the Liberal government has stated in their new direction and echoed in the CFDS, ultimately there are two ISR objectives for Canada. 1) The ability to conduct effective ISR across the Canadian AOR be it west coast, east coast or the Artic in the interest of Canadian security and sovereignty and; 2) The ability to integrate the information that is obtained into the OGDs and agencies allowing for commanders and leaders to have information and decision superiority. Metrics 1 and 2 become the most important because they measure the ability to conduct effective ISR and the ability to integrate the information. These two metrics will change based on which ISR asset you are using. For this paper, metric one, the measures of sensor performance, will be broken into five parts, Persistence, Availability, Revisit Time, Range and Reliability (PAR^3). Metric 2 will stay as one, the measure of fusion performance. For the remainder of the paper these will be referred to as the PAR^3 fusion metrics.

THE ASSETS AND THEIR CAPABILTIES

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[11] Gauthier, Y., S. Bourdon, S, Dore and V. Fong. *Defining and Selecting Metrics for Intelligence, Surveillance, and Reconnaissance(ISR)* (Ottawa:DND Canada, 2004), 4.

CP-140 Aurora

The Aurora has become Canada's workhorse for ISR missions. It contributes greatly to the maritime domain awareness goals of all three West Coast, East Coast and Artic Regions. Obtained in the 1980s as a maritime Patrol and Anti-Submarine hunter, it acts as the RCAF's primary ISR asset. Domestic operations include combatting illegal immigration, illegal fishing, pollution, drug trafficking and Search and Rescue. As the RCAF Association states, "the CP140 Aurora currently represents a critical strategic C4ISR capability, one which will be increasingly important to Canada in the future for deployed operations, coastal surveillance and Artic sovereignty."[12] The Aurora has been upgraded over recent years as part of the Aurora Incremental Modernization Project(AIMP) which included major sensor upgrades. Two of note, that bring world leading ISR capabilities, are the Electro Optical Infrared Camera(EO/IR) and the Synthetic Aperture Radar(SAR). The camera allows the Aurora to stand off from vessels or targets of interest while not being seen either during the day or night. As is mentioned by Col Major in an interview with Skies magazine,

> The MX-20 is also proving valuable on mission at home, where the RCAF is tasked with supporting counter terrorism, anti-smuggling, sovereignty, fisheries and pollution patrols…if you're catching someone who is polluting in our waters, you can do it from far enough away that they can't see you, but you can see them if they're discharging oil.[13]

The only drawback to the EO/IR is the weather. The camera cannot see through cloud or visible moisture.[14] The Aurora then would have to either reposition closer to the target which is not always a possibility when attempting to remain undetected or the aircraft would have to descend

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[12] Royal Canadian Air Force Association. "C4 ISR",Last accessed 06 April 2016, 3. http://rcafassociation.ca/advocacy/position-papers/2013-2/012013-c4isr/
[13] Skies Magazine. "Aviation is our passion." Last accessed 23 April 2016, 5. http://skiesmag.com/features/article/16087-aurora-s-appeal.html.
[14] Author's experience as a CP140 pilot from 2003-2008.

below the weather or cloud deck in an attempt to regain visual contact. At times, descending below the cloud that is regularly found over the oceans is not a possibility due to the severity of the weather system. This is where the Synthetic Aperture Radar(SAR) becomes extremely valuable. The Block 3 upgrade to the Aurora saw the introduction of SAR. As Sandia National Laboratories states on their website, "Synthetic Aperture Radar (SAR) systems take advantage of the long-range propagation characteristics of radar signals and the complex information processing capability of modern digital electronics to provide high resolution imagery."[15] The Synthetic aperture radar sees through weather and visible moisture to give the crew unimpeded photos of the target of interest. These sensors on the Aurora give it an unmatched advantage combined with a multi-mission capability that can be re-tasked airborne. As it is stated by the RCAF Assocation, "The upgraded CP140 Aurora is considered by knowledgeable observers, from a systems perspective, as being one of it not the most capable multi-mission Long Range Patrol aircraft currently in existence."[16] The Aurora, however, is not only an excellent ISR platform for maritime awareness on the surface but it also has a highly effective anti-submarine warfare function. This capability will only become more and more relevant especially in the Artic where the ice continues to disappear. Submarines from other nations are continuing to move under the Artic ice and the Aurora brings the capability to defend and protect our sovereignty in the North. "The Canadian Forces quietly scrambled an investigative team to the High Artic last August to probe what it considered a reliable report of a foreign submarine sighting near the entrance of the Northwestern Passage."[17] The sub sighting is only one of what

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[15] Sandia National Laboratories, "What is Synthetic Aperture Radar?" Last accessed 24 April 2016, http://www.sandia.gov/radar/what_is_sar/index.html
[16] Royal Canadian Air Force Association. "C4 ISR",Last accessed 06 April 2016, 2. http://rcafassociation.ca/advocacy/position-papers/2013-2/012013-c4isr/
[17] The Globe and Mail. "Military scrambled over foreign sub sighting." Last accessed 07 April 2016. http://www.theglobeandmail.com/news/national/military-scrambled-over-foreign-sub-sighting/article1150247/

one can assume are many that move and transit in the Artic taking advantage of the short transit distances of the Northwest passage as well as the relatively unguarded area of the Artic. The Aurora at least provides a solution via Northern Patrol and anti-submarine capability. The deter/detect function of the Aurora cannot be discounted and it is the only long range ISR platform that has an ASW capability in Canada.

In examining the Aurora against the PAR[3] fusion metrics, it has substantial persistence for a manned platform. Regularly planning 10 hours patrol but with the ability to loiter two engines, it can extend this on-station time by several hours.[18] It also has substantial range with the RCAF website quoting a range number of 7400km.[19] This would allow the Aurora to fly anywhere within the Canadian AOR, find, look and loiter.

The first Gap appears in examining the Aurora under the PAR[3] fusion metric of reliability. One of the major downsides of the Aurora is that they in fact were obtained in the 1980s. Although there has been a recent project call the Aurora Structural Life Extension Program (ASLEP) that is intended to reset the structural life of the aircraft. ASLEP includes replacing the entire wing and horizontal stabilizer, and a number of additional structural problem areas are also addressed. This is a key factor in extending the fleet to 2030.[20] Military Briefing notes obtained by CBC news, suggest that an Aurora replacement aircraft was slated for procurement in 2017 but now earliest date that now might happen is 2020 and some Auroras

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[18] Author's experience as a CP140 pilot from 2003-2008.
[19] Royal Canadian Air Force."CP140 Technical Specifications." Last accessed 15 April 2016. http://www.rcaf-arc.forces.gc.ca/en/aircraft-current/cp-140.page
[20]Canadian Naval Review. Last accessed 24 April 2016. http://www.navalreview.ca/2015/07/changing-with-the-times-the-evolution-of-canadas-cp-140-aurora/

could still be flying in 2030 – almost 50 years after they were introduced into the Canadian fleet. [21] The reliability of a 50 year old aircraft is questionable to say the least.

The other major gap that exists is actual availability. Canada does not have enough of them. Of the 18 Auroras Canada has in its inventory, there are currently 14 Auroras scheduled for ASLEP although they have not all been upgraded to Block 3. "To date, the LRP Force has received half (6) of the Block 3 modified airframes, with the remainder scheduled to be modified over the next four to five years."[22] This represents a major Gap in Canada's aerial surveillance capability. Six aircraft that have been upgraded to Block 3 which consists of replacing the mission computer, the acoustics system, electronic warfare system, magnetic anomaly detector and synthetic aperture radar. This means that the RCAF only has six aircraft split between both the East Coast and West Coast that have full day/night all weather ISR capability due to the SAR sensor. There will invariably aircraft down for maintenance on each coast and one cannot forget the responsibility to Operation Impact and the deployment of two Block 3 Auroras to Iraq in October 2014. The actual effect of this operation cannot be understated. With two Block 3s in theatre and one back in maintenance being prepared to rotate back into theatre, half of the Block 3 fleet is tied into the Operation overseas and unable to participate in domestic ISR.[23] The lack of availability also dovetails into revisit time. Less Auroras in the air, means that you can't return to look at targets of interest (TOIs).

The counter argument to the low amount of Block 3 Auroras for domestic ISR is the fact is that Block 2 Auroras can be used for domestic ISR roles. The issue is that Block 2s only have

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[21] CBC News. "$35M military plane upgrades highlight Canada.s procurement delays." Last accessed 14 April 2016. http://www.cbc.ca/news/politics/35m-military-plane-upgrades-highlight-canada-s-procurement-delays-1.2539886

[22] Canadian Naval Review. Last accessed 24 April 2016. http://www.navalreview.ca/2015/07/changing-with-the-times-the-evolution-of-canadas-cp-140-aurora/

[23] Email conversation with Aurora pilot currently on JCSP 42. Canadian Forces College, April 2016.

the EO/IR pod as an ISR sensor. "Block 2 introduced an electro-optical infrared camera turret was installed underneath the nose of the aircraft."[24] Although the Block 2 Aurora is a very capable asset, it means that weather affects the obtaining of information. This also does not take into account the Northern patrols that given the low amount of Auroras available are limited in the capability to do them. The Gap still exists. Even with Block 2 Auroras there are not enough to ensure maritime domain awareness by themselves. In regards to metric 2, data fusion, the Block 3 communications upgrades makes the ability to integrate information between different agencies seamless and with the Beyond Line of Sight (BLOS) communications the capability is even further advanced. The problem is that until the fleet has the BLOS upgrade (part of block 3), the communication and fusion capability are limited to voice only and data download upon landing.

RadarSat- 2/ Polar Epsilon

The second asset that Canada uses for its maritime domain awareness is RadarSat- 2 and is Canada's primary space based ISR asset. It was launched in December 2007 and as the Canadian Space Agency states, "Canada's next-generation commercial radar satellite offers powerful technical advancements that enhance marine surveillance, ice monitoring, disaster management, environmental monitoring, resource management and mapping in Canada and around the world."[25] This single satellite uses synthetic aperture radar, just like on the Block 3 Aurora, to give day or night pictures in any weather. It can look at a specific area with high

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[24] Canadian Naval Review. Last accessed 24 April 2016. http://www.navalreview.ca/2015/07/changing-with-the-times-the-evolution-of-canadas-cp-140-aurora/
[25] Canada Space Agency. "Radarsat2 » Last accessed 08 April 2016. http://www.asc-csa.gc.ca/eng/satellites/radarsat2/default.asp

resolution or take wide angle pictures with a lower resolution. It has the capability of a 500km

swath width which will be a lower resolution but detection of maritime targets is possible. [26]

Examining RadarSat 2 against the PAR[3] fusion metrics, it is clear that range and

reliability are not in question. With a 500km swath width and with the asset being space based,

range is not an issue. As for reliability, with a launch date of 2007 and no forecasted termination

date, a satellite does not have the same reliability limitations that air based ISR assets have to

contend with. Persistence and revisit time represent the first capability gap. The problem appears

when the satellite is in its maximum detection mode of 500km. Coverage access using a 500km

swath with at North of 70 deg is daily, and between 48 and 70 deg is every 1-2 days.[27] This

presents a significant gap in coverage. Targets of interest especially if they are in the Arctic, can

disappear quickly and persistence and revisit time become important considerations for satellite

ISR. Although the radar sat has an excellent capability of detection, its sensor measure of

performance for persistence and revisit time is lacking. The last part of metric one, availability, is

not an issue as it continues to orbit the earth and will eventually return over the area of interest.

Metric 2, the fusion of data, is also not assessed to be an issue as the data obtained from

RadarSat-2 is civilian owned and thus there are no issues with ensuring data flow is

uninterrupted.

The counter to RadarSat-2 being a single complete ISR capability returns to the argument

of persistence and revisit time. If for example a target of interest is detected, the only way to get

surveillance and reconnaissance on the target is to task another asset such as an aircraft that can

get to the target faster than the returning satellite in 1-2 days. To satisfy the PAR3 fusion metric,

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[26] Ibid.
[27] Ibid.

RadarSat-2 needs another asset to cue onto the TOI. This further argues the point of the

requirement for an integrated umbrella system, where the Radar Sat 2 would cue to possible

targets while smaller oxygen breathing aircraft would be able to gather information through

actual reconnaissance of the target.

From an Arctic point of view, the military has further developed the data provided by

RadarSat-2 and created the Polar Epsilon project, a space based wide area surveillance capability

to improve ISR of the Artic. As the Department of Defense website states,

> The Polar Epsilon project involves using information from RADARSAT-2 to
> produce imagery for military commanders in their areas of responsibility during
> the conduct of operations. This includes the surveillance of Canada's Arctic
> region, including its ocean approaches, the detection and tracking of foreign
> vessels, and support to CF operations globally. [28]

Although Polar Epsilon is an excellent tool for monitoring Artic sovereignty, it again uses the

information from RadarSat-2 and has the same drawbacks of limited revisit time, persistence and

the need for another aircraft to investigate suspicious tracks. It does not provide continuous

surveillance but that being said it is an essential capability. As Doug Bancroft, director of

Environment, Canada's Canadian Ice Service, states, "Routine surveillance to support

sovereignty and security in the icy waters of the North would not be affordable without RadarSat

programs."[29] Satellites play a key role in ISR due to their reliability and consistency. As the

Canada Space agency maintains, "Earth-observation satellites have an advantage over aerial

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[28] Department of Defense. "Polar Epsilon." Last accessed 04 April 2016.
http://www.forces.gc.ca/en/news/article.page?doc=polar-epsilon-project/hnps1uo5
[29] Bond, Levon. JUSTAS and Project Epsilon: Integrated Intelligence, Surveillance, and Reconnaissance of the
Canadian Artic. Last accessed 04 April 2016, 3. http://www.journal.forces.gc.ca/vo11/no4/24-bond-eng.asp

surveillance missions. Satellites operate day and night in all weather conditions and provide timely coverage of vast areas."[30]

<u>National Aerial Surveillance Program(NASP)</u>

There are also civilian aircraft based ISR assets that contribute to Canadian maritime domain awareness. Transport Canada is the lead agency for preventing illegal ship pollution through the National Aerial Surveillance Program. As the Transport Canada states, "Internationally, aerial surveillance is widely adopted and considered to be the most effective method for the detection of oil spills. The presence of NASP maritime patrol aircraft acts as a deterrent by discouraging illegal discharges of pollution at sea."[31] Transport Canada uses three specialized maritime patrol aircraft to carry out their patrols. They have one Dash 8 in Moncton, NB, one in Vancouver, B.C and one Dash 7 that is located in Ottawa in the summer but deploys to Iqaluit, NU for the Artic shipping season from July to October.[32] Examining the PAR[3] fusion metrics, Transport Canada also uses data from RadarSat-2 for environment Canada's Integrated Satellite Tracking of Pollution (ISTOP) program. This clearly demonstrates the fusion of information capability of this asset.

> ISTOP is used as an early warning system to help personnel direct the aircraft to locations of potential pollution incidents in near real time. Identified anomalies are then examined by an aircraft to confirm the spill, identify the source if possible and gather evidence for prosecution.[33]

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[30] Ibid.
[31] Transport Canada. "Spill Prevention: National Aerial Surveillance Program." Last accessed 07 April 2016. http://www.tc.gc.ca/eng/marinesafety/oep-ers-nasp-2195.htm
[32] Ibid.
[33] Ibid.

They also have high reliability operating a historically safe, well maintained aircraft and a decent range of approximately 1800km[34] using the twin engine Dash 8 aircraft. So although the Dash 8 provides a civilian ISR component to the overall Canadian ISR objectives, there are disadvantages. Transport Canada's NASP provides a specific capability for pollution detection and prevention of this environmental based threat to Canada. Although having the Dash 8 on each of the coast for West and East Coast availability, they only deploy to the Artic from July to October. There are still 8 months of the year where there is no Artic pollution patrols taking place. They are not patrolling for sovereignty or investigating targets of interests.

This is the main counterargument to NASP that although the NASP aircraft are of medium range and excellent reliability, they lack the persistence and revisit time that is possible with a larger ISR aircraft or a satellite. They also lack the availability one would need for a dedicated ISR asset as their sole mission is pollution prevention. The fusion of data again is a neutral metric to examine as they are equipped with the latest communications technology making the ability to transmit the data to OGDs and the military a non-issue.

Provincial Aerospace (PAL)

A second civilian company providing maritime domain awareness does so through the Department of Fisheries and Oceans(DFO) Air Surveillance program. Provincial Aerospace (PAL) has held long term contracts to provide aerial ISR. As Wings magazine mentioned in their article on Keeping an Eye on Canada's Oceans,

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[34] Wikipedia. "Bombardier Dash 8." Last accessed 26 April 2016. https://en.wikipedia.org/wiki/Bombardier_Dash_8

Provincial Aerospace has maritime surveillance aircraft based in St John's, Halifax and Comox, B.C. The company's primary domestic client is DFO but other government departments such as Transport Canada use the data and direct aircraft use for other maritime surveillance mission.[35]

They carry out missions for Environmental Protection and Pollution, illegal immigration and illegal fishing. In using the PAR[3] fusion metrics, they fly the reliable King Air 200 aircraft for their patrols that have been modified with radar, forward looking infrared/Electro-Optical cameras and advanced communications systems. They are able to integrate data between OGDs and the military thus Metric two of data fusion again proves to not be an issue. PAL patrols are normally used to patrol the inner Zone from 0-50nm. They are always available for missions and this has proven to be extremely helpful reducing the CP140 workload. Before the block upgrades, CP 140 Auroras were not equipped with Automated Identification Service (AIS) that each ship larger than 300T or a passenger ship of any size is required to have on board.[36] AIS is an automatic tracking system used on ships for identifying and locating vessels by electronically exchanging data with other nearby ships, AIS base stations, and satellites.[37] The inner patrol area is historically the busiest area to work. With PAL able to fly these missions, Auroras could patrol the middle and outer areas where its endurance capability could be put to use.

The counter to the PAL capability again appears when we consider the use of the medium to small, manned ISR platform. Persistence and revisit time are limited to non-existent in an aircraft of this size. The aircraft's range was 3338 km with max fuel and a 45 min reserve.[38] This meant that the inner zone was a regular mission location but the availability of flying in the Artic

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[35] Wings. "Keeping an Eye on Canada's Oceans." Last accessed 11 April 2016.
https://www.wingsmagazine.com/operations/keeping-an-eye-on-canadas-oceans-4757
[36] Author's experience as a CP140 pilot from 2003-2008.
[37] Wikipedia. "Automatic Identification System." Last accessed 26 April 2016.
https://en.wikipedia.org/wiki/Automatic_Identification_System
[38] Wikipedia. "Beechcraft King Air 200 Range." Last Accessed 02 May 2016,
https://en.wikipedia.org/wiki/Beechcraft_Super_King_Air

was not a possibility. PAL was effectively able to provide Canada ISR close in but had no ability to reach and stay on-station for extended periods of time. A further capability gap is presented by an experienced Aurora tactical navigator that has flown many of these patrol missions. In his Solo flight from JCSP 40, Major Kurt Lalonde, states that the counter argument to using PAL is that " Although PAL is contracted to carry out some of these tasks, it is still not persistent ISR, nor can they perform the security roles required under the auspices of Canadian Defence."[39] The gap in capability becomes clear in considering these smaller manned ISR platforms such as PAL and NASP. They don't have the persistence and revisit time that is needed in the massive Canadian maritime AOR. They also don't have the military mandate if an actual military response to a threat would be required.

THE FIX

The PAR3 fusion metrics have given a logical and straight forward measure of the current Canadian ISR capabilities. The Aurora is an extremely capable platform. The issue is that there are not enough of them and as they continue to age they will only become more difficult to maintain. RadarSat-2 is consistent but not persistent. The swath size to cover 500km at a time requires the resolution to be reduced and thus targets are only detected vice examined. NASP and PAL although very capable platforms, are used for specific mission sets, have reduced ranges, revisit times and persistence and are civilian owned and operated which negates the ability to respond to the asymmetric threats that may face Canada in the future. With Auroras stretched to the limit on the coasts and the contribution to expeditionary ops, there is simply not enough military and or civilian ISR assets to protect Canada and her sovereignty. In using the ISR

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[39] Lalonde, K. "Bridging the Gap – Small Manned ISR Platforms." JCSP Paper, Canadian Forces College, 2014, 14.

metrics it has become clear that Canada has assets that can integrate and fuse information between partners but what Canada is missing is a regularly available, persistent asset that has a short revisit time.

One possible solution has actually been in development for over a decade. Joint Unmanned Surveillance Targeting and Acquisition System (JUSTAS) is Canada's project to procure unmanned aerial vehicles. While the project is still in the options analysis, we have seen recent press from the Chief of the Defence Staff, General Vance. "We do need UAVs (unmanned aerial vehicles) and I am of the view that we need armed UAVs."[40] Vance told senators that such drones would improve the military's ability to patrol and monitor Canadian territory as well as help in search and rescue efforts.[41] Whether or not the end product will be armed, it is clear the top leadership of the Canadian Forces is thinking about JUSTAS and is actively working on options. After stating that the CFDS was out of date, the Prime minister laid out his initial direction for the CF. "In addition to replacing the CF-18s and re-equipping the Royal Canadian Navy, top equipment priorities will include acquiring cost effective search and rescue aircraft, long range surveillance UAVs, and finalizing a variety of Army projects."[42] It then also clear the government is looking at long range UAVs to fill an ISR role. The question is what will this capability look like? The Canadian Forces does have a UAV Campaign Plan however it is dated Mar 2007 and there has not been an update since. The end state that is documented in the Campaign plan, however, is applicable. "The desired end-state is a fielded, fully operational

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[40] CBC News. "Vance Speaking to a Senate Committee." Last accessed 23 April 20116.
http://www.cbc.ca/news/politics/vance-canada-armed-drones-1.3480278
[41]Ibid.
[42]Liberal government. "Real change" Last accessed 05 May 2016. https://www.liberal.ca/files/2015/09/A-new-plan-to-strengthen-the-economy-and-create-jobs-with-navy-investment.pdf

capable family of UAVs to support domestic and international operations."[43] The operational

requirements for a UAV procured through JUSTAS specify;

> A Class III Medium Altitude Long Endurance(MALE) UAV, capable of at least
> 1852km range, 18 hours of endurance, the ability to conduct operations over land
> and sea(especially the Artic) and the capacity to carry multiple payloads(both
> surveillance and strike packages).[44]

How then do you support domestic and international operations? What does a UAV bring to the

fight? UAVs are effectively force multipliers without the risk associated with normal manned

ISR assets. You can deploy an asset for extended periods of time while performing ISR tasks and

the pilot is taken out of the equation. The dull, dirty and dangerous jobs now become an option

for UAVs without the crew to worry about. A UAV procured under JUSTAS would satisfy all

the PAR[3] fusion ISR metrics and complete the proposed Canadian integrated ISR umbrella.

JUSTAS could be the missing piece.

The counter to JUSTAS is that there are still many obstacles that need to be address

before a UAV can be flown in Canada for domestic ISR. The first obstacle is that UAVs have

not been flown in the climates that are found in Canada. Artic operations and the ability for

satellites to communicate with the UAVs at Artic Latitudes present challenges that have not yet

been tested. There will need to be some substantial testing before Canada's ISR of the Artic and

far maritime approaches are handed to a UAV.

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[43] Canada. Department of National Defence. Canadian Forces UAV Campaign Plan. Edition 1. (Ottawa: DND Canada, 2007), 19.
[44] Royal Canadian Air Force. "Will JUSTAS Prevail? Procuring a UAS capability for Canada." Last accessed 20 April 2016. http://www.rcaf-arc.forces.gc.ca/en/cf-aerospace-warfare-centre/elibrary/journal/2015-vol4-iss1-05-will-justas-prevail.page

The second major obstacle is that there are still questions in the regulations and procedures about flying a UAV in Canadian domestic airspace. As its mentioned by Danny Garrett-Rempel in his Article Will Justas Prevail, "Despite Transport Canada having recently clarified regulations for civilian UAS usage, with plans to create further guidelines in the future, regulatory and safety concerns will remain issues to consider as Canada pursues UASs for military application."[45] Flying UAVs in the vicinity of other aircraft and specifically airliners with hundreds of passengers will need to be regulated and examined in order that all shareholders are comfortable with this very real future possibility.

JUSTAS, however, is not the only possible missing piece to the Canadian ISR umbrella puzzle. Another solution that is slated to deploy in the near future is a development on RadarSat-2. Canada is presently building the first of three RadarSat Constellation Mission satellites with an estimated launch date in 2018. The RadarSat Constellation is the evolution of the RadarSat program with the "objective of ensuring data continuity, improved operational use of Synthetic Aperture Radar and improved system reliability."[46] It becomes clear under the PAR[3] fusion metrics why this solution would work quite nicely. Three satellites instead of one means consistent, reliable and increased revisit times while providing a more flexible available system. As the Canadian Space agency states;

> For example, while the mission design initially focused on maritime security requirements, land security, particularly in the Artic, will be dramatically enhanced. The system offers up to four passes per day in Canada's north, and several passes per day over the Northwest passage.[47]

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[45] Danny Garret-Rempel, "Will Justas Prevail? Procuring a UAS Capability for Canada." Air Force Journal. Vol 4, No.1(Winter 2015): 25.

[46] Canada Space Agency. "RADARSAT Constellation." Last accessed 20 April 2016. http://www.asc-csa.gc.ca/eng/satellites/radarsat/description.asp

[47] Ibid.

The counter to this capability returns to the fact that although the revisit and relook capability will be dramatically increased, the lacking metric will be that of persistence. By their very nature, no matter how many satellites there are, they are constantly following their orbital flightpath. Their constant movement away from the TOI means that they cannot persist in the area. This is where the umbrella system would support and replace this missing metric. The fact remains that RADARSAT Constellation will need to be within the integrated Canadian ISR system and not a standalone capability.

THE PIECE TO THE PUZZLE FOUND?

Canada has many tasks when it comes to maintaining maritime domain awareness and security. But there is really one goal, as Capt(N) Peter Nevis states in Surveillance and Canadian Maritime Domestic Security, " Our goal in maritime security is to know what is happening and where it is happening in the maritime approaches so we can deal with a potential asymmetric threat instead of reacting to the consequences of a disaster."[48] As this paper has shown with the size of the Canadian AOR there are substantial gaps in our ISR coverage with the assets we currently employ. After measuring each of Canada's capabilities against ISR metrics it is obvious that no one asset can accomplish maritime domain awareness in isolation. Threats such as illegal smuggling, asymmetric terrorism, drug importation, challenges to our sovereignty, pollution, overfishing and development in the Artic will only continue into the future. The only way to protect against these threats is to form an integrated umbrella ISR system that takes advantage of the capabilities of multiple systems thereby allowing the weaknesses of others to be ignored. This idea is supported by Capt Levon Bond, an air force intelligence officer that has

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[48] Avis, Peter. "Surveillance and Canadian Maritime Domestic Security." Last accessed 21 April 2016. http://www.journal.forces.gc.ca/vo4/no1/policy-police-eng.asp

served in the ISR Division at 1 CAD HQ and has numerous tours on ISR related missions. The key to solving the solution of the Canadian ISR problem is a case for "employing layered and integrated ISR, utilizing different sensor capabilities offered by different platforms."[49] It is only through this layered umbrella approach that Canada can hope to ensure that its maritime security is maintained and that it continues towards information dominance. It is not clear on the actual timelines of JUSTAS and the RadarSat Constellation and at what time the Liberal government's defence review will be completed. It is, however, clear that Canada has a gap in its coverage with no ISR asset that satisfies the PAR[3] fusion metric. Until which time the government is able to procure such a capability, Canada needs to prioritize its ISR assets to ensure maximum effect by the limited assets it has to employ. Domestic security and sovereignty will have to be weighed against all competing priorities in order to ensure the domestic agencies have the tools required and that Canadian decision makers have decision superiority in the maritime domain. Failing in this will mean a failure of the national ISR objectives and a hole in the Canadian domestic umbrella.

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[49]Bond, Levon. "JUSTAS and Project Epsilon: Integrated Intelligence, Surveillance, and Reconnaissance of the Canadian Artic." Last accessed 04 April 2016 http://www.journal.forces.gc.ca/vo11/no4/24-bond-eng.asp

Bibliography

Books

Best, Richard. *CRS Report for Congress. Intelligence, Surveillance and Reconnaisance(ISR) Programs: Issues for Congress.* Washington: Library of Congress, 2005.

Blom, John David. *Unmanned Aerial Systems: A historical Perspective. Occasional Paper 37*. Kansas: Combat Studies Institute, 2010.

Canada. Department of National Defence..B-GA-400-000/FP-000. RCAF Doctrine Manual. Ottawa: DND Canada, 2012.

Canada. Department of National Defence..B-GA-402-000/FP-001. Canadian Forces Aerospace Sense Doctrine Manual. Ottawa: DND Canada, 2012.

Canada. Department of Defense. Air Symposium 2001. Intelligence, Surveillance and Reconnaissance. Toronto:Canadian Forces College, 2001.

Canada. Department of National Defence. Canadian Forces UAV Campaign Plan. Edition 1. Ottawa: DND Canada, 2007.

Chizek, J., J. Elsea, R. Best and C. Bolkcom. *Military Transformation. Current Issues in Intelligence, Surveillance and Reconnaissance.* New York: Novinka Books, 2003.

Danny Garret-Rempel, "Will Justas Prevail? Procuring a UAS Capability for Canada." Air Force Journal. Vol 4, No.1(Winter 2015)

Gauthier, Y., S. Bourdon, S, Dore and V. Fong. *Defining and Selecting Metrics for Intelligence, Surveillance, and Reconnaissance(ISR)*. Ottawa:DND Canada, 2004.

International ISR handbook. Edited bu Michael Puttre. London: Edefense., 2005.

Pardesi, Majeet Singh. "UAVs/UCAVs – Missions, Challenges, and Strategic Implications for Small and Medium Powers." Institute of Defence and Strategic Studies. No. 66 (May 2004)

United States. Department of Defense. Intelligence, Surveillance and Reconnaissance Operations. USAF Doctrine Document 2-9. Washington, D.C.: US Government Printing Office, 2007.

CFC Student Papers

Goldie, T. "JUSTAS Now: An Argument against the prevailing "Wait and See" Approach." JCSP Paper, Canadian Forces College, 2015.

Godefroy, J.D. "The Future of US/Canadian Cooperation in the Surveillance of North America." Master of Defence Studies Paper, Canadian Forces College, 2013.

Reimer, L. "Leading the Way with Eyes in the Sky: Why Canada should Contribute its CP-140 Auroras to United Nations PeaceKeeping." JCSP Paper, Canadian Forces College, 2014.

Lalonde, K. " Bridging the Gap – Small Manned ISR Platforms." JCSP Paper, Canadian Forces College, 2014.

Huddleston, I. "Canada First? Defence Strategy and the Future Aerospace ISR "System of Systems." Master of Defence Studies, Canadian Forces College, 2009.

Osmond, M.C. "Joint Surveillance Capabilites to Operationalize Canadian Sovereignty in the Artic." JCSP Paper, Canadian Forces College, 2014.

Leifso, T.M. "UAVS in Canada: The Need for a Strategic Implementation Plan and a Primary Department to Coordinate." Master of Defence Studies, Canadian Forces College, 2015.

Websites

Joint Publication 1-02, "Department of Defense Dictionary of Military and Associated Terms. 8 Nov 2010 as Amended through 15 Feb 2016." Last accessed 24 April 2016 http://www.dtic.mil/doctrine/new_pubs/jp1_02.pdf

Statitics Canada. "Land and freshwater area, by province and territory." Last accessed 11 April 2016. http://www.statcan.gc.ca/tables-tableaux/sum-som/l01/cst01/phys01-eng.htm

Hickey, Laurence. "Background brief – The Recognized Maritime Picture". Last accessed 19 April 2016. http://www.parl.gc.ca/Content/SEN/Committee/372/defe/witn/hickey2-e.htm

Nav Canada. "TP 1820 designated Airspace Handbook."pg 187, 192. Last accessed 23 April 2016. http://www.navcanada.ca/EN/productsandservices/Documents/DAH_Current_EN.pdf

Transport Canada. "Explanation of Terms." https://www.tc.gc.ca/eng/civilaviation/publications/tp1258e-terms-1347.htm

Transport Canada. "Marine Security Operations Centres." Last accessed 14 April 2016. https://www.tc.gc.ca/eng/marinesecurity/operations-269.html

Royal Canadian Air Force. "CP-140 Aurora." Last accessed 11 April 2016 http://www.rcaf-arc.forces.gc.ca/en/aircraft-current/cp-140.page

Skies Magazine. "Aviation is our passion." Last access 23 April 2016. http://skiesmag.com/features/article/16087-aurora-s-appeal.html.

Royal Canadian Air Force Association. "C4 ISR". Last accessed 06 April 2016. http://rcafassociation.ca/advocacy/position-papers/2013-2/012013-c4isr/

The Globe and Mail. "Military scrambled over foreign sub sighting." Last access 07 April 2016. http://www.theglobeandmail.com/news/national/military-scrambled-over-foreign-sub-sighting/article1150247/

CBC News. "$35M military plane upgrades highlight Canada.s procurement delays." Last accessed 14 April 2016. http://www.cbc.ca/news/politics/35m-military-plane-upgrades-highlight-canada-s-procurement-delays-1.2539886

Wings. "Keeping an Eye on Canada's Oceans." Last accessed 11 April 2016. https://www.wingsmagazine.com/operations/keeping-an-eye-on-canadas-oceans-4757

Canada Space Agency. "Radarsat2 » Last accessed 08 April 2016. http://www.asc-csa.gc.ca/eng/satellites/radarsat2/default.asp

Department of Defense. "Polar Epsilon." Last accessed 04 April 2016. http://www.forces.gc.ca/en/news/article.page?doc=polar-epsilon-project/hnps1uo5

Bond, Levon. "JUSTAS and Project Epsilon: Integrated Intelligence, Surveillance, and Reconnaissance of the Canadian Artic." Last accessed 04 April 2016 http://www.journal.forces.gc.ca/vo11/no4/24-bond-eng.asp

Transport Canada. "Spill Prevention: National Aerial Surveillance Program." Last accessed 07 April 2016. http://www.tc.gc.ca/eng/marinesafety/oep-ers-nasp-2195.htm

Wikipedia. "Automatic Identification System." Last accessed 26 April 2016. https://en.wikipedia.org/wiki/Automatic_Identification_System

CBC News. "Vance Speaking to a Senate Committee." Last accessed 23 April 20116. http://www.cbc.ca/news/politics/vance-canada-armed-drones-1.3480278

Royal Canadian Air Force. "Will JUSTAS Prevail? Procuring a UAS capability for Canada." Last accessed 20 April 2016. http://www.rcaf-arc.forces.gc.ca/en/cf-aerospace-warfare-centre/elibrary/journal/2015-vol4-iss1-05-will-justas-prevail.page

Canada Space Agency. "RADARSAT Constellation." Last accessed 20 April 2016. http://www.asc-csa.gc.ca/eng/satellites/radarsat/description.asp

Canadian Naval Review. Last accessed 24 April 2016. http://www.navalreview.ca/2015/07/changing-with-the-times-the-evolution-of-canadas-cp-140-aurora/

Royal Canadian Air Force."CP140 Technical Specifications." Last accessed 15 April 2016. http://www.rcaf-arc.forces.gc.ca/en/aircraft-current/cp-140.page

Avis, Peter. "Surveillance and Canadian Maritime Domestic Security." Last accessed 21 April 2016. http://www.journal.forces.gc.ca/vo4/no1/policy-police-eng.asp

Thatcher, Chris. "Vanguard online." Last accessed 27 April 2016. http://www.vanguardcanada.com/2013/02/01/justas-seeking-right-solution/

Liberal government. "Real change" Last accessed 05 May 2016. https://www.liberal.ca/files/2015/09/A-new-plan-to-strengthen-the-economy-and-create-jobs-with-navy-investment.pdf

Sandia National Laboratories, "What is Synthetic Aperture Radar?" Last accessed 24 April 2016, http://www.sandia.gov/radar/what_is_sar/index.html

Wikipedia. "Bombardier Dash 8." Last accessed 26 April 2016. https://en.wikipedia.org/wiki/Bombardier_Dash_8

Wikipedia. "Beechcraft King Air 200 Range." Last Accessed 02 May 2016, https://en.wikipedia.org/wiki/Beechcraft_Super_King_Air