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Canada First?

Defence Strategy and the Future Aerospace ISR 'System of Systems'

MDS

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Abstract

The development of an effective Intelligence, Surveillance and Reconnaissance (ISR) 'system of systems' is of critical importance for Canada. Recent and perceived security threats, combined with Canada's economic interests, bilateral responsibilities and international relationships make current weaknesses in surveillance capabilities unacceptable. These weaknesses have been apparent since at least the late 1960s and have only become more so with time, despite successive governments claiming that improving the situation was one of their priorities. This paper examines current and historic security policy with a particular focus on the maritime domain. Canada's maritime surveillance requirements are outlined and the effect of Arctic, ASW, and deployed operations considered. The resulting surveillance capability gap is then compared against current and planned surveillance capabilities. The paper concludes by identifying the three key weaknesses of the future ISR 'system of systems' and suggests a number of ways in which these can be mitigated. The final conclusion, however, is that the group of four ISR projects that form the core of the proposed system will not meet Canada's surveillance requirements as they are currently conceived and funded.

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Chapter 1 - Introduction

The development of an effective Intelligence, Surveillance and Reconnaissance (ISR) 'system of systems' is of critical importance for Canada. Recent and perceived security threats, combined with Canada's economic interests, bilateral responsibilities and international relationships make current weaknesses in surveillance capabilities unacceptable. These weaknesses have been apparent since at least the late 1960s and have only become more so with time, despite successive governments claiming that improving the situation was one of their priorities. Recent efforts by the Martin and Harper governments have taken steps to address this problem but much remains to be done.

The 2008 *Canada First* Defence Strategy (CFDS) states that "first and foremost, the Canadian Forces must ensure the security of our citizens and help exercise Canada's sovereignty."[1] The fact that Canada's security has both a domestic and an international component is also recognized in the second and third priorities. "The CF must be able to deliver excellence at home, be a strong and reliable partner in the defence of North America, and project leadership abroad by making meaningful contributions to international security."[2] Surveillance capabilities are inextricably linked to these mandates. Sovereignty is exercised by knowing what is going on in a given area and by having the ability to affect or control an event. The interrelationship between national sovereignty, national security and national defence has been reinforced in the post-9/11 era and the foundational nature of surveillance efforts reinforced. "Only by knowing

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[1] Department of National Defence, *Canada First Defence Strategy* [Archived document on-line]; available from http://www.forces.gc.ca/site/focus/first-premier/June18_0910_CFDS_english_low-res.pdf; Internet; accessed 23 April 2009, 7.

[2] *Ibid.*, 3.

what is happening and where, can a state respond to and formulate strategies to address security issues."[3]

1.1. Threats

Security threats are becoming increasingly asymmetric in nature, with non-state actors adding another level of complexity to an already complex world. Canada faces threats ranging from the smuggling of illicit drugs and people into the country to illegal fishing and other environmental issues. The threat of biological and chemical agents arriving by ship is very real, and the periodic sightings of unidentified submarines operating in the Arctic place Canada's sovereignty in question. Canada's international commitments can help to combat the apparent sources of these threats, but a lack of resources at home is leaving gaps in surveillance and control capabilities that can be easily exploited.

Illicit drug smuggling is a continuing security problem for Canada, despite a number of recent successes in drug interdiction efforts. In April 2006, HMCS Fredericton spearheaded a Royal Canadian Mounted Police (RCMP) counter-drug operation off the coast of Africa that intercepted 23 tons of hashish bound for Canada. In September of the same year, an operation conducted by the CF, RCMP and the Canadian Coast Guard (CCG), captured 751 kilograms of cannabis resin, two boats and 12 suspects off the eastern shore of Nova Scotia.[4] In the Caribbean and Eastern Pacific, the CF has participated in multi-national drug interdiction operations for a number of years. As part

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[3] Glen J. Herbert and Fred W. Crickard, eds, *Canada's Three Oceans: Strategies for Maritime Enforcement* (Halifax, Nova Scotia: Centre for Foreign Policy Studies, Dalhousie University, 1998), 54.

[4] Oliver Moore, "Navy's 'Stalker of the Seas' Nabs Drug Boat," *The Globe and Mail*, 22 September 2008 [Article on-line]; available from http://forums.army.ca/forums/index.php?topic=80016.0; Internet; accessed 23 April 2009.

of this effort, a CP-140 *Aurora* played a central role in the seizure of $242M worth of cocaine off Panama, an event which included the capture of a self-propelled semi-submersible (SPSS). Worryingly, it is estimated that 32% of the drugs originating in South America are now carried in such vessels, each with the capacity to carry as much as 12 metric tonnes of cocaine.[5] The SPSS are far more difficult to detect than traditional 'go-fasts' but do not have good sea-keeping characteristics. As a result, it is not likely that one will appear off Canadian shores in the near future, but the motivation to improve the vessels beyond their current capabilities is certainly there. Each is as capable of transporting weapons and terrorists as it is drugs.

Also in 2006, two separate incidents highlighted the Arctic as an avenue for illegal entry into Canada. In September 2006, a Romanian man was apprehended after voyaging 1000 kilometres undetected from Greenland to Grise Fjord in a six-metre fiberglass boat.[6] Fortunately, the local inhabitants considered this unusual enough to inform the appropriate authorities. The unannounced arrival in August 2007 of the *Berserk II*, a Norwegian adventurer's sailboat, in Gjoa Haven, Northwest Territories, was not an attempt at illegal entry but rather a historic reenactment. Interestingly, this was only one of five small vessels reportedly operating in the Northwest Passage in 2007, none of which was tracked by Canadian authorities.[7] The August 2008 sighting of a submarine

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[5] Cindy Chan, "Canadian Forces Aid Southern Drug Busts," *Epoch Times Staff*, 4 March 2009 [Article on-line]; available from http://www.theepochtimes.com/n2/content/view/13109/; Internet; accessed 23 April 2009.

[6] "Romanian who boated to High Arctic," Unattributed, *CBC News*, 15 November 2006 [Article on-line]; available from http://www.cbc.ca/canada/north/story/2006/11/14/grise-romanian.html; Internet; accessed 23 April 2009.

[7] Sara Minogue, "Rites of Passage Thwart Northern Adventurers," *The Globe and Mail*, 8 September 2007 [Article on-line]; available from http://www.saraminogue.com/stories/rites.html; Internet; accessed 23 April 2009.

operating in Lancaster Sound[8] is not as unusual as one might first assume, and represents a somewhat more significant challenge to Canada's surveillance infrastructure. These incidents indicate a lack of control on the part of Canadian authorities. When combined with conflicting sovereignty claims, recent posturing by the Russian Federation, and increasing commercial activity in the North, this becomes of even greater concern.

The incident of the 'Anthrax' ship in 2003, the *Wadi Alarab*, which thankfully turned out to be a false alarm, underlined fears that weapons of mass destruction could be transported into our country via the sea.[9] Smaller, expendable merchant vessels are available relatively cheaply on the world market and could easily be used to attempt a breach of Canada's defences.[10] The increase in container transshipment through projects like the Asia-Pacific Gateway and Corridor Initiative will provide criminal and terrorist elements with another maritime avenue of approach to North American targets. A single container ship can carry up to 13,800 individual twenty-foot equivalent units (TEU), the standard unit of measure for sea containers.[11] On any given day, there are as many as 1700 ships in Canada's Area of Responsibility (AOR), many of which remain unidentified due to a lack of surveillance assets.[12]

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[8] Steven Chase, "Military Scrambled Over Foreign Sub Sighting," *The Globe and Mail*, 20 March 2009 [Article on-line]; available from http://blog.marport.com/2009/03/23/military-scrambled-over-foreign-sub-sighting/; Internet accessed 23 April 2009.

[9] "Anthrax ruled out in death of Egyptian sailor," Unattributed, *CTV News*, 30 April 2003 [Article on-line]; available from http://www.ctv.ca/servlet/ArticleNews/story/CTVNews/1051632607624_94/?hub=Canada; Internet; accessed 24 April 2009.

[10] Standing Senate Committee on National Security and Defence, *Canada's Coastlines: The Longest Under-Defended Borders in the World, Volume 1* (Ottawa: Senate of Canada, October 2003), 50.

[11] Ships and Yacht Information, "Emma Maersk," http://www.ships-info.info/mer-emma-maersk.htm; Internet; accessed 23 April 2009.

[12] Captain(N) Peter Avis, "Surveillance and Canadian Maritime Domestic Security," *Canadian Military Journal*, Vol. 4, no. 1 (Spring 2003): 9.

Future threats to the environment are also significant. As many as 300,000 seabirds are killed annually off the shores of Newfoundland by a combination of intentional and accidental oil pollution from merchant shipping transiting Canadian waters.[13] The increase in merchant traffic to British Columbian ports and the opening of the Arctic to commercial operations will spread this problem around the country. In December 2008 the Government introduced a bill amending the federal Arctic Waters Pollution Prevention Act, extending federal jurisdiction from 100 to 200 nautical miles.[14] Unfortunately Canada's ability to enforce this legislation is small, with Transport Canada (TC) operating only four aircraft tasked with pollution surveillance, none of which is assigned regularly to the Arctic.[15] This force will be looked at more closely later in this paper. The CCG is responsible for fisheries protection and has a long-term contract with Provincial Aerospace Ltd. (PAL) of Newfoundland for aerial surveillance. This contract involves three aircraft flying some 5200 patrol hours annually.[16]

Canada's engagement internationally is focused on the perceived sources of the asymmetric threats, with the goal of "project[ing] leadership abroad by making meaningful contributions to international security."[17] While the mission in Afghanistan holds much of the media spotlight, Canadian efforts on other United Nations missions are also significant. Naval support for the World Food Programme is one such contribution.

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[13] Hinterland Who's Who – Oil Pollution and Birds, "Why do spills happen?," http://www.hww.ca/hww2.asp?id=229&cid=4; Internet; accessed 23 April 2009.

[14] Transport Canada, "Canada moves to further protect its sovereignty and safeguard Arctic waters from pollution," http://www.tc.gc.ca/mediaroom/releases/nat/2009/09-h023e.htm; Internet; accessed 24 April 2009.

[15] Transport Canada, "National Aerial Surveillance Program – May 2006," http://www.tc.gc.ca/mediaroom/backgrounders/b04-m126e.htm; Internet; accessed 23 April 2009.

[16] Transport Canada, *National Maritime Domain Awareness (MDA) Strategy Framework 2020* (Ottawa: Transport Canada, 31 March 2009), 39.

[17] DND, *Canada First* …, 3.

International engagement includes the sharing of intelligence information with other nations, particularly as it relates to the movement of ships, passengers and cargo, and developing threats to Canada. The integration and use of this intelligence is one of the main challenges facing the various government departments responsible for the security of the country.

1.2. Priorities

The transit of the American Steam Ship (SS) *Manhattan* through the Northwest Passage in 1969 incited the Trudeau government to a flurry of activity. Though the tanker was actually escorted through the passage by a Canadian icebreaker, the American view that the Passage was an international waterway opened a debate on national sovereignty. This debate, when combined with Trudeau's wish to withdraw Canada from its commitments to the North Atlantic Treaty Organization (NATO), produced the 1971 White Paper on Defence, *Defence in the 70's.* New priorities were established for Canada's armed forces, placing the surveillance of our own territory and coastlines ahead of the more traditional focus on collective defence.[18] Shortly after the release of this document the Prime Minister reconsidered his desire, in an effort to appease unhappy allies, and invested in equipment destined for Europe.[19] On the whole, the stated change in policy had had little impact on the ability of the CF to conduct surveillance missions; in fact, it actually declined as the number of surveillance aircraft was reduced.[20] When faced with the need to replace Canada's force of 32 CP-107 *Argus* long-range patrol

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[18] Department of National Defence, *Defence in the 70's - The 1971 White Paper* (Ottawa: Information Canada, 1971), 8.

[19] Edna Keebles, "Rethinking the 1971 White paper and Trudeau's impact on Canadian defense policy," *American Review of Canadian Studies* (Winter 1997): 554-560.

[20] Martin Shadwick, "Aurora Renaissance," *Canadian Military Journal,* Vol. 8, no. 4 (Winter 2007-2008): 102-103.

aircraft (LRPA), the Department of National Defence (DND) calculated that 20-30 modern aircraft were required.[21] Fiscal considerations eventually limited this purchase to only 18 CP-140 *Aurora*. These reductions and those made to the fleet of CP-121 *Tracker* coastal-patrol aircraft are shown graphically in figure 1. The resulting lack of airframes led to a higher than normal utilization rate, particularly in the case of the *Aurora*, which, in turn, has resulted in the structural issues confronting the fleet today.[22]

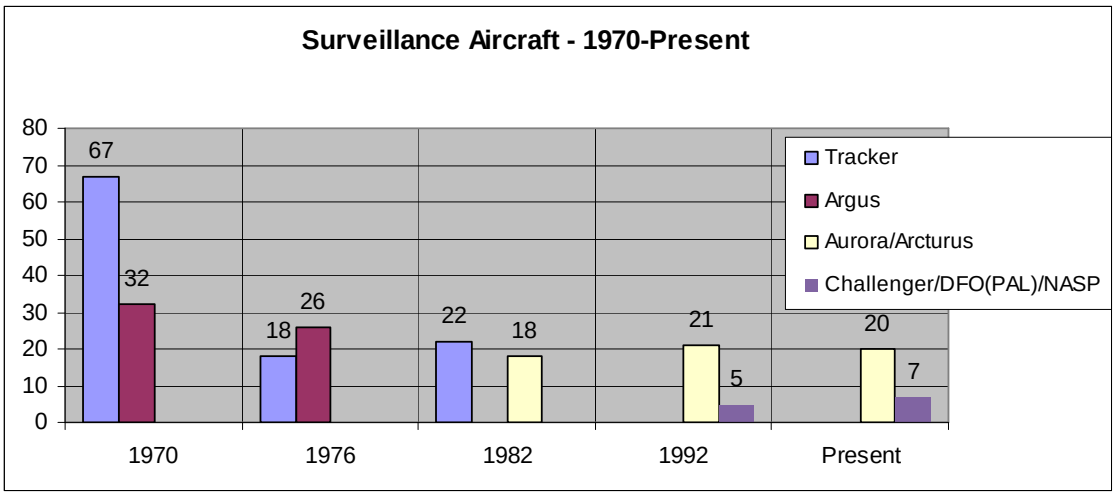

Figure 1 – Surveillance Aircraft – 1970 - Present

In 1985 a second unauthorized northern transit by an American ship, the US Coast Guard Cutter (USCGC) *Polar Sea*, rekindled the Arctic debate.[23] In 1987, the Mulroney government issued a White Paper entitled *Challenge and Commitment*. This document promised a revitalized CF, in particular detailing the creation of a 'three ocean navy'

[21] Martin Shadwick, *Who's Watching the Oceans?* (Toronto, Ontario: York University Centre for International and Strategic Studies, December 1989), 5.

[22] Shadwick, "Aurora Renaissance,", 102.

[23] Adam Lajeunesse, "Sovereignty, Security, and the Canadian Nuclear Submarine Program," *Canadian Military Journal*, Vol. 8, no. 4 (Winter 2007-2008): 76.

based on a force of 10 to 12 nuclear-powered attack submarines (SSN).[24] This far-reaching plan soon fell victim to a poorly informed electorate, with various interest groups effectively using the nuclear powered aspect of these submarines to sink them. Also, the Government was facing a recession at the time and had inherited a $38B deficit. Mulroney chose not to deal with this problem directly, opting instead to reduce the operational budgets of departments such as Transport and Defence.[25] The political will to back large capital projects for Defence fell with the Berlin Wall and the 1987 White Paper was effectively neutered two years after it was written.[26] Not only were the submarines cancelled but a proposal to purchase at least six additional *Auroras* and modernize the *Trackers* also fell victim to the peace dividend. [27] Again, the gap in surveillance capabilities was not addressed in spite of the shortfalls that had been identified in the development of the 1987 White Paper.

This pattern in Government policy actually worsened through the 90s, with the Chretien government's promises and high-sounding ideals matched by program cancellations, budget cutbacks and a high operational tempo.[28] A series of prolonged and costly international deployments in support of the United Nations and NATO dominated this period and, within a very restricted budget, domestic security took a back seat to

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[24] Department of National Defence, *Challenge and Commitment – The 1987 White Paper* [Archived document on-line]; available from http://www.forces.gc.ca/admpol/newsite/downloads/Challenge%20and%20Commitment%201987.pdf; Internet; accessed 23 April 2009, 52-53.

[25] The Hon. Michael Wilson, "The Budget." *The Empire Club of Canada Speeches 1989-1990* (Toronto, Canada: The Empire Club Foundation, 1990), 3.

[26] Lajeunesse, "Sovereignty, Security, …", 81.

[27] Shadwick, "Aurora Renaissance,", 103.

[28] Martin Shadwick, "Commentary - The Chretien Legacy," *Canadian Military Journal*, Vol. 4, no. 4 (Winter 2003): 68-69.

deployed operations. Only recently has the CF seen any real change in this dynamic. The events of 9/11 have refocused some of Canada's attention to continental concerns and money has been invested in both transportation and border security. The CF has also received additional funding and has been able to increase operational readiness across the force. However, the majority of recent capital purchases continue to be made to meet urgent shortfalls identified on deployed operations, with improvements to domestic surveillance capabilities coming only in 2014.

1.3. Canada First?

Canada's geographic significance from an American point of view has changed dramatically since the fall of the Twin Towers. Suddenly, the security of the Canadian perimeter really matters again and, without it, Canada faces restrictions along the 'longest undefended border' and the emasculation of its economy. Rather than governments simply promising security improvements, they actually need to do something about it. Both the Martin and Harper governments have acknowledged this fact in turn, and a number of policy documents have been produced over the last five years, the most recent being the CFDS. The CFDS promises significant real growth in the Defence budget over time, coupled with a 20-year procurement plan amounting to some $60B and a commitment to fund operational deployments separately from the main budget.[29] Unlike the preceding White Papers on Defence, it is a document that has already passed in principle through the Cabinet and the Treasury Board approval processes. This will help streamline the procurement process for the capital projects introduced as part of the Defence Strategy. The CFDS also commits DND to accrual accounting, which spreads

[29] Brian MacDonald, "The Canada First Defence Strategy of 2008 and the 20 Year Defence Budget," *The Conference of Defence Associations - CDA Commentary 4-2008*, 28 July 2008, 2.

the total cost of a capital project over its lifetime.[30] The positive aspect of this is that more projects can be initiated at the same time within the capital procurement budget, allowing the CF to be reconstituted more rapidly. A concern is that choices made now will dominate Defence spending for many years, with less room available to adjust the strategy to address unforeseen requirements. This is the 'longer-term' nature of the document as compared to its predecessors. The problem is that, even with this massive injection of money and political support, Canada will still be left with domestic surveillance capability gaps.

The CF already had three major procurement projects aimed at addressing this gap and the CFDS introduced one more. The Canadian Multi-Mission Aircraft (CMA) project promises a fleet of 10-12 aircraft to replace Canada's current CP-140 *Aurora*. "The new aircraft will become part of a surveillance 'system of systems' that will also comprise sensors, unmanned aerial vehicles and satellites and keep Canada's maritime approaches safe and secure, including in the Arctic."[31] CMA joins Polar Epsilon, the Joint Unmanned Surveillance Target Acquisition System (JUSTAS), and the Maritime Helicopter Project (MHP) as Canada's future aerospace ISR 'system of systems'. There are other projects that will contribute to this system but these four projects will form its core capability. This paper will demonstrate that these four projects, as envisioned and funded, will fall short of meeting Canada's surveillance requirements and it will identify potential solutions to this problem.

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[30] *Ibid.*, 3-4

[31] DND, *Canada First …*, 17.

This paper is divided into six chapters, this Introduction being the first. The second chapter expands on what is meant by the term ‘surveillance and control’. The concept of Maritime Domain Awareness is introduced, as are recent pertinent changes to CF Command and Control (C2) structure. Chapter 3 demonstrates that current Government policies support the development of a robust ISR ‘system of systems’. Five recent security policy documents are examined and, through specific examples, the overall effect on surveillance capabilities over time is assessed. The fourth chapter turns to recent studies on Canada’s surveillance requirements in order to define, in rather general terms, what a CF ISR ‘system of systems’ would be expected to accomplish. For reasons that will be explained, this investigation will focus mainly on the maritime domain but will include consideration of both Arctic and deployed operations. The fifth chapter details current CF surveillance capabilities and a number of new technologies that will help address the capability gap. The four procurement projects mentioned above will then be summarized and potential issues identified. Lastly, this paper will conclude by identifying the specific weakness of the proposed ISR ‘system of systems’ and recommend a number of measures at improving the situation.

Chapter 2 - Surveillance and Control

DND is not the lead federal department for national security, but its responsibilities for national defence engender capabilities that form one of the pillars of the national security framework.[32] Domestically, this pillar is given substance by the degree to which the CF is able to conduct surveillance and exercise control over Canada's territory. Improving this ability is the ultimate goal of the future ISR 'system of systems'. This system will enable the CF to develop the level of awareness required to meet the first priority of the CFDS, namely that the CF must secure Canada and Canadians first. It will also address the second, that of being a "strong and reliable partner in the defence of North America."[33] This effort has two distinct but interrelated parts. The first is the ability to plan and conduct effective surveillance across the entire AOR; the second is the ability to integrate and disseminate the resulting information to allow decision makers to apply the appropriate measures of control.

The domestic AOR can be subdivided into three distinct domains: the maritime, the aerospace and the land domain. DND's mandate concentrates its surveillance capabilities on the maritime and aerospace domains and, in fact, they may not be brought to bear on the land domain except in support of other government departments or in response to a request from a provincial attorney general.[34] Surveillance of the aerospace domain is addressed by the bilateral North American Aerospace Defence (NORAD) Agreement, which involves a shared responsibility for a substantial network of airborne

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[32] Privy Council Office, *Securing an Open Society - Canada's National Security Policy* (Ottawa: Privy Council Office, 2004), 38.

[33] DND, *Canada First* …, 3.

[34] Department of Justice, *National Defence Act* [Archived document on-line]; available from http://laws.justice.gc.ca/en/N-5/index.html; Internet; accessed 24 April 2009, art 277.

and surface-based assets. While NORAD has recently gained a maritime warning responsibility, surveillance of the maritime domain remains a national responsibility. The maritime warning role has not yet been fully defined but its focus will be on the integration and dissemination of maritime intelligence and information, not collection.[35] This expansion of NORAD's responsibilities highlights rather than diminishes Canada's weaknesses, particularly where the Arctic is concerned. This is true for a number of reasons, one of which is the nature of the maritime surveillance task, which is more complicated and platform intensive than its aerospace equivalent. Another is the lack of an established static maritime surveillance network to supplement the scarce mobile platforms.

2.1 - Maritime Domain Awareness

An Interdepartmental Marine Security Working Group (IMSWG) was established shortly after 9/11 to address the weaknesses identified in Canada's maritime security framework. This group is chaired by TC and is meant to coordinate the efforts of 17 departments and agencies aimed at improving maritime security. The IMSWG identified "that the foundation of a marine security plan is domain awareness."[36] It also identified the need for closer collaboration between government departments and the sharing of information with international partners. Unfortunately this working group uses a consensus approach in its deliberations, which has delayed the creation of a national plan

[35] Canada Treaty Information, "E105060- Agreement Between The Government of Canada and the Government of the United States of America on the North American Aerospace Defense Command," http://www.treaty-accord.gc.ca/ViewTreaty.asp?Treaty_ID=105060&bPrint=True&Language=0; Internet; accessed on 23 April 2009.

[36] Avis, "Surveillance …", 11.

for developing maritime domain awareness to be agreed upon.[37] On 31 March 2009, TC published the National Maritime Domain Awareness (MDA) Strategy Framework 2020. The purpose of this document is to act as a "stepping-stone to facilitate policy development towards a formal National MDA Strategy for Canada,"[38] but there is no indication that a timeline has been imposed. While the members of the IMSWG have all initiated projects that will contribute to improving MDA, their efforts remain hampered by this lack of an overarching strategy.

The CF definition of 'Maritime Domain Awareness' is "the effective understanding of anything that could threaten Canada's security, and that pertains to the marine domain."[39] Though somewhat simpler than that in the MDAF it captures the essence of the term. A National Surveillance Working Group (NSWG) was established within DND in May 2006 to study the entire range of CF surveillance requirements. "The primary aim of the NSWG [is] to develop and articulate the CF national surveillance capability goals, and recommend a way ahead to ensure that the appropriate surveillance capabilities [are] developed."[40] One of the first products of the NSWG was the *National Surveillance Study 2008* (NSS 08), a classified document that focuses on Canadian maritime, aerospace and Arctic surveillance requirements. A number of references will be made to some of the unclassified portions of this study in the following discussion.

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[37] Office of the Auditor General of Canada, "Chapter 1 – National Security: Intelligence and Information Sharing," *2009 Status Report of the Auditor General of Canada of the House of Commons* (Ottawa: Minister of Public Works and Government Services Canada, 2009), 17-20.

[38] TC, *National Maritime Domain Awareness* …, 43.

[39] Department of National Defence, *National Surveillance Study 2008* (Ottawa: Department of National Defence, 7 January 2009), 22-23(U).

[40] *Ibid.*, iii(U).

In order to establish MDA there is a requirement to perform three basic functions, namely surveillance, patrol and response.[41] The surveillance function "involves the maintenance of an observation infrastructure capable of detecting and notifying authorities of conditions, activities or events of interest."[42] This implies persistence greater then that which is possible with Canada's current airborne sensors and lends itself to the development of a broad area sensor system, combining the virtues of various platforms to achieve the required coverage. The patrol function involves a more focused surveillance effort aimed at specific areas of interest. Patrols can be "carried out to demonstrate 'presence' … and are likely to be tied to areas in dispute, choke points, or seasonal [activities] such as fishing."[43] The response function addresses the need to control an event, and involves taking action to address threats to national security and enforce regulations within Canada's AOR.[44] It also implies the ability to react to a given situation in a timely manner with a range of capabilities, including an armed response.

Understanding these three functions is useful when assessing a given system's contribution to domain awareness. The *Aurora* is a very capable patrol and response asset, but its ability to perform the surveillance function is limited by the distance to the area of interest from its operating base and its maximum endurance. Traditionally these limitations have been overcome by establishing an orbit over an area of interest, which is then patrolled by a number of aircraft in turn. Satellites can and Unmanned Aerial Vehicles (UAV) may provide a more efficient response to this challenge.

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[41] John Orr, "New Era or False Dawn? AIMP Aurora and the Canada First Defence Strategy," *Canadian Naval Review*, Vol. 3, no. 2 (Summer 2007): 8.

[42] Herbert and Crickard, eds, *Canada's Three Oceans* …, 58.

[43] Orr, "New Era or False Dawn? …", 9.

[44] *Ibid.*, 9.

2.2 – Command and Control

DND has also made efforts to improve the CF's C2 system through the creation in 2006 of Canada Command and its regional Joint Task Forces (JTF). One of the purposes of Canada Command is to provide a focal point for civil authorities seeking the support of the CF. Another is to improve overall domain awareness through the sharing of information between the CF and other government departments involved in security operations.[45] In 2004, the Auditor General's Report on National Security found that:

> departments and agencies were not sharing intelligence information because of concern with violating provisions of the *Privacy Act* or the *Charter of Rights and Freedoms*, whether this concern was valid or not. While the Act appeared to accommodate sharing of information for national security reasons, departments and agencies could not support their interpretation of the law for not sharing information.[46]

Unfortunately, the 2009 Status Report indicates that there has been "little progress on balancing privacy concerns with information sharing."[47] Regionally, the CF made steps to address these issues through the Maritime Security Operation Centre (MSOC) project. Five key partners, namely TC, the RCMP, the Canada Border Service Agency (CBSA), the CF, and the CCG have been brought together at two coastal MSOCs located in Esquimalt and Halifax. These double as the C2 nodes for the CF's Joint Task Force Atlantic (JTFA) and Pacific (JTFP), and are intended to improve inter-agency coordination and effectiveness. A third MSOC, for the Great Lakes and St. Lawrence Seaway, was established in Niagara and is run primarily by the RCMP.[48] The ultimate goal of these operation centres is to establish maritime domain awareness sufficient to

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[45] This view of Canada Command roles and responsibilities was presented to JCSP 35 on 23 April 2009 by J5 Canada Command in Toronto, ON.

[46] Auditor General of Canada, "Chapter 1 – National Security …", 16.

[47] *Ibid.*, 16.

[48] TC, *National Maritime Domain Awareness …*, 43.

produce the maritime portion of a governmental Common Operating Picture (COP).[49] This effort has been hampered by a lukewarm commitment on the part of some of the departments involved. Budgetary pressures and technical issues are claimed as the main obstacles but Commodore (ret'd) Eric Lehre, an experienced operational naval commander, writes that the real issue is a lack of centralized governmental leadership and direction.[50]

2.3 Summary

Weaknesses in CF surveillance and control capabilities are most apparent in the maritime domain. The concept of domain awareness is important to the study of these weaknesses. While DND is working to improve its ability to generate and maintain MDA, it is hampered by a lack clear governmental direction. This has resulted in a consensus approach at an interdepartmental level to a problem that is already challenging enough. It is not obvious why achieving this level of clarity is so difficult, particularly as deficiencies in MDA were identified early in the mandate of the IMSWG. Nevertheless, DND has moved forward with its efforts to identify national surveillance requirements and to improve the integration of relevant information at the regional level. The ability to integrate and disseminate information in order to produce a Common Operating Picture is the near-term goal of these efforts. Enabling decision makers to apply the appropriate measures of control is the ultimate goal.

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[49] TC, *National Maritime Domain Awareness …*, 3.

[50] Cmdre(ret'd) Eric Lehre, *Connecting the Dots and the Canadian Counter-terrorism Effort - Steady Progress or Technical, Bureaucratic, Legal and Political Failure?* (Calgary: Canadian Defence & Foreign Affairs Institute, March, 2009), 12-13.

Chapter 3 - Canadian National Security Policies

> There can be no greater role, no more important obligation for a government, than the protection and safety of its citizens.[51]

An effective surveillance network is a pre-condition for national security. Without knowledge of an incident or potential threat the Government loses the ability to control and manage the event to the benefit of Canadians. Government policies have shaped the national security framework into its current form and it is worthwhile examining selected documents and decisions to see their effect. This will provide a better understanding of how Canada arrived at its present state of weakness in surveillance capabilities. While specific policies have differed, Canadian defence and security priorities have been surprisingly consistent over the last forty years. The same cannot be said of funding or political will, particularly if there were no near term political gain associated with a given decision. According to Martin Shadwick, a regular commentator on sovereignty issues, decisions related to surveillance capabilities have:

> …been characterized by a monotonous proclivity for indecisiveness, ill-considered qualitative and/or quantitative reductions, false starts, false economies, and ill-conceived business plans.[52]

A number of capital projects have suffered over the years from this phenomenon. A striking example of this tendency is the already mentioned Canadian SSN project. It is more than a little ironic that the last submarine would have been delivered to the CF this year at a time when, once again, Canadian politicians are focusing on Arctic sovereignty and Canada's lack of Arctic capabilities.[53] In the past two federal governments,

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[51] Privy Council Office, *Securing an Open Society* …, vii.

[52] Shadwick, "Aurora Renaissance,", 102.

[53] William J. Yost, ed., *In Defence of Canada's Oceans* (Pembroke, Ontario: DFR Printing, 1988), 5.

Canadians have seen a strengthening resolve where national security is concerned but the surveillance capability gaps have yet to be adequately addressed.

Two historic policy documents, *Defence in the 70's* and *Challenge and Commitment,* have already been briefly examined but are worth investigating further, as they provide useful context for the present debate. A number of more recent documents will then be considered and, finally, the *Canada First* Defence Strategy will be reviewed. While there are many documents that could be added to this policy discussion, the following selections provide a sufficient picture of both the historic trend and current policy. This study will focus on Government policies concerning the maritime domain and associated Arctic policies, as it is here where Canada's weaknesses in surveillance capabilities are most evident. The Defence priorities that each document introduced and any specific effect on surveillance capabilities, particularly those associated with aerospace systems, will be examined. Policy that addresses CF surveillance requirements for deployed operations, beyond those required for domestic purposes, will also be examined. This focus on the maritime and deployed domains matches that of the four aerospace ISR projects introduced earlier in this paper.

3.1 - Defence in the 70's

The 1971 White Paper on Defence, *Defence in the 70's*, established new priorities for Canada's armed forces. These were:

- the surveillance of our own territory and coastlines--i.e., the protection of our sovereignty;
- the defence of North America in cooperation with United States forces;
- the fulfillment of such NATO commitments as may be agreed upon; and

- the performance of such international peace-keeping roles as we may, from time to time, assume.[54]

This represented a significant change given that, to that point, Canada's foreign and defence policies had been focused primarily on the United Nations and NATO, with a large Canadian force based in Europe. Trudeau halved this commitment in 1969 when he entered office, from 10,000 to 5,000 personnel and from six to three fighter squadrons.[55] This was a compromise between his desire for a complete pullout and the advice of officials from both Foreign Affairs and Defence.[56] 1970 saw the decommissioning of Canada's single aircraft carrier, HMCS Bonaventure, which had only just gone through an extensive refit.[57] National requirements would take precedence over collective defence arrangements and this ship's main role was the defence of the North Atlantic. This attitude was reinforced by the voyage of the SS Manhattan, an event that caused many Canadians to question the close Canada-US security relationship. The *White Paper on Defence* published in 1964 had stated that it was "impossible to conceive of any significant external threat to Canada which is not also a threat to North America as a whole."[58] Few would have expected the most public challenge of Canadian sovereignty to come from our closest ally. The House of Commons Standing Committee on External Affairs and National Defence reacted strongly, arguing that it was time for Canada "to be prepared to incur reasonable expenditures for its own defence in order to maintain its

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[54] DND, *Defence in the 70's* …,16.

[55] 1 Air Division, "The Background behind 1 Air Division," http://www.marville.org/mabackground.html; Internet; accessed 24 April 2009.

[56] Keebles, "Rethinking the 1971 White paper …", 550.

[57] RN type Light Fleet Carriers, "HMCS Bonaventure (1967)," http://www.hazegray.org/navhist/canada/postwar/carriers/; Internet; accessed 24 April 2009.

[58] Department of National Defence, *White Paper on Defence – March 1964* (Ottawa: Queen's Printer Canada, 1964), 13.

independence and freedom of action as a nation."[59] It was also well known that both the Union of Soviet Socialist Republics (USSR) and the US conducted regular submarine operations in the Arctic. The USS Seadragon had conducted a submerged transit of the Northwest Passage as early as the summer of 1960.[60] These issues corresponded well with Trudeau's elevation of national sovereignty to the first priority of national defence.

In terms of specific maritime surveillance capabilities, *Defence in the 70's* stated that Canada had a "substantial capability for surveillance over Canada's waters in the temperate zone".[61] It also noted that only long-range aircraft could conduct surveillance over the Arctic. In 1971 Canada had 32 CP-107 *Argus* LRPA, considered an excellent Anti-Submarine Warfare (ASW) platform and capable of regular missions as long as twenty-six and a half hours long.[62] A fleet of 67 shorter range CP-121 *Tracker* supported the *Argus* in the coastal patrol and ASW mission.[63] Both fleets were subjected to a "comprehensive systems analysis of the alternatives [for their replacement]."[64] Fiscal considerations eventually dictated that only 18 CP-140 *Aurora* aircraft would be purchased to replace the elderly Argus.[65] A reduction in the number of *Trackers* also occurred, stabilizing at 22 aircraft by 1981.[66] The stated change in policy had little impact on the ability of the CF to conduct surveillance missions. In fact, it decreased as

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[59] Donat Pharand and Leonard H. Legault, *The Northwest Passage: Arctic Straits* (Dordrecht, The Netherlands: Martinus Nijhoff Publishers, 1984), 149.

[60] *Ibid.*, 147.

[61] DND, *Defence in the 70's* …,18.

[62] RCAF.com, "Canadair CP-107 Argus," http://www.rcaf.com/aircraft/patrol/argusmp/?name=CP-107%20Argus; Internet; accessed 24 April 2009.

[63] Shadwick, *Who's Watching* …, 5.

[64] DND, *Defence in the 70's* …,18.

[65] Shadwick, "Aurora Renaissance," …, 102.

[66] Shadwick, *Who's Watching* …, 10.

the force responsible was reduced. Despite the priorities set out in this White Paper commitments to NATO were maintained at the expense of domestic security, albeit at a much reduced level.[67]

3.2 - Challenge and Commitment

> The ability to exercise effective national sovereignty is the very essence of nationhood.[68]

Brian Mulroney summarizes his Government's defence policy in this introduction, stating that the 1987 White Paper "takes as its first priority the protection and furtherance of Canada's sovereignty as a nation."[69] The policy identified the existence of a significant "commitment-capability gap"[70] and promised a reduction in overall commitments combined with stable funding over a fifteen-year period in order to address this issue.[71] *Challenge and Commitment* promised a revitalized CF, in particular detailing the creation of a 'three ocean navy' based on a force of 10 to 12 SSNs.[72] It also mandated the purchase of at least six additional LRPA, as "the flying time available from the present fleet of 18 *Aurora* aircraft is insufficient."[73] To support the long-range fleet, the *Tracker* force would also be modernized.[74] A *Sea King* replacement project would be initiated, the Distant Early Warning (DEW) radar installations would be replaced, and five Forward Operating Bases (FOBs) would be established in the North for fighter

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[67] Keebles, "Rethinking the 1971 White paper …", 554-560.

[68] DND, *Challenge and Commitment* …, 23.

[69] *Ibid.*, II.

[70] *Ibid.*, 43.

[71] *Ibid.*, 67.

[72] *Ibid.*, 53.

[73] *Ibid.*, 57.

[74] *Ibid.*, 57.

interceptors.[75] Lastly, Canada would invest in space-based assets, as "only space-based surveillance [has] the potential for complete coverage of Canadian territory and adjoining air and sea space."[76] This potential will be examined more closely later in this paper.

Challenge and Commitment linked sovereignty directly to national security in a way that *Defence in the 70's* did not. The SSN purchase challenged the allied status quo, and would have forced our allies to disclose the movements of their own nuclear submarines in order to avoid any chance of misidentification or collision. The Soviet under-ice threat could be countered by Canadian submarines, providing security and establishing a sovereign presence in the Canadian Arctic at the same time. Even if an SSN was not actually deployed to the Arctic it could be said to be there, which would have had exactly the same effect. Not purchasing the fleet of SSNs would effectively cede underwater sovereignty in the North to the Americans.[77]

Unfortunately this argument was not enough, and the far-reaching plan fell victim to a poorly informed electorate, a recession, and a large national debt.[78] Unwilling to deal with the financial issues directly, Mulroney opted instead to reduce the operational budgets of departments such as Transport and Defence.[79] The political will to back large capital projects for defence fell with the Berlin Wall and the 1987 White Paper was effectively neutered two years after it was written.[80] The submarines were never purchased and the *Trackers* were phased out of service, replaced by a combination of

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[75] DND, *Challenge and Commitment* …, 51-56.

[76] *Ibid.*, 58.

[77] Lajeunesse, "Sovereignty, Security, …", 79-80.

[78] *Ibid.*, 81.

[79] Wilson, "The Budget," …, 1-10.

[80] Lajeunesse, "Sovereignty, Security, …", 81.

three re-roled *Challenger* business jets and a contracted civilian fisheries patrol capability.[81] In addition to the cancellation of military projects, a planned Polar 8 class icebreaker for the CCG was also cancelled as part of the budget reductions.[82] On the plus side three CP-140A *Arcturus* were purchased, aircraft that were similar to the *Aurora* but lacked its ASW capability.[83] Again, the surveillance capabilities of the CF declined in spite of well-defined shortfalls in the national security framework. The claim that "the government will not allow Canadian sovereignty to be diminished in any way" [84] rang somewhat hollow.

3.3 - The 90s

Budget cuts and force reductions continued into the 90s, exacerbated by a change of government. In 1992 Mulroney announced the complete withdrawal of Canadian troops from Europe[85] and in 1993 the newly elected Chretien government cancelled the existing contract to replace Canada's *Sea King* and *Labrador* helicopters.[86] The *1994 White Paper on Defence* committed Canada to maintain significant combat-capable forces for possible international deployments while at the same time cancelling $15B worth of

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[81] Shadwick, "Aurora Renaissance,", 103.

[82] "Shortsighted '80s politics now compromising northern sovereignty: experts," Unattributed, *CanWest News Service*, 10 August 2007 [Article on-line]; available from http://www.canada.com/cityguides/princegeorge/story.html?id=4b4147c5-eee3-49ac-a11a-8ad4846e48db; Internet accessed 24 April 2009.

[83] Shadwick, "Aurora Renaissance,", 103.

[84] DND, *Challenge and Commitment* …, 24.

[85] Clyde Farnsworth, "Canadian Troops to Pull Out of Europe by '94," *New York Times*, 27 February 1992 [Article on-line]; available from http://www.nytimes.com/1992/02/27/world/canadian-troops-to-pull-out-of-europe-by-94.html; Internet accessed 24 April 2009.

[86] Sharon Hobson, "Plain Talk: The Process of (Not) Acquiring Maritime Helicopters," *Canadian Naval Review*, Vol. 4, no. 4 (Winter 2009): 39.

planned capital projects and cutting the operational budget.[87] The promise that the CF could do more with less was hollow but left unquestioned by the general public. This lack of public interest and support can be linked to institutional failures of the early 90s such as the Somalia Affair and the disgrace of the Airborne Regiment. Significant budget cuts and personnel reductions, married to an ever-increasing operational tempo, forced the CF to make a lot of tough decisions. The operational readiness of forces in Canada was reduced and the overall effect on maritime surveillance capabilities was negative.

Two key surveillance related projects were delayed during this period: the mid-life upgrade of the *Aurora* fleet and the revised *Sea King* replacement project, now called the Maritime Helicopter Project (MHP). These projects and the effect of these delays will be examined in more detail later in this paper. The *Challenger* coastal patrol capability was eliminated and the *Aurora* fleet suffered a 40% reduction in yearly flying hours (YFR) in 1998 from 19,200 to 11,500.[88] The policy statements concerning surveillance activities were general enough that no quantitative requirements could be derived from them. This and the lack of a comprehensive maritime security strategy contributed to the overall lack of visibility of this issue.

The 1997 *Canada Oceans Act* was the first step towards developing a maritime security strategy for Canada. It recognized Canada's responsibilities with respect to its vast ocean areas, establishing the Canadian Economic Exclusion Zone (EEZ) under the terms of the United Nations Convention on the Law of the Sea (UNCLOS). It also

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[87] Joel J. Sokolsky, *Canada, Getting it Right This Time: The 1994 Defence White Paper* (Pennsylvania: US Army War College, 31 May 1995), 11.

[88] CP-140 YFR information was taken from a PowerPoint presentation prepared in 2007-2008 by A3 Maritime staff at 1 Canadian Air Division, Winnipeg.

provided for the development and implementation of a national strategy based on the sustainable development and integrated management of oceans, coastal activities and resources. Finally, it clarified the role of the Department of Fisheries and Oceans (DFO) as the lead ministry responsible for managing Canada's oceans and defined the powers, duties and functions of the Minister.[89] *Canada's Ocean Strategy* was then developed to meet these legislative commitments and was presented in 2002. While the strategy focused primarily on economic and environmental issues it also identified the need for stakeholders to develop a collaborative, integrated approach to ocean management as a whole. With respect to maritime security, the strategy recognized that "the maintenance and preservation of sovereignty over national ocean space is … a fundamental right in international law and is a priority for Canada."[90] The safety of shipping and life at sea was highlighted as a critical goal and "national and international collaboration to prevent illegal activity" was promoted.[91] In summary, *Canada's Ocean Strategy* proposed the development of an integrated surveillance and enforcement regime, involving international collaboration and the sharing of assets between stakeholders, to ensure the safety and security of Canada's maritime approaches. Unfortunately, it did not provide any measures of effectiveness or timelines on which to base decision-making or direct procurement efforts, a fact that significantly reduced its practical usefulness.

The events of 9/11 brought security preparedness to the forefront of national policy discussions, at least in public forums. Under Chretien, the Government initiated a

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[89] Department of Justice, *Oceans Act* [Archived document on-line]; available from http://laws.justice.gc.ca/en/O-2.4/; Internet; accessed 23 April 2009.

[90] Department of Fisheries and Oceans Canada, "Our Oceans, Our Future" *Canada's Oceans Strategy* (Ottawa: Fisheries and Oceans Canada Oceans Directorate, 2002), 15-18.

[91] *Ibid.*, 24.

number of measures to align Canadian efforts with the US and to deal with the most obvious weaknesses. Immediate steps were taken to improve security along the Canada-US border, the *Smart Border Declaration* was signed on 12 Dec 2001 and significant funding was provided for new equipment and improved information sharing to improve border security.[92] The *Anti-Terrorism Act* of October 2001 was the most immediate legislative response, introducing new powers of investigation for Canada's intelligence and enforcement agencies while clarifying and emphasizing individual rights and freedoms.[93] A Cabinet Committee on Foreign Affairs and National Security was formed, and the Minister of Transport was given the responsibility to establish an IMSWG.[94] A new *Immigration and Refugee Protection Act* was penned in June 2002 to address the perception and reality that Canada's immigration system was too open to abuse by criminal elements.[95] Finally, a new department was created in December 2003 called the Department of Public Safety and Emergency Preparedness (PSEP), placing the RCMP, the Canadian Security Intelligence Service (CSIS), and the fledgling CBSA under a single federal Minister.[96]

Despite these measures the Prime Minister himself seemed less than interested in acknowledging the dismal state of the Canadian security domain and, in particular, that of the CF. Those who identified the risk of CF 'rust-out' were labeled pawns of the Defence

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[92] Lehre, *Connecting the Dots* …, 7-8.

[93] Department of Justice Canada, "Anti-terrorism Act," http://laws.justice.gc.ca/en/ShowFullDoc/cs/A-11.7///en; Internet; accessed 24 April 2009.

[94] TC, *National Maritime Domain Awareness* …, 9.

[95] Department of Justice Canada, "Immigration and Refugee Protection Act," http://laws.justice.gc.ca/en/ShowFullDoc/cs/I-2.5///en; Internet; accessed 24 April 2009.

[96] Public Safety Canada, "Who we are," http://www.publicsafety.gc.ca/abt/wwa/index-eng.aspx; Internet; accessed 24 April 2009.

industry, while the Prime Minister likened Canada's peacekeepers to 'Boy Scouts'.[97] It was not until Prime Minister Paul Martin came to power in 2003 that any comprehensive changes in security policy occurred, and that the CF contribution to that policy was recognized. Canada had suddenly become geographically significant again from an American perspective, and it had to be acknowledged that weaknesses in the Canadian security framework were damaging to the Canada-US relationship. The importance of dealing responsibly with Americans concerns was recognized and developing a coordinated security policy, as outlined in the *Ocean Strategy*, became an overriding priority.

3.4 - Securing an Open Society

Securing an Open Society: Canada's National Security Policy (NSP), published in April 2004 by the Martin government, marked a refreshing change in that it was both a detailed and specific document. It was introduced as "Canada's first-ever comprehensive statement of national security policy which provide[d] an integrated strategy for addressing current and future threats to our country."[98] The NSP articulates three core national security interests: first, protecting Canada and Canadians at home and abroad; second, ensuring Canada is not a base for threats to our allies, and third, contributing to international security.[99] On security and values the policy states that:

> A clear and effective approach to security is not just the foundation of our prosperity, it is the best assurance that future generations will continue to enjoy the very qualities that make this country a place of hope in a troubled world… The Government is determined to pursue our national

[97] Shadwick, "Commentary …", 68-69.

[98] Privy Council Office, *Securing an Open Society* …, iii.

[99] *Ibid.*, vii.

> security interests and to be relentless in the protection of our sovereignty and our society in the face of these new threats.[100]

With respect to the three core national security interests the NSP highlights the Government's responsibility "to be able to defend against threats to Canadian sovereignty, ranging from illegal entry to incursions into our territorial waters."[101] Marine security is singled out as a particular area of weakness and a six-point plan is proposed to address key vulnerabilities. The six-point plan will:

- clarify responsibilities and strengthen co-ordination of marine security efforts;
- establish networked marine security operations centres;
- increase the Canadian Forces, RCMP, and Canadian Coast Guard on-water presence and Department of Fisheries and Oceans aerial surveillance;
- enhance secure fleet communications;
- pursue greater marine security co-operation with the United States; and
- strengthen the security of marine facilities.[102]

The NSP divides maritime security responsibilities between three government departments. The Minister of Transport is given lead responsibility for safety and security coordination and regulation, the Minister of Public Safety and Emergency Preparedness for enforcement and policing, and the Minister of National Defence for coordination of any on-water response to maritime threats or developing crisis in our EEZ. Interestingly, the role of DFO is not mentioned in the NSP, but the Department's official website indicates that their Minister remains the lead in marine search and rescue and environmental response. The recent MDA Strategy Framework indicates that DFO is also the lead for increased surveillance flights, though what control they have over DND

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[100] Privy Council Office, *Securing an Open Society* …, 1.

[101] *Ibid*., 5.

[102] *Ibid*., vii.

and TC in this area is unclear.[103] The remaining DFO responsibilities, and by extension those of the CCG, focus on economic and environmental issues vice the security domain.

From this somewhat confusing division of labour five key organizations can be identified as sharing responsibility for domestic maritime security. These are TC, the RCMP, the CBSA, the CF, and the CCG. These five partners are brought together at the MSOCs introduced earlier in chapter 2. Difficulties in sharing information are hampering the effectiveness of these operation centers and a consensus approach to issue management is making improvements difficult. The Auditor General has concluded that the lack of "consistent guidance to departments on managing the balance between the privacy of individuals and requirements to maintain the security of the nation" has led to this situation.[104]

The NSP mandates an increase to on-water patrols by both the CCG and the CF. It also mandates an increase to DFO's contracted aerial surveillance. The practical aspect of this, including the numbers of patrol hours assigned and the historical fluctuations in surveillance coverage, will be dealt with later in this paper.

The final chapter of the NSP addresses the question of international security. Canada's "pursuit of international peace and security is … driven, in large part, by our national security interests."[105] Four international security threats are identified, namely international terrorism, the proliferation of weapons of mass destruction, failed and

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[103] TC, *National Maritime Domain Awareness …*, 28.

[104] Auditor General of Canada, "Chapter 1 – National Security …", 31.

[105] Privy Council Office, *Securing an Open Society …*, 47.

failing states, and intra- or inter-state conflicts. This aspect of the Canadian security domain is discussed more completely in the following policy document.

3.5 - A Role of Pride and Influence in the World

Canada's International Policy Statement - A Role of Pride and Influence in the World (IPS) was published in 2005 under the Martin government. Divided into three parts, Defence, Diplomacy and Development, the IPS addressed the activities of two departments and one agency: DND, the Department of Foreign Affairs and International Trade (DFAIT) and the Canadian International Development Agency (CIDA). Interestingly, of the three, DND is the only one that continues to acknowledge the IPS and include it in its list of policy documents. One cannot access the IPS through the DFAIT website, and the CIDA website includes a disclaimer stating that the agency has never officially adopted the document.[106] Despite this the IPS remains relevant for the purposes of this paper, as its precepts continue to form the basis of current Defence Policy.

The IPS-Defence builds on the direction found in the NSP, but is specifically focused on the CF and its contribution to Canadian security through. The document covers both domestic and international responsibilities, stating that "the Canadian Forces will continue to perform three broad roles: protecting Canadians, defending North America in cooperation with the US, and contributing to international peace and security."[107] The IPS emphasizes the increased requirement for coordination and

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[106] Canadian International Development Agency, *A Role of Pride and Influence in the World: Development - Canada's International Policy Statement* (2005) [Archived document on-line]; available from http://www.acdi-cida.gc.ca/CIDAWEB/acdicida.nsf/En/JUD-2107401-GV3#snav; Internet; accessed 23 April 2009.

[107] Department of National Defence, *A Role of Pride and Influence in the World: Defence - Canada's International Policy Statement* (2005) [Archived document on-line]; available from

cooperation between government departments and identifies the CF as a source of key enablers. It highlights the requirement to improve CF information sharing and intelligence fusion capabilities and identifies the need for better surveillance and control measures.

> One of the most critical security issues now facing the Government is its ability to conduct surveillance of our vast territory, airspace, and maritime approaches, and to respond to asymmetric threats.[108]

The IPS specifically mentions key aerospace ISR capabilities; the continuing modernization of the *Aurora*, a plan to purchase UAVs to support domestic and international operations, and improved access to satellite imagery and services.[109] The NORAD Agreement will be expanded to include maritime warning and the CF will "strengthen [its] ability to counter threats to Canada, especially in terms of monitoring and controlling activity in the air and maritime approaches to our territory."[110] The Arctic is included under this umbrella, with specific reference made to improving Arctic surveillance and search and rescue capabilities.[111]

With respect to international operations, and aerospace ISR capabilities in particular, the IPS states that Canada will:

> … sustain indefinitely the deployment overseas of two embarked maritime patrol helicopters and one *Aurora* maritime patrol aircraft as the forward

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http://www.forces.gc.ca/admpol/newsite/downloads/Canada_Defence_2005.pdf; Internet; accessed 23 April 2009, 2.

[108] *Ibid*., 16.

[109] *Ibid*., 14.

[110] *Ibid*., 23.

[111] *Ibid*., 17.

> element of the Standing Contingency Task Force (SCTF) anywhere in the world.[112]

If the SCTF is deployed, an additional *Aurora* will be added to the force as an integral element. While the SCTF project itself has been temporarily shelved, the Navy's *Leadmark 2020* doctrinal document still includes two maritime patrol aircraft (MPA) as an integral part of future naval task forces.[113] The IPS also states that the CF "will provide a globally deployable special operations aviation capability to the Special Operations Group", which could certainly include ISR assets.[114]

3.6 - Canada's Ocean Action Plan

The final policy document of interest produced by the Martin government, *Canada's Ocean Action Plan* (OAP) of 2005 provides some of the detail that the *Ocean Strategy* of 2002 lacked. As with previous DFO policy documents, the OAP is focused primarily on economic and environmental issues but it does include International Leadership, Sovereignty and Security as one of its four pillars.[115]

> Sovereignty and security are the essential base for oceans policy and management [and] the national ability to conduct surveillance, patrol and interdiction operations is pivotal.[116]

The document states that Canada's claim over the Continental Shelf will be formalized in the interests of economic security. This includes ongoing scientific efforts to legitimize Canada's Arctic claims under the provisions of UNCLOS. It also mandates a 100%

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[112] DND, *A Role of Pride* …, 30.

[113] Department of National Defence, *Securing Canada's Ocean Frontiers – Charting the Course from Leadmark* (Ottawa: Directorate of Maritime Strategy, 2005).

[114] DND, *A Role of Pride* …, 30.

[115] Department of Fisheries and Oceans Canada, *Canada's Oceans Action Plan* (Ottawa: Communications Branch Fisheries and Oceans Canada, 2005), 5.

[116] *Ibid.*, 6.

increase in pollution patrols by a combination of TC's National Aerial Surveillance Program (NASP) and contracted aircraft flown by PAL.[117] The actual increase was significantly lower than this with NASP flying hours increasing by only 26% to 1550 hours[118] in 2005 and PAL hours remaining relatively constant at 4800 hours annually.[119] The OAP also suggests that "by coordinating the pollution surveillance patrols with Radarsat satellite reports of anomalies on the ocean's surface… the overall effectiveness of pollution surveillance will be increased."[120] The Integrated Satellite Tracking of Pollution (ISTOP) Program is still in its infancy but has shown promise.[121] The main limitation is the infrequent coverage provided by the single *Radarsat-2* (*R2*).

The three documents produced by the Martin government shared a consistent theme, and each of them included specific measures that would be taken in order to improve the security of Canada. In many ways words were followed by acts, with significant funding found in the federal budget of 2005. This budget introduced an additional $1B for national security initiatives, including $220M for marine security.[122] Defence saw promises of $12.8B in extra spending over five years with $7B of that being new budgetary funding. As is often the case, 80% of this spending was forecast for the

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[117] DFO, *Canada's Oceans Action Plan*, 18.

[118] Transport Canada, "National Aerial Surveillance Program – May 2006," http://www.tc.gc.ca/mediaroom/backgrounders/b04-m126e.htm; Internet; accessed 23 April 2009.

[119] Fisheries and Oceans Canada, "Minister announces $51 Million Air Surveillance Contract," http://www.dfo-mpo.gc.ca/media/npress-communique/2004/hq-ac20-eng.htm; Internet; accessed 24 April 2009.

[120] DFO, *Canada's Oceans Action Plan*, 18.

[121] Transport Canada, "National Aerial Surveillance Program – May 2006," http://www.tc.gc.ca/mediaroom/backgrounders/b04-m126e.htm; Internet; accessed 23 April 2009.

[122] Department of Finance. *The Budget Plan 2005* (Ottawa: Department of Finance Canada, 2005), 223.

last two years of the specified period but the intent was at least there.[123] Unfortunately, much of this money was required just to raise the minimum operational readiness of current forces through the purchase of spares and the provision of training time. One capital surveillance project did benefit directly from this largesse, namely the MHP, which was contracted in 2004 with a planned first delivery in 2008.[124] This project will be discussed in more detail later in this paper.

3.7 - Canada First Defence Strategy

The current Prime Minister has been unusually vocal in his support of the CF and in his concern for national security issues. One of Stephen Harper's first acts was to conduct an unannounced trip to Afghanistan to demonstrate his support for Canadian troops and their mission.[125] His message with respect to the domestic security challenges facing Canada has been very consistent and he has also clarified Canada's position on a number of ongoing international conflicts. The 2007 Speech from the Throne highlights this:

> Canada is built on a common heritage of values, which Canadians have fought and died to defend… Our Government is resolved to uphold this heritage by protecting our sovereignty at home and living by our values abroad… Our Government believes that focus and action, rather than rhetoric and posturing, are restoring our influence in global affairs.[126]

In concrete terms this has resulted in strong political support for the CF in its domestic and deployed operations. Some is likely due to the correspondingly strong

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[123] *Ibid*., 222.

[124] Hobson, "Plain Talk…", 39.

[125] Prime Minister Stephen Harper, "Address by the Prime Minister To the Canadian Armed forces in Afghanistan," Speech (13 March 2006) [Speech on-line]; available from http://pm.gc.ca/eng/media.asp?category=2&id=1056; Internet; accessed 24 April 2009.

[126] Governor General, "Strong Leadership. A Better Canada" *Speech from the Throne: October 16, 2007* (Ottawa: 39th Parliament, 2nd Session, 2007).

public support for the CF and its members. Whether individuals agree with the mission in Afghanistan or not they invariably support the troops. This has translated into an unprecedented influx of new equipment and money, meant to stave off the effects of decades of neglect and also to provide critical capabilities for immediate use in the field. These systems range from the massive C-17 *Globemaster III* transport aircraft to the Expedient Route Opening Capability (EROC), a mine clearing system that has been central to Canadian Counter-Improvised Explosive Device (C-IED) efforts. The Government has also fast tracked a temporary replacement for the *Sperwer* Tactical UAV, and announced the family of future aerospace surveillance projects that are of particular interest to this paper.

The CFDS, presented in May 2008, repeats the three broad priorities outlined in the IPS of 2005. These priorities are that:

> … the CF must be able to deliver excellence at home, be a strong and reliable partner in the defence of North America, and project leadership abroad by making meaningful contributions to international security.[127]

The term 'strategy' differentiates this document from the past series of White Papers in that it emphasizes its long-term nature. The CFDS is unique in that it not only delineates policy, but it also details significant real growth in the Defence budget over time, coupled with a 20-year capital reinvestment plan and a commitment to fund operational deployments separately from the main budget.[128] Unlike the preceding White Papers on Defence, it is a document that has already passed in principle through the Cabinet and the Treasury Board approval processes. Combined with a newly adopted method of accrual

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[127] DND, *Canada First …*, 3.

[128] MacDonald, "The Canada First Defence Strategy of 2008 …", 1.

accounting, these measures will provide the financial stability required to rebuild the CF, replacing or augmenting all key capabilities.[129] The CFDS identifies six core missions that the CF must be capable of conducting, often simultaneously. These are:

- Conduct daily domestic and continental operations, including in the Arctic and through NORAD;
- Support a major international event in Canada, such as the 2010 Olympics;
- Respond to a major terrorist attack;
- Support civilian authorities during a crisis in Canada such as a natural disaster;
- Lead and/or conduct a major international operation for an extended period; and
- Deploy forces in response to crises elsewhere in the world for shorter periods.[130]

The CFDS states that domestically:

> … the [CF must] be aware of anything going on in or approaching our territory, [must] deter threats to our security before they reach our shores, and [must] respond to contingencies anywhere in the country.[131]

The CF is further mandated to work with other federal departments to "ensure the constant monitoring of Canada's territory and air and maritime approaches, including in the Arctic."[132] These two statements, and the six core missions, outline the requirement for a robust CF surveillance capability. The CFDS mentions a future surveillance 'system of systems', but specifically identifies only one major capital project that addresses this issue. This is the CMA project, which will see the *Aurora* replaced by 10-12 new maritime patrol aircraft.[133] A promise is also made to investigate "acquiring radars and

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[129] *Ibid*., 3-4.

[130] DND, *Canada First* …, 3.

[131] *Ibid*., 8.

[132] *Ibid*., 7.

[133] *Ibid*., 17.

satellites to improve surveillance capabilities, especially in the Arctic."[134] These initiatives will be briefly examined later in this paper, along with the other projects that currently represent the future ISR 'system of systems'. The CFDS also places significant emphasis on increased readiness, an important contributing factor to increased CF surveillance capacity.[135]

While the CFDS represents a step forward for the CF in terms of both stable funding and a well-defined vision, it also raises some questions, particularly when one looks closely at the future balance of forces. The strategy is short on details for Army procurement projects saying only that "a new family of land combat vehicles and systems … will provide a robust and flexible capability for Canada's soldiers on high-risk missions abroad."[136] For the Navy and Air Force though, the CFDS is very specific, and it is notable that, while the Navy will retain and even grow its fleet, the Air Force faces airframe reductions in fighter and patrol aircraft that will significantly affect its ability to deploy on operations.[137] Not only that but, as will be discussed later in this paper, the Air Force will be hard pressed to improve or even meet its mandated domestic surveillance and control responsibilities. It seems that the statement that the new patrol aircraft "will become part of a surveillance 'system of systems' that will also comprise sensors, unmanned aerial vehicles and satellites" is the key. These new technologies will certainly make significant contributions but it seems premature to become dependent on them.

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[134] *Ibid*., 17.

[135] *Ibid*., 18.

[136] *Ibid*., 17.

[137] The issues affecting the patrol aircraft will be discussed in Chapter 5. With respect to fighter aircraft the CFDS indicates that 65 NGFC aircraft will be purchased to replace the 80 operational CF-18's. That this will restrict deployments is a factor of NORAD and force generation commitments. According to DAR staff involved with the NGFC 65 fighters is the minimum number required to maintain domestic requirements, leaving no deployable fighter capability.

3.8 - Summary

Since 1971 Government policy has emphasized the critical role the CF plays in maintaining Canada's national sovereignty. The common broad themes of protecting Canada, maintaining effective bilateral arrangements with the US, and participating in international security organizations are seen in each subsequent document. The decline of Canada's surveillance capabilities over this period has not been the result of stated policy. Instead, it has been caused by a number of somewhat random decisions and a lack of vision on the part of a series of Prime Ministers. Defence spending does not garner votes in Canada while Defence cuts unfortunately have. As well, Canada's international commitments and collective security arrangements have not been reduced in any real way. The opposite is actually the case, with dramatic increases seen in operational tempo since the early 90s. This dynamic has made it very hard to invest in capabilities and systems primarily focused on the protection of Canada. Direct threats to Canada have always been sufficiently hypothetical that Governments have not been forced to act. Sovereignty protection has therefore been achieved through the residual capability inherent in the equipment purchased to meet Canada's international commitments. This has occurred despite policy statements that suggest that the reverse should be the case. The current threat environment is somewhat different in that Canada's economic livelihood is intrinsically tied to its ability to secure its perimeter. The events of 9/11 have made Canada geographically significant again to our American allies and a real investment in capabilities must be made.

Recent governmental defence and security policy documents recognize this fact but political commitment and funding have been slow to materialize. The CFDS is a

concrete step towards correcting this trend in its commitment to a 20-year capital reinvestment plan. A potential problem is the balance of the projects that have been announced, particularly as they address the capability gaps in Canada's surveillance framework. The possibility that the document will not survive a change in government is another potential problem but will not be a focus of this paper.

Prime Minister Harper has said that "Protecting national sovereignty – the integrity of our borders – is the first and foremost responsibility of the national Government; a responsibility which has too often been neglected."[138] On Arctic sovereignty specifically he had this to add; "Canada's New Government understands the first principle of Arctic sovereignty: use it or lose it."[139] The following chapter of this paper will focus on the challenge that faces the CF and Canada in addressing these policy goals.

[138] Prime Minister Stephen Harper, "Prime Minister announces expansion of Canadian Forces facilities and operations in the Arctic," Speech (10 August 2007) [Speech on-line]; available from http://pm.gc.ca/eng/media.asp?category=2&id=1787; Internet; accessed 24 April 2009.

[139] *Ibid*..

Chapter 4 – Canadian Surveillance Requirements

> We cannot defend against the unforeseen. We simply must foresee. And we simply must defend. The alternative does not befit any society worth saving.[140]

The Canadian surveillance problem is readily apparent given Canada's huge landmass and maritime areas of responsibility. Bounded by three oceans, Canada's coastline is the longest in the world at 243,795 km. The Canadian EEZ extends out to 200nm (370km) from shore encompassing more than 5.5 million square kilometres or more than 10 times the total area of France.[141] Canada's maritime AOR, from a military and search and rescue perspective, extends further from shore on all three coasts, doubling the total area to approximately 11 million square kilometres.[142] When Canada's landmass of nearly 10 million square kilometres is included in the discussion one can begin to see the significant challenge faced by Canada's security forces. The Canadian Arctic is by itself a huge AOR, with the Arctic Archipelago comprising 40% of the total Canadian landmass and 65% of the coastline. The waters contained by the archipelago and by the Arctic EEZ represent 3.5 million square kilometres or 64% of the total EEZ.[143] The harsh Arctic climate and sparse population complicate the security challenge by extending lines of communication (LOC) and requiring the use of specialized equipment and training.

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[140] Standing Senate Committee on National Security and Defence, *Canada's Coastlines: The Longest Under-Defended Borders in the World, Volume 1* (Ottawa: Senate of Canada, October 2003), 2.

[141] Wildlife Habitat Canada, "The Status of Wildlife Habitats in Canada's Oceanic and Coastal Seacapes," http://www.whc.org/documents/FinalOceansLongVersionEnglish.pdf; Internet; accessed 24 April 2009, 2-3.

[142] Avis, "Surveillance and Canadian Maritime Domestic Security,", 9.

[143] Wildlife Habitat Canada, "The Status of Wildlife Habitats in Canada's Oceanic and Coastal Seacapes," http://www.whc.org/documents/FinalOceansLongVersionEnglish.pdf; Internet; accessed 24 April 2009, 2-3.

Figure 2 – Map of Canada – depicts Economic Exclusion Zone

Canada's economy is heavily reliant on the maritime dimension, with the majority of non-US international exports travelling by sea. On any given day, there are as many as 1700 ships in Canada's AOR, with many more unreported contacts operating on the fringes of or outside the established maritime reporting system.[144] Forecast increases in maritime traffic through Canadian waters, due to globalization and the melting of the Arctic sea ice, will serve to increase Canada's dependence on the oceans. Shifts in global power are intensifying ocean politics, particularly in the Asia-Pacific region, and the competition for maritime resources continues to create friction between otherwise friendly nations.[145] The vast mineral resources present below Arctic waters and off Canada's East Coast have yet to be fully exploited but represent a significant portion of

[144] Avis, "Surveillance and Canadian Maritime Domestic Security,", 9.

[145] This strategic viewpoint was presented to JCSP 35 on 20 February, 2009 by Director Maritime Strategy, NDHQ in Toronto, ON.

the world's remaining wealth in oil and gas. The security of Canada's maritime approaches and EEZ is therefore a crucial aspect of its future economic prosperity, and is of vital national interest.

Canada's surveillance requirements within its massive AOR are a direct consequence of Government policy. The preceding chapter on policy identified the security of Canadians and the sovereignty of Canada as the first national security and Defence priority. The ability to conduct effective surveillance over one's territory is the first step to establishing sovereignty, and the CFDS focuses on this requirement. It states that, domestically, "the [CF must] be aware of anything going on in or approaching our territory."[146] The CF is mandated to work with other federal departments to "ensure the constant monitoring of Canada's territory and air and maritime approaches, including in the Arctic."[147] The ability to control an event, either directly or indirectly, is the second step to establishing sovereignty. The CFDS addresses this as well, stating that the CF must "deter threats to our security before they reach our shores, and [must] respond to contingencies anywhere in the country."[148] Given fiscal constraints and the geographic challenges facing the CF, identifying the ideal mix of systems to provide these surveillance and control capabilities becomes very difficult. Adding to the problem, the demand for ISR support on deployed operations such as those in Afghanistan is increasing, introducing yet another set of capability requirements.

As was mentioned earlier, the maritime domain is arguably where the majority of Canada's surveillance weaknesses exist. The aerospace surveillance challenge is more

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[146] DND, *Canada First* …, 8.

[147] *Ibid*., 7.

[148] DND, *Canada First* …, 8.

difficult in many ways but is addressed by NORAD and its well-established network of sensors and aircraft. Though NORAD has been assigned a maritime warning role, this existing network of systems does not lend itself well to the maritime domain. NORAD will process all available data and advise Canada Command and US Northern Command on issues of concern, but creating a maritime surveillance network to develop this data will remain primarily a national responsibility.[149] The responsibility to respond to maritime threats will also remain with the individual commands. The surveillance requirements that determine the size and nature of this network are the focus of this chapter. While this cannot be an all-encompassing study, the main drivers will be identified and the nature of current weaknesses addressed. Specific challenges associated with subsurface contacts, the Canadian Arctic, and deployed operations will also be briefly discussed.

4.1 - Maritime Surveillance Requirements

The geography of the country makes effective surveillance of the maritime AOR a very difficult task. Historically this vast area has been divided east and west between Commander Maritime Forces Atlantic (MARLANT) and Commander Maritime Forces Pacific (MARPAC). With the creation of Canada Command, these two areas have been assigned to three JTFs, namely JTF Atlantic, JTF Pacific, and JTF North. Despite this recent change, responsibility for the maritime surveillance task remains divided along the original naval lines, primarily because it has been easier to do so. JTF North does not have tasking authority over any surveillance assets other than the Canadian Rangers. Nor

[149] National Defence and the Canadian Forces, "Five years after 9/11 – A CANR perspective," http://www.forces.gc.ca/site/news-nouvelles/view-news-afficher-nouvelles-eng.asp?id=2052; Internet; accessed 24 April 2009.

does it have the C2 network necessary to direct surveillance efforts or to analyze and disseminate the results.[150] For the moment therefore, along with their own AORs, Commanders JTF Atlantic and Pacific retain responsibility for conducting surveillance in the North to the east and west respectively. When considering the portion of these areas that cannot be covered by land-based assets, the unique challenges of the Arctic, and the desired level of coverage, the lion's share of the mission must fall to aerospace systems.

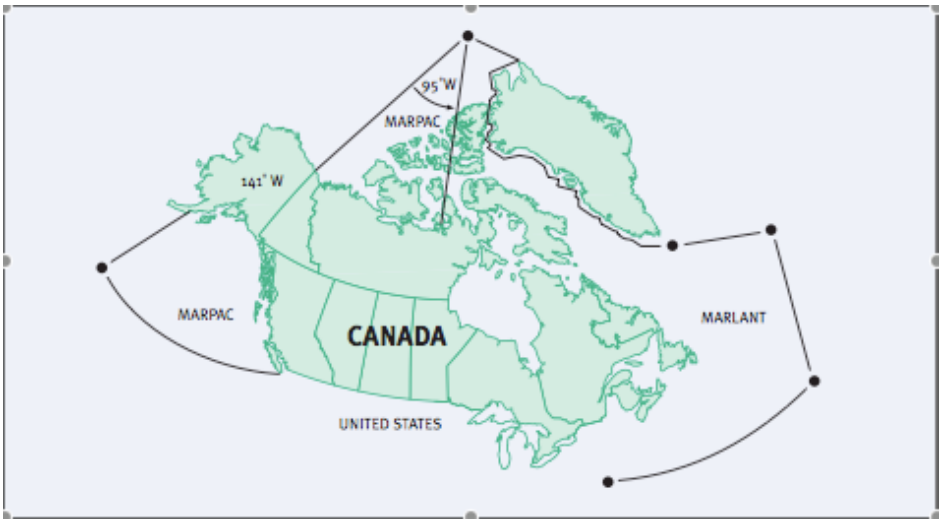

Figure 3 – MARLANT /JTF Atlantic AOR and MARPAC / JTF Pacific AOR

The CF's only dedicated surveillance aircraft is the CP-140 *Aurora*, of which 18 are divided between the two coasts. Two of the three CP-140A *Arcturus* purchased in the early 90s are still in service as well, but they are both scheduled to be retired this coming summer. Though the fleet seems relatively large the numbers are somewhat misleading. Two ongoing aircraft upgrade programs, one which addresses the sensor and navigation suites and the other structural issues, are significantly affecting availability. So significantly that there are currently only two to three serviceable aircraft on any given

[150] This information was presented to JCSP 35 on 3 February 2009 by Commander JTF North in Iqaluit, NU.

day.[151] In terms of capabilities the Aurora sensor suite is at the end of its useful life, particularly with respect to ASW. Its two most capable sensors are the AN/APS-506 maritime surface-search radar and the modern L-3 Wescam MX-20 Electro-Optical/Infra-Red (EO/IR) camera system. The ongoing upgrade includes one of the best ASW sensor suites in the world, a new Synthetic Aperture Radar (SAR), and a very capable Electronic Warfare (EW) suite.[152] The availability issues and the capabilities of the key systems will be discussed in greater detail in the following chapter.

While the CFDS states that the CF will be aware of anything approaching our coasts, the idea that these areas could be monitored 100% of the time is unrealistic. In developing their Concept of Operations (CONOP) for east coast surveillance, the JTF Atlantic staff has identified a number of ways to focus the efforts of the limited surveillance assets available. This CONOP is called Operation Leviathan. Though still currently a draft document, the principles behind Op Leviathan are instructive and provide a solid basis from which to assess a future ISR 'system of systems'. For naval planning purposes, Canada's maritime approaches have been subdivided into four zones spanning from the coastline to 1000nm offshore. These are the Inner Zone (0 – 50nm), the Middle Zone (50-250nm), the Outer Zone (250-1000nm) and the Arctic Zone.[153] Op Leviathan combines the Inner Zone along the Atlantic coast with the Middle Zone to reflect the fact that an airborne surveillance asset would rarely focus only out to 50nm

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[151] This information comes from officers on JCSP 35 familiar with current operations at 14 Wing Greenwood and 19 Wing Comox, the two main operating bases of the CP-140 *Aurora*.

[152] An Electronic Warfare suite could include a wide rang of capabilities but the focus here would be on collection of Signals Intelligence (SIGINT), Communications Intelligence (COMINT), and Threat Warning.

[153] DND, *National Surveillance Study 2008*, 23(U).

from shore.[154] It then subdivides the resulting Inner-Middle and Outer Zones into smaller regions in order to make it easier to assess the effects of regular airborne patrols.

The next step in reducing the surveillance problem was to define the levels of detection and identification required in each region. Given limited surveillance assets it was understood that the Commander would play a significant role in establishing regional priorities. It was also understood that these priorities would vary for a number of reasons ranging from seasonal usage patterns to the identification of a specific maritime threat. While the ultimate aim is to identify 100% of surface contacts approaching Canada, this goal is some years from being achievable. Op Leviathan identifies three measures of performance to help assess the effectiveness of the surveillance effort. These are the probability of identification and revisit rate, track update rate, and picture completeness.[155] The first measure is the best developed of the three and will be examined in detail. The track update rate refers to how frequently the positions of known contacts are reconfirmed by the surveillance network. One of the difficulties with this measurement is that, aside from the case where a given contact is continuously tracked, updating a contact requires the same level of effort as the original detection and identification cycle. A potential technological solution to this problem will be discussed in the following chapter. Picture completeness is the least developed measure of performance and falls beyond the scope of this paper to discuss.

To assess the probability of identification and calculate the required revisit rate, the characteristics of an average contact of interest must first be defined. Consider that

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[154] Neil Carson, *OR Support to CONOP Leviathan – DRAFT* (Halifax: Defence Research and Development Canada, 2008), 3.

[155] *Ibid.*, 5.

the radar cross-section, speed of advance (SOA), and normal pattern of activity of a sailboat will be significantly different from those of a supertanker. Each of these will affect the range at which the contact can be initially detected. Then to identify a contact positively the aircraft must close to within visual range, unless it is equipped with an EO/IR device and the weather allows the crew to capture a useful image. In the areas off the East Coast weather is a particular problem as fog is very common. For these reasons and others a surveillance framework based on the most likely contact of interest must retain enough flexibility to deal with the worst-case scenario. For the purposes of Op Leviathan it was considered critical to focus on those vessels approaching Canada directly that were not emitting any electronic signals, whether through criminal intent or system malfunction.[156] Vessels of this type would spend the least time exposed to the surveillance effort and would be impossible to identify from a useful standoff range. This is the worst case where surface contacts are concerned, and has the effect of significantly reducing the area that can be patrolled by a single airborne asset. The use of this scenario allows the Commander to understand the risk he is taking in a given region on a given day. The contribution made by friendly surface vessels is not considered in this discussion due to their small surveillance footprint. If a shipborne helicopter were available to the ship it could simply be treated as a short duration airborne asset.

The process of detecting a contact and subsequently identifying it is an iterative one and, due to the relatively slow speeds of advance involved, can extend over a period of hours or even days. With this in mind, a pattern of surveillance can be developed to establish a regular revisit to a given area, with the ultimate aim of identifying all vessels

[156] Carson, *OR Support …*, 6.

approaching Canada before they cross into the Inner Zone. Very simply, a minimum 'revisit rate' can be determined by considering the range of the primary sensor involved and the SOA of the average contact of interest. Given an SOA of 20 kts and a radar range for the average contact of 100nm, an aircraft must return to the same spot every 10 hours in order to ensure 100% detection. A wide range of factors including actual meteorological conditions, real radar performance, and even operator experience complicates this equation and can increase the required revisit rate dramatically. Therefore, when developing a pattern of surveillance a certain degree of redundancy or overlap must be introduced. Through this somewhat subjective process one can determine the number of surveillance hours required of a given sensor platform. The integration of a number of different sensors and surveillance platforms into a single surveillance framework complicates this process significantly.

Using the measures of performance, the MARLANT Operational Research Staff of Defence Research and Development Canada (DRDC) conducted a study of *Aurora* flying hours. The aim was to determine the number of flying hours required to achieve the desired probability of identification and revisit rate over the JTF Atlantic AOR, including the Eastern Arctic. The result was 6886 hours, representing almost 2 flights each day if an average of 10 hours per flight is assumed. Canada Command is the supported command in this instance and these hours cover its surveillance requirements as well as DND's contribution to DFO and the *Aurora's* role as a secondary Search and Rescue platform. ASW, support provided to Other Government Departments (OGDs) for contingency operations such as specific drug interdiction operations, and the contribution made by the contracted DFO and TC surveillance flights are not taken into account. This

study prompted a similar assessment by the MARPAC staff for the JTF Pacific AOR, adding another 5035 hours for a total of 11,921.

In the 07/08 fiscal year only 1800 *Aurora* force employment (FE) flying hours were dedicated to Canada Command surveillance operations. [157] This represented 30% of the total *Aurora* YFR for that year, the remainder of the 6500 hours being assigned to support other commands and force generation (FG) tasks. By assigning surveillance missions to FG flights this percentage was raised to approximately 45%.[158] Based loosely on these numbers, staff at 1 Canadian Air Division have calculated that the total *Aurora* YFR required would be approximately 23,000 flying hours annually. The 12,000 hours dedicated to Canada Command would represent more than 50% of this total. Given that *Aurora* YFR was increased to 8000 flying hours in 08/09, the current capability gap is some 15,000 hours.

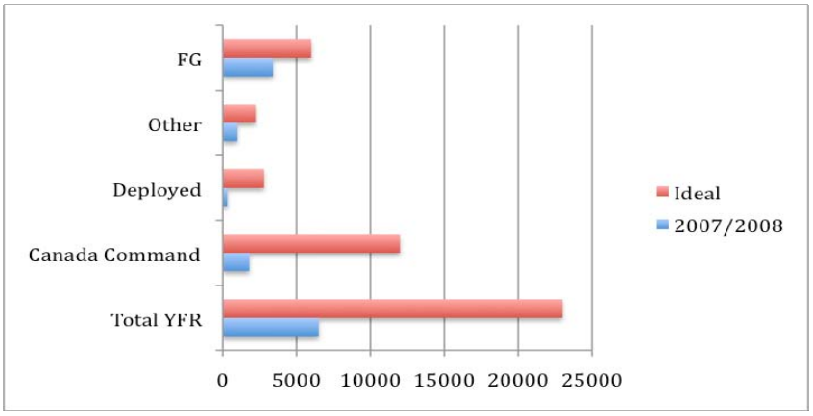

Figure 4 – *Aurora* YFR Comparison – Ideal to 2007/2008

[157] CP-140 YFR and surveillance requirement information was taken from a PowerPoint presentation prepared in 2007-2008 by A3 Maritime staff at 1 Canadian Air Division, Winnipeg. Force Employment (FE) hours are those flying hours dedicated to one of the Aurora's defence tasks.

[158] A Force Generation (FG) mission is technically a training mission. As can be expected these flights often take place over the maritime regions off both coasts where crews practice their various roles, including surface surveillance. A proactive approach to assigning training areas allows the FG flying hours to contribute to the Canada Command surveillance FE task.

This number must be taken in context but it is significant. The weakness it identifies is mitigated in a number of ways, including the many hours flown by DFO and TC. Also, the Op Leviathan model is based on the current sensor fit. The new radar and EW system will have a positive effect though it is hard to say how much. The most significant effect may actually come from a much simpler system called the Automatic Identification System (AIS). AIS will also be discussed further in the following chapter.

4.2 - Subsurface Contacts

To this point the sub-surface threat to Canada has not been considered and any effort dedicated to ASW would represent an additional requirement above and beyond that already identified. A submarine complicates the surveillance problem described above significantly and, as a result, ASW is traditionally very flying-hour intensive. Decreased sensor ranges due to modern submarine design and fleeting detection opportunities due to better diesel and nuclear powerplant technology make ASW a challenging undertaking. While submarines are becoming quieter, acoustic sensor suites and the associated air dropped sonobuoys are becoming much more effective. In the early 80's the *Aurora* was considered the premiere ASW aircraft in the world but almost thirty years later the same mission equipment would be more appropriately housed in a museum. One of the most advanced systems available is actually produced here in Canada by General Dynamics Canada. Eighteen of these systems have already been bought and are waiting for the *Aurora* Incremental Modernization Program (AIMP) to progress to Phase III. As mentioned already, AIMP will be discussed in the next chapter.

Offensive ASW assets are generally cued to areas of potential interest by intelligence. With the end of the Cold War a number of the sources of this intelligence

have been retired or allowed to degrade, making open ocean ASW a primarily defensive activity. Airborne ASW platforms can still be used to screen naval forces and to monitor chokepoints temporarily, but are unable to hunt for submarines as they once did during the Cold War. In terms of the defence of Canada the focus should be on creating an intelligence capability to provide the necessary cueing in Canadian waters. Establishing a network of underwater acoustic 'tripwires' in critical chokepoints and areas of particular interest is the way ahead. This approach has been frequently suggested over the years but has never had the required resources, or political will, applied to bring a sensor network into being. Through this failure and the cancelled nuclear submarine project, Canada has effectively ceded its underwater sovereignty in the North to the US. Unsurprisingly, an underwater surveillance system is once again topical and has been the subject of recent debate.[159]

Despite what many in the CF have claimed, ASW is not dead. In fact, with the known proliferation of modern diesel submarines and the number of new nuclear submarine designs being considered globally, the ASW problem has actually worsened. Whether or not Canada will become the focus of a submarine threat is somewhat academic so long as Canadian naval task groups are fully committed to supporting international operations. This pattern of activity demands the support of long-range ASW aircraft and the Navy, in its doctrine, acknowledges this fact.[160] For the occasional submarine transiting through the Canadian AOR, Canada not only needs the ability to

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[159] "Tories plan to bolster Arctic defence," Unattributed, *CBC News*, 22 December 2005 [Article on-line]; available from http://www.cbc.ca/story/canadavotes2006/national/2005/12/22/elxn-harper-dfens.html; Internet; accessed 24 April 2009.

[160] Department of National Defence, *Securing Canada's Ocean Frontiers – Charting the Course from Leadmark* (Ottawa: Directorate of Maritime Strategy, 2005).

detect but also the ability to respond, particularly in the North. Events of this kind are not normally advertised to the general public, which may avoid the public pressure to act, but does not reduce the Government's responsibility to maintain a long-range ASW capability.

The actual number of flying hours required will vary and, other than support of deployed task groups, ASW activities will generally be unplanned. There will be a force generation bill but, with modern simulators and far more capable acoustic suites, the requirement for in-aircraft training can be reduced significantly. Well into the 90s the majority of the *Aurora's* YFR of 19,200 hours serviced the perceived ASW threat. This level of focus is not only unnecessary in the current context but is also unaffordable. That said, an ASW capability remains important for Canada and an appropriate fraction of the current YFR of 8000 hours must be used to maintain it. If Canada eventually moves forward with an underwater surveillance network the number of dedicated ASW hours required can be reassessed.

4.3 - Arctic Operations

Canada can no longer afford to delay increasing its Arctic surveillance and control capabilities. The rapidly melting icecap will result in increased maritime activity in the North with a corresponding increase in potential threats, whether they are criminal or environmental. The recent increase in Russian northern activity and rhetoric are another indication that Canada must refocus on establishing its Arctic sovereignty.[161] There are many parts to this process, of which developing an effective Arctic surveillance

[161] Steven Chase, "Russia goes one step further," *The Globe and Mail*, 27 March 2009 [Article on-line]; available from http://www.theglobeandmail.com/servlet/story/RTGAM.20090327.wrussia0327/BNStory/Front/home; Internet accessed 24 April 2009.

framework is only one. As has been mentioned previously however, it is a critical first step and must be addressed. The lack of infrastructure, the long distances involved, and the harsh climate all present unique challenges to the CF ISR 'system of systems'.

The full range of surveillance capabilities is required in the North. This has been underlined by a number of recent events, including a recently reported submarine sighting in Lancaster Sound at the eastern entrance to the Northwest Passage.[162] *Auroras* were dispatched to investigate the sighting but were unable to locate the vessel of interest. Such events are not as rare as one would assume, and the fact that a submarine was not found certainly does not mean that one was not in the area. A number of countries have the ability to operate with relative impunity in Canadian Arctic waters, and until Canada establishes a persistent underwater surveillance network they will continue to do so. The examples introduced earlier in this paper of illegal entry via small boats present another significant security challenge. Such vessels would be difficult to detect even with a well-established surveillance network.

In terms of surveillance hours required, the model introduced by Op Leviathan does not fully address the requirement in the Arctic. Leviathan is based on contacts approaching Canada from the East. Contacts travelling to northern ports will therefore be exposed to the Canadian surveillance effort for a significant period of time before they reach Arctic waters. As the Arctic sea-ice recedes, non-traditional maritime threat axes will become significant to the discussion, with contacts approaching Canada via the polar sea. Modifying the model to include these new avenues of approach will have a

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[162] Steven Chase, "Military Scrambled Over Foreign Sub Sighting," *The Globe and Mail*, 20 March 2009 [Article on-line]; available from http://blog.marport.com/2009/03/23/military-scrambled-over-foreign-sub-sighting/; Internet accessed 24 April 2009.

significant effect on the total *Aurora* flying hours required to provide the desired probability of identification and rate of revisit. The Polar Epsilon project is aimed at addressing this issue through a new Radarsat satellite constellation, and will be discussed in greater detail in the following chapter. One problem with using this approach exclusively is the predictable nature of satellite surveillance. In order to retain the required degree of randomness other surveillance and patrol activities will still be necessary. Another problem is that a satellite cannot exert control over a situation on the ground. Instead, satellites act as a 'tripwire' to initiate a response by other assets. In the Arctic this task will likely fall to manned platforms, as the technological hurdles involved in operating UAVs in the North are still significant. The concept of 'presence' operations, as with the *Aurora* Northern Patrols (NORPATs) which involve low-level flights over northern communities, adds another requirement best met by a manned platform. Though only two of these patrols are currently flown each year, the number of flying hours dedicated to them will depend on a variety of factors, many of which are not military in nature.[163]

4.4 - Deployed Operations

The demand for increasingly capable surveillance systems to support deployed operations has been growing rapidly since the First Gulf War. The more traditional Airborne Early Warning (AEW), Signals Intelligence (SIGINT) and ASW aircraft have had their systems augmented by EO/IR cameras, Full-Motion Video (FMV) and Synthetic Aperture Radar / Ground Moving Target Indicators (SAR/GMTI). The use of the term 'Intelligence, Surveillance and Reconnaissance' grew from the overlapping of distinct

[163] SCONSAD, *Canada's Coastlines* …, 20.

capabilities in single platforms, and has come to describe an integrated process of sensing, analyzing and disseminating information to warfighters. Throughout the 90s and over the course of the current conflicts in both Iraq and Afghanistan, the introduction of ever more capable, manned and unmanned ISR systems has fundamentally changed the way operations are conducted.

UAVs have been supporting operations for many years, but recently their use has escalated dramatically, particularly in Iraq and Afghanistan. US military drones logged over 285,000 hours supporting operations in 2007, flying as many as 18 combat air patrols each day,[164] without taking into account those hours flown by smaller UAVs assigned to tactical formations. The larger unmanned systems have been armed with precision munitions, with some carrying weapon loads comparable to those of fighter aircraft. With a loiter capability of as much as 40 hours they represent a significant force multiplier to the supported unit. A variety of fixed-wing assets also contribute to the ISR mission, ranging from the relatively light, twin-engine RC-12 to the US Navy's P-3C. Dominating the battlefield are the triumvirate of the E-3 Airborne Warning and Control System (AWACS), the E-8 Joint Surveillance and Target Attack Radar System (JSTARS), and the EC-135 Rivet Joint Signals Intelligence (SIGINT) aircraft.[165] Commanders planning ground operations, particularly those of the Special Operations

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[164] "Rise of the Machines: UAV Use Soars," Unattributed, *Associated Press*, 2 January 2008 [Article on-line]; available from http://www.military.com/NewsContent/0,13319,159220,00.html; Internet; accessed 24 April 2009.

[165] John A. Tirpak, "ISR Miracles, At a reasonable price," *Air Force Magazine*, 2 February 2006 [Article on-line]; available from http://integrator.hanscom.af.mil/2006/February/02022006/02022006-20.htm; Internet; accessed 24 April 2009.

Forces (SOF), have increasingly identified ISR support as a 'go-no-go' item.[166] Experience gained by the CF in Afghanistan has underlined the importance of airborne ISR while at the same time identifying the overall scarcity of platforms, even with the resources identified above. The lack of a robust, nationally controlled capability has often left Canadian troops unsupported, with allied ISR assets tasked to other priorities. Unfortunately the CF has had difficulty procuring new ISR assets quickly, after much of the political support for sole source contracting was spent on larger capital projects.[167]

The purchase in 2003 of the CL-161 *Sperwer* Tactical UAV (TUAV) is an example of good intent gone wrong. Though it was obtained relatively quickly, the choice of system was not coordinated effectively between the Air Force and Army. The characteristics of the platform made it difficult to use in Afghanistan and the air vehicles have suffered numerous crashes over the course of the operation. [168] Despite these setbacks, the *Sperwer* proved that ISR support was a significant force multiplier. At the same time, the Air Force virtually ignored the overland capabilities inherent in the *Aurora*, despite evident allied success with similar platforms operating over the battlefields of both Iraq and Afghanistan. A two-aircraft detachment was deployed to conduct maritime interdiction operations in the Middle East from 2001-2003 on Operation Apollo. This was repeated in 2004 in support of Operations Sirius in the

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[166] This information comes from discussions the author has had with Canadian officers in Afghanistan as well as from personal experience flying the RAF's Nimrod MR2 over Iraq in the ISR role.

[167] Sole source contracting has created much recent controversy. Basically, it is a process by which the military identifies and purchases the system it requires without initiating a formal competitive process. This normally involves projects where the capabilities required by the CF will not realistically be met by any other system on the market. One example of recent sole sourcing was the CC-177 Globemaster III.

[168] Canadian American Strategic Review, "Unattainable Aerial Vehicles? Overview – Canadian Forces' CU-161 Sperwer UAV in Afghanistan," http://www.casr.ca/id-afghan-uavs-1.htm; Internet; accessed 24 April 2009.

Mediterranean, but the *Aurora's* first overland ISR deployment is only just being planned.[169] By contrast, the recent lease of three *Heron* UAVs under Project NOCTUA was well managed and coordinated with the aircraft already operating in theatre at full potential in a matter of months after the contract was initially let.[170]

The number of flying hours required of these systems is variable and depends a great deal on the operation being conducted. As an example, the three *Heron* UAVs in Afghanistan are contracted to fly up to 550 hours each month or 6600 hours annually.[171] Currently only 300 Aurora hours are dedicated to deployed operations. Under the 23,000-hour model this would increase to 2800 flying hours.[172] The correct mix of unmanned and manned systems is an important consideration, one which the CF seems to have ignored. UAVs generally have an advantage over manned platforms in both endurance and in their more expendable nature. Manned platforms generally have advantages in speed, an ability to operate in adverse weather conditions, their greater capacity for both weapons and sensors, and a more complete 'situational awareness'.[173] Manned platforms are also capable of self-deploying and can operate without additional

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[169] Matthew Fisher, "Canadian Air Force to map Afghanistan," *Canwest News Service*, 6 April 2009 [Article on-line]; available from http://www.canada.com/news/Canadian+force+Afghanistan/1469223/story.html; Internet; accessed 24 April 2009.

[170] "Canadian Air Force Takes Delivery of First Heron UAV System," Unattributed, *Deagl.com*, 15 October 2008 [Article on-line]; available from http://www.deagel.com/news/Canadian-Air-Force-Takes-Delivery-of-First-Heron-UAV-System_n000005178.aspx; Internet; accessed 24 April 2009.

[171] Department of National Defence, *NOCTUA Project Unmanned Aerial Vehicle Concept of Operations – Draft 2.0* (Winnipeg: Commander 1 Canadian Air Division, 2008), 3-4.

[172] CP-140 YFR and surveillance requirement information was taken from a PowerPoint presentation prepared in 2007-2008 by A3 Maritime staff at 1 Canadian Air Division, Winnipeg.

[173] This last point is debatable but, in the author's experience on operations, is accurate. The world of a UAV is limited to a great extent by the field of view of its EO/IR sensor. The advantage of being able to simply look out the window cannot be discounted. Additional UAV sensors will improve this but, in the author's opinion, fixed-wing aircraft will retain an advantage in complex situations, whether caused by events on the ground or by changing weather conditions in the air.

support for extended periods of time. Unmanned platforms often cannot do either, particularly if there is a requirement to transit foreign airspace. Different platforms have specific strengths and weaknesses. Canada must determine the correct mix based on requirements, cost and overall force flexibility.

4.5 - Summary

Canada's surveillance requirements are dominated by its huge AOR and by its international commitments. This discussion has focused on the maritime domain, as this is where Canada's surveillance capabilities are weakest. The capability gap identified by the Op Leviathan model is in the order of 15,000 *Aurora* flying hours. The model does not address developing Arctic surveillance issues but hours for ASW and deployed operations are included. While the contributions of the DFO surveillance aircraft and NASP reduce the requirement for the CF to focus on the Inner-Middle Zone, neither of these can be brought to bear against sub-surface threats or deployed on operations. The model will obviously need to be refined to take into account emerging threats and planned sensor improvements but the starting point presents a significant challenge.

The security of Canada's maritime approaches and EEZ is a crucial aspect of its future economic prosperity, and is thus of vital national interest. An effective surveillance and control network must form the basis of this security. Persistent awareness of one's AOR provides decision superiority. The resulting Common Operating Picture will provide the Canadian Government with an invaluable tool on which to base its decisions, and its integration with US data sources through NORAD will only increase its value. Getting there from here is the challenge.

Unfortunately Canada has progressively shed surveillance capabilities over the past forty years, beginning with the cuts of the early 70s. The CFDS mandates that "the [CF must] be aware of anything going on in or approaching our territory."[174] It also states that the CF must "deter threats to our security before they reach our shores, and [must] respond to contingencies anywhere in the country."[175] These are significant challenges for a surveillance force of 20 aged aircraft and the crews that fly them. There are certainly other forces that contribute to this effort but the *Aurora* is the only Canadian platform that can begin to address all that these statements imply. Canada's current and planned surveillance capabilities are the focus of the following chapter.

[174] DND, *Canada First …*, 8.

[175] *Ibid.*, 8.

Chapter 5 - An ISR 'system of systems'

A variety of surveillance platforms can contribute to achieving the desired level of coverage across Canada's AOR. Fixed surface-based radars located along the coastline could cover a significant portion of both the Inner and Middle Zones. Radar systems mounted on tethered balloons would expand coverage through increased line-of sight (LOS) but would be challenged by Canada's difficult weather conditions. Ships can make significant contributions, particularly if they are paired with a shipborne helicopter or UAV system. However, when considering the portion of Canada's AOR that cannot be covered by land-based assets, the unique challenges of the Arctic, and the desired level of coverage, the lion's share of the mission must fall to aerospace systems.

Aerospace systems provide the reach and timeliness necessary to establish surveillance and control over the entire AOR while at the same time minimizing the number of actual platforms required. Where historically these platforms would all be manned aircraft, improvements in technology allow a range of platforms, including space-based, manned and unmanned systems to be integrated into the surveillance framework. This is the essence of an ISR 'system of systems'. One of the challenges associated with developing such a system is accurately determining the nature of the contribution that each system can make to the whole. The degree to which a given platform addresses the functions of surveillance, patrol and response must be considered. For example, while the *Aurora's* capabilities lie mainly in the patrol and response functions, those of *R2* lie squarely in the surveillance function. The tendency to inflate the benefits of given technological advances must be avoided, particularly when budgetary pressures are brought to bear. The importance of setting an appropriate

balance between acquiring new technology and retaining a core capability in traditional systems is also critical to achieving timely improvements to Canada's surveillance capabilities.

The four CF ISR projects of specific interest are Polar Epsilon, the CMA, JUSTAS, and the MHP. These projects represent the future ISR 'system of systems' at the strategic and operational level. There are other projects planned that will contribute to the COP, but they reside mainly at the tactical level and will not be looked at in detail. Before delving into particulars, current CF aerospace ISR capabilities will be outlined and three modern sensor technologies introduced. The basic parameters of each of the future projects will then be examined to identify the potential contributions that they will make to the whole, as well as the potential risks and weaknesses of each project.

5.1 - Current Canadian Airborne ISR Capabilities

Canada's maritime surveillance requirements are currently addressed by a mixed force of manned aircraft operated by, or on behalf of, three government departments, namely DND, TC, and DFO. The most capable platform, in terms of reach and the range of capabilities it possesses, is the CP-140 *Aurora* LRPA. As was mentioned earlier the Aurora fleet suffers from very poor availability. It is also severely undermanned, a fact that will be discussed below. Canada's *Sea King* helicopters do not regularly contribute to domestic surveillance activities but they do still provide effective service on deployed maritime operations. TC operates four fixed-wing aircraft as part of NASP, the focus of which is marine pollution detection. Lastly, DFO contracts PAL to operate three aircraft in the maritime surveillance role, conducting fisheries patrols in the Inner-Middle Zone primarily.

The Chretien government announced AIMP in 1998. In order to spread the cost of the program over a longer period, AIMP was to upgrade the fleet of 18 aircraft through a four-phased approach involving 23 sub-projects, to be completed in 2008. Phase I focused on replacing legacy systems that were no longer supportable or that no longer met Canadian aerospace regulations. Phase II replaced the navigation and communications systems and upgraded certain aspects of the flight deck. Phase III dealt with the *Aurora's* obsolete sensor suite, replacing the mission data computer, radar, acoustics system and electronic warfare system. Phase IV, which was never funded, was meant to provide the aircraft with a modern standoff weapon and a self-defence system. The three *Arcturus*, purchased in the early 80s, were not included in AIMP and were scheduled to retire in 2004 though two have subsequently been extended to 2009.[176]

Though this sounded like a reasonable way to approach an expensive and complicated upgrade, the devil was in the details. The key problem was that the mission data computer would not be replaced until the third phase, meaning that most of the modern systems added in Phases I and II had to be backward engineered to mate with the original 1980s vintage computer. A second problem was that each aircraft would have to cycle through the upgrade facility four times. The effort required to prepare an aircraft for an upgrade is significant, involving a partial teardown and the removal of many systems, often including systems that have nothing to do with the upgrade itself. Once the new equipment is installed, the aircraft must be put back together and go through a thorough test and acceptance program to return it to operations. As is often the case the

[176] This information comes from officers on JCSP 35 familiar with current operations at 14 Wing Greenwood, where the two *Arcturus* are based. The *Arcturus* will be flown up to the point when their next periodic maintenance inspection is required and then retired. A periodic is currently required every 6000 flying hours and involves a significant 'teardown' and rebuild of the entire aircraft.

prime contractor, IMP Aerospace, was overly confident in its ability to manage this $1.6B program. The result was that work did not begin on the Phase III prototype until 2007 with a planned first flight in the summer of 2009.[177] This will delay overall program completion to no earlier than 2012.[178]

Another complication was the identification in 2000 of a fleet wide corrosion problem that would limit the aircraft life to the 2012-2015 timeframe at planned usage rates. The *Aurora* Service Life Extension Project (ASLEP) was proposed at a cost of approximately $600M. The aim of the program was to replace major structural elements in the wing and horizontal stabilizer in order to extend the aircraft to at least 2025. As of 2007 ASLEP remained unfunded and the Conservative government made a controversial decision to cancel AIMP in September 2007, stating that a new aircraft would instead be purchased to replace the *Aurora*.[179] It was soon realized that even with a significant reduction to the *Aurora* YFR a replacement aircraft would not be available until well after the last *Aurora* was grounded. AIMP was therefore reinstated for all 18 aircraft and ASLEP for the 10 'youngest' was approved in December 2007. The fleet YFR was also increased to 8000 hours from a low of 6500 hours and the planned retirement of the two remaining *Arcturus* was delayed until 2009. These measures are intended to extend the *Aurora* to 2020, by which time the new CMA will be in service.[180]

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[177] Canadian American Strategic Review, "Continuing the Aurora Incremental Modernization Project," http://www.casr.ca/doc-dnd-aurora-aimp.htm; Internet; accessed 24 April 2009.

[178] This information was taken from a PowerPoint presentation prepared in 2009 by Director of Air Requirements (DAR) staff in Ottawa working on the CMA project.

[179] "Ottawa halts $1.6B upgrade of patrol aircraft," Unattributed, *CBC News*, 20 September 2007 [Article on-line]; available from http://www.cbc.ca/canada/story/2007/09/20/aurora-upgrade.html; Internet; accessed 24 April 2009.

[180] This information was taken from a PowerPoint presentation prepared in 2009 by DAR staff in Ottawa working on the CMA project.

Manning for the *Aurora* fleet has also been reduced significantly over the past fifteen years. In 1995 there were three operational and one training squadron, with a total of 27 crews, including 21 line crews.[181] 415 Maritime Patrol (MP) Squadron was disbanded in August 2005 and crews have been progressively reduced to a current total of 12, only eight of which are line crews. These reductions have fed the new headquarters created by CF Transformation, the new Air Warfare Centre, and the creation of a strategic lift capability amongst other initiatives. Two of the remaining ten crews are currently assigned to project NOCTUA, operating the *Heron* in support of operations in Afghanistan. Over the same period *Aurora* YFR has been reduced from 19,200 to the current 8000 hours. Aircraft availability has become progressively worse, the result of a 'just-in-time' spare parts philosophy, [182] a lack of experienced maintenance personnel, and the poor performance of the third-line contractor.[183] Combined, these factors have reduced the effectiveness of the *Aurora* fleet to a point from which the recovery of a robust long-range surveillance capability will be a long and arduous process. This is a critical issue. While other CF communities contribute in various ways, the *Aurora* community is the repository of long-range surveillance expertise. As a result of these various issues the *Aurora* readiness posture has been reduced to two aircraft at 12 hours

[181] CP-140 manning information was taken from a PowerPoint presentation prepared in 2007-2008 by A3 Maritime staff at 1 Canadian Air Division, Winnipeg. The term 'line' crew refers to those crews that carry out normal day-to-day operations. Personnel assigned duties with the operational squadron headquarters, the training squadron and other *Aurora* support units form the remaining crews.

[182] The 'Just-in-time' approach to spare parts was introduced in the 90s as a cost savings measure. Rather than keeping expensive parts on the shelf the intention was to use predictive models to determine more accurately what parts would be required and purchase them 'just-in-time'. This concept was flawed and has resulted in aircraft waiting extended periods of time for even the most basic part.

[183] The third-line contractor is IMP Aerospace, the same company coordinating AIMP and ASLEP. Their resources have reportedly become overwhelmed, to the point that the *Aurora* periodic maintenance cycle has been significantly delayed. Aircraft reaching the 6000 flying hour limit are grounded for significant periods of time waiting for a spot in the cycle.

notice-to-move, one on each coast, and one aircraft and two crews available to be deployed.[184]

The contribution made by DFO and TC is significant. The three PAL *King Air 200* aircraft currently fly as many as 5200 hours annually, conducting fishery and pollution patrols primarily within the East and West Coast EEZs.[185] NASP *Dash-7* and *Dash-8* aircraft are equipped with modern sensors optimized for identifying maritime polluters. These aircraft are programmed to fly as many as 2000 hours each year and include the Arctic and the Great Lakes in their operating area.[186] TC reports that, during 2006-2007, 10,063 vessels were identified over the course of NASP patrols totaling 1649 flying hours. Of these contacts 98, or just under 1%, were identified as polluters. [187] Given that 1700 vessels can be found in the Canadian maritime approaches each day,[188] an extrapolation of these results would indicate that a significant number of polluters is going undetected.

Each of the three fixed-wing fleets feed patrol results into the still-nascent COP being developed by the MSOC project, particularly on the East Coast. At the moment this process is not automated and occurs post-flight. The ability to transfer real-time surveillance information via datalink has not yet been established.

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[184] Current CP-140 readiness posture information was obtained from A3 Maritime staff at 1 Canadian Air Division, Winnipeg.

[185] TC, *National Maritime Domain Awareness* …, 39.

[186] Transport Canada, "National Aerial Surveillance Program – May 2006," http://www.tc.gc.ca/mediaroom/backgrounders/b04-m126e.htm; Internet; accessed 23 April 2009.

[187] Fisheries and Oceans Canada, "Health of the Oceans Initiatives – A Listing by Lead Department or Agency," http://www.dfo-mpo.gc.ca/oceans/management-gestion/healthyoceans-santedesoceans/initiatives-eng.htm; Internet; accessed 24 April 2009.

[188] Avis, "Surveillance and Canadian Maritime Domestic Security,", 9.

The ever increasing demands for ISR products on deployed operations, and the relative lack of available allied assets, has forced the CF to obtain its own systems. The first such system, the CU-161 *Sperwer* TUAV, had significant weaknesses but nevertheless proved that ISR systems were critical force multipliers. The follow-on Medium-Altitude Long-Endurance (MALE) UAV, recently leased for service in Afghanistan, has been mentioned a number of times already.[189] The CU-170 *Heron* is far more capable than the *Sperwer*, but particularly in terms of endurance and equipment fit. The contract calls for a single 14-hour mission daily with the ability to surge to a monthly YFR of 550 hours. The UAV is capable of remaining aloft for 24 hours and carries a mix of sensors including SAR, EO/IR, EW and laser designation systems to a maximum total weight of 250 kg.[190] Two smaller drone systems, the CU-168 *Skylark* mini-UAV[191] and Boeing *Scan Eagle*,[192] have also been acquired, primarily to provide force protection for tactical units. A manned ISR system has recently deployed in the form of the Interoperable *Griffon* Reconnaissance Escort Surveillance System (INGRESS). This is basically a modern EO/IR turret mounted on the CH-146 *Griffon* utility helicopter, which will be used primarily to escort Canada's small force of CH-47D *Chinooks*.[193] Operations in Afghanistan have allowed effective tactics, techniques and procedures

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[189] NOCTUA is Latin for 'little owl'

[190] DND, *NOCTUA Project* …, 2.

[191] "Canada Selects Skylark as its Future Mini-UAV," Unattributed, *Defense Industry Daily*, 6 October 2006 [Article on-line]; available from http://www.defenseindustrydaily.com/canada-selects-skylark-as-its-future-miniuav-02689/; Internet; accessed 24 April 2009.

[192] "ScanEagle UAV Logs 150,000 Service Hours in Iraq and Afghanistan," Unattributed, *Air Force News*, 14 April 2009 [Article on-line]; available from http://www.defencetalk.com/scaneagle-uav-logs-150000-service-hours-in-iraq-and-afghanistan-17714/; Internet; accessed 24 April 2009.

[193] "INGRESS: New Eyes for Canada's Griffon Helicopters," Unattributed, *Defense Industry Daily*, 15 July 2008 [Article on-line]; available from http://www.defenseindustrydaily.com/INGRESS-New-Eyes-for-Canadas-Griffon-Helicopters-04980/; Internet; accessed 24 April 2009.

(TTPs) for employing individual systems to be developed but have stopped short of establishing an integrated ISR 'system of systems'. While completely focused on overland ISR missions, these assets will allow CF personnel to gain much needed experience in ISR operations, which hopefully will translate into a better understanding of requirements.

5.2 - Modern Sensor Technology

Modern EO/IR cameras and AIS have recently made maritime surveillance efforts significantly more effective and more efficient. A third sensor improvement, the introduction of SAR/GMTI, promises to improve this even further. The combined effect of these technologies is to increase the standoff range at which a contact can be identified. Meteorological conditions that would curtail operations due to their effect on older sensors are now largely mitigated. Surveillance capabilities at night have also been greatly improved. Where traditionally the need to obtain a positive identification has implied a visual confirmation of the name or registration number of a vessel, these sensors introduce the ability to develop a probable identification that, in many situations, is more than sufficient. The process of collating data derived from various sensors to develop a COP has always been an element of Anti-Surface Warfare (ASuW) in a threat environment. These new sensors make this a much simpler process.

EO/IR cameras such as the L-3 Wescam MX-20 mounted on the *Aurora* integrate several distinct sensors into a single turret, adding the flexibility to optimize the sensor fit to match a specific mission. As the name implies, electro-optical sensors with both fixed and variable focal lengths are available, as well as very sensitive infrared sensors. Images can be digitally enhanced to improve performance in fog and haze conditions, and a laser

illuminated night spotter allows subject identification in total darkness. A laser rangefinder allows accurate targeting information to be derived through the camera system, and a laser designator can be used to provide terminal guidance for precision strikes.[194] In good conditions, day and night, standoff positive identification ranges of as much as 50nm are possible against larger contacts.[195] The capabilities provided by EO/IR cameras are equally useful in domestic and deployed operations.

AIS is to a ship what a transponder is to an aircraft. Originally designed for collision avoidance, AIS receiver/ transmitters respond to queries from like systems with a standard format data stream, providing information automatically. The stream includes the "ship's identity, type, position, course, speed, navigational status and other safety-related information."[196] AIS must be mounted on all ships of 150 tons or more that are carrying more than 12 passengers on international voyages. If fewer than 12 passengers are carried the minimum is 300 tons and if the vessel is operating domestically it is 500 tons. Fishing vessels are not included in this requirement. A shore-based AIS installation can be used to monitor all ships within range 24/7. A patrol aircraft equipped with AIS can correlate the received data with radar contacts thereby 'identifying' them. As the system can be tampered with, a number of random confirmatory passes must be conducted against transmitting vessels, but overall AIS will enable a given platform to significantly expand its effective patrol area. The introduction of AIS will reduce the

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[194] L3 Communications Wescam, "The Wescam™ MX-20," http://www.l-3com.com/wescam/products/products_services_1h.asp; Internet; accessed 24 April 2009.

[195] This statement is based on the author's own experience operating EO/IR-equipped LRPA.

[196] Transport Canada, "Automatic Identification System (AIS) Requirement – July 1, 2008," Ship Safety Bulletin (09/2007): 2.

surveillance problem to identifying those vessels detected that are not emitting AIS signals.

Despite the fact that AIS has existed for a number of years and is inexpensive, the *Aurora* fleet is only just being fitted to carry it. By contrast the PAL contract aircraft were the first surveillance aircraft in North America to be so equipped.[197] An ability to detect AIS via satellite is being developed for Canada and is already available through a US military-sponsored satellite constellation, called TacSat.[198] While the highly elliptical orbits of TacSat satellites are focused on US requirements, they will increase AIS coverage of Canada's eastern and western maritime approaches significantly. In terms of shore-based AIS infrastructure, the CCG will complete a network in 2009 covering the Atlantic and Pacific coasts as well as the St. Lawrence Seaway and Great Lakes Region.

In very basic terms a Synthetic Aperture Radar emits wide-bandwidth electromagnetic pulses that are then processed through a complicated algorithm to develop a picture of the target area. Computing power, combined with the forward movement of the carrying platform, synthetically increases the radar aperture resulting in highly detailed radar images.[199] The small size of a SAR system allows it to be mounted on both airborne platforms and satellites, and the high-resolution products lend themselves to many surveillance applications. In poor weather conditions SAR can be used to paint a picture of a contact, allowing the class of vessel and even the individual

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[197] "Provincial Airlines Successful in Bid for Five-Year DFO Aerial Surveillance Contract," Unattributed, PAL News Release, 16 March 2004 [Article on-line]; available from http://www.provincialairlines.ca/documents/dfoNR.pdf; Internet; accessed 24 April 2009.

[198] Peter J. Brown, "Scanning Borders and Seas via Satellite," Satellite Today, 1 April 2007 [Article on-line]; available from http://www.satellitetoday.com/via/supplement/Scanning-Borders-And-Seas-Via-Satellite_17412.html; Internet; accessed 24 April 2009.

[199] Sandia National Laboratories, "What is Synthetic Aperture Radar?," http://www.sandia.gov/radar/whatis.html; Internet; accessed 24 April 2009.

unit to be identified in some cases. The comparison of multiple SAR images taken of the same target area over a period of time can be used to identify terrain disturbances as small as a few centimetres.[200] This is called SAR interferometry or 'coherent change-detection' and has a real world application in Canadian efforts to detect IEDs in Afghanistan. SAR images can be used to create a 3-D map of a target area and SAR can also be used to track moving targets through a process called Ground Moving Target Indicator (GMTI).[201] A Canadian company, MacDonald, Dettwiler and Associates Ltd. (MDA), is a world leader in SAR technology and is the force behind *R2* and the new SAR/GMTI system being developed for the *Aurora*.

Other technologies are being developed that sit somewhat beyond the scope of this paper but which may eventually contribute to a CF ISR 'system of systems'. These are surface-based systems whose aim will be to provide continuous coverage of specific areas within the Canadian AOR. The example of an underwater tripwire has already been introduced. A High-Frequency Surface Wave Radar (HFSWR) system, installed at two locations along the Newfoundland coast, has been the subject of a recent DRDC study. These efforts have had mixed results, with weather and local electronic interference significantly reducing effectiveness. Another concept involves mounting surface-search radar on a tethered aerostat to utilize the Line-of-Sight (LOS) advantage. This approach is hampered mostly by weather, in particular high winds, but could be very useful in a temporary or mobile application.

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[200] Sandia National Laboratories, "What is Synthetic Aperture Radar?," http://www.sandia.gov/radar/whatis.html; Internet; accessed 24 April 2009.

[201] This capability is already installed in the US Air Force Joint Surveillance and Targeting Attack Radar System (JSTARS) and the Royal Air Force Airborne Stand-Off Radar (ASTOR) aircraft and has been used with great success over the battlefields of Iraq and Afghanistan.

5.3 - Polar Epsilon

Project Polar Epsilon is the CF's exploitation of the R2 satellite to conduct surveillance of Canada's maritime approaches and the Arctic. Special algorithms and beam modes are being developed to allow ships and even oil slicks to be differentiated from the surrounding sea and ice. TC is focusing on the use of this second capability in its ISTOP project. [202] Two satellite ground stations have been established, one in Esquimalt and the other in Halifax, to enable near real-time ship detection when the satellite is in communications range. Initial tests to coordinate R2 surveillance efforts with airborne patrols have been quite successful and the satellite is forecast to achieve its full maritime surveillance capability by March 2011. This will not include an AIS-via-satellite capability and the downlink of Arctic surveillance information will be time-delayed by the lack of a northern ground station. The Canadian Space Agency currently plans to launch the Radarsat Constellation Mission (RCM) in the 2014 timeframe, utilizing three to six satellites with improved capabilities. Named Polar Epsilon II, the CF's interests in RCM lie mainly with its more frequent coverage of the Canadian AOR and a promised AIS-via-satellite capability. Given the polar orbits of the RCM satellites, the majority of the Arctic will be swept at least four times a day in the event only three satellites are launched.(ref – Figure 5) Though this will not necessarily equate to one pass every six hours it will be a significant improvement over current coverage, providing an effective 'tripwire' to launch airborne missions. The establishment of a third ground station in the north would then allow this warning to be near real-time. The CF had hoped to leverage a satellite-based GMTI capability through the RCM but the planned

[202] Environment Canada, "Satellite aims to reduce marine pollution," http://www.ec.gc.ca/EnviroZine/english/issues/70/feature2_e.cfm; Internet; accessed 24 April 2009.

radar antenna size for the new satellites will not allow this, despite the advantages of SAR technology.[203] Interestingly, the US has initiated a very similar project to RCM called Space Based Radar, with hopes to launch the first of twelve satellites in 2015.[204] Combined, these two systems represent a significant surveillance capability, one that will hopefully be fully integrated through NORAD.

The 1987 White Paper stated that "only space-based surveillance has the potential for complete coverage of Canadian territory and adjoining air and sea space."[205] While this is accurate to a certain point it must be qualified. The planned satellite constellation will provide Canada's first true surveillance capability, but it must still be supported by assets operating in the patrol and response roles, in order to meet both the surveillance and control requirements.

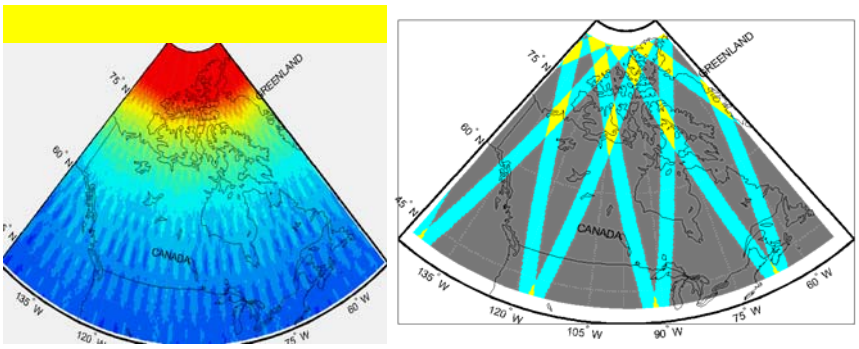

Figure 5 – Comparison of RCM daily coverage to R2. (Red = 4 passes/day; Dark Blue = less than 1 pass/day) (Yellow = 2 passes/day; Blue = 1 pass/day)

[203] This information was presented to JCSP 35 on 13 January 2009 by Director of Space Development staff in Toronto, ON.

[204] Los Angeles Air Force Base, "Space Radar," http://www.losangeles.af.mil/library/factsheets/factsheet.asp?id=5308; Internet; accessed 24 April 2009.

[205] DND, *Challenge and Commitment* …, 58.

5.4 - Canadian Multi-Mission Aircraft (CMA)

The CFDS announced plans to purchase:

> … 10-12 maritime patrol aircraft to replace the Aurora fleet. The new aircraft will become part of a surveillance 'system of systems' that will also comprise sensors, unmanned aerial vehicles and satellites and keep Canada's maritime approaches safe and secure, including in the Arctic.[206]

The CMA project has been assigned a budget of $3B and has a planned Initial Operating Capability (IOC) of 2018.[207] Given the small fleet size, it is interesting to note that the planned 'system of systems' is not further defined in the CFDS despite its obvious importance to the future Canadian surveillance framework.

Major procurement projects such as CMA are defined by a set of High Level Mandatory Capabilities (HLMC) determined by a detailed assessment of the defence tasks assigned to the asset. Rated Capabilities are those that are considered important but not critical. CMA is envisioned as a joint ISR and Command (ISR&C) platform, capable of contributing to the surveillance effort in the overland, maritime, and Arctic domains. The list of capabilities serves to frame the project in a succinct fashion, making it easier to explain and also allowing the main cost drivers to be identified. For CMA these are the sub-surface surveillance capability and the surface and subsurface weapons capability. Of these two, subsurface surveillance is a mandatory requirement while the weapons capability is currently rated.[208] A second rated capability is the ability to operate in a medium threat environment. This last is not actually a significant cost driver but will limit the aircraft's ability to deploy on operations if it is not included in the project.

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[206] DND, *Canada First* …, 17.

[207] This information was taken from a PowerPoint presentation prepared in 2009 by DAR staff in Ottawa working on the CMA project.

[208] This information was taken from a PowerPoint presentation prepared in 2009 by DAR staff in Ottawa working on the CMA project.

The Air Force Structure Analysis (ASTRA) tool was used to assess the minimum CMA fleet size needed to meet the force employment requirements established by the defence tasks currently assigned to the *Aurora* fleet. These are the ability to maintain a single 24/7 orbit on one coast, fly one mission a day on the other coast and on a deployed operation. The result of 15-17 aircraft takes into account periodic maintenance and an 80% serviceability rate, leaving nine aircraft for domestic operations and two deployed.[209] The ISR 'system of systems' would reduce the requirement to establish a surveillance orbit in the case of a surface contact, but would have little effect if the threat were sub-surface. Arctic surveillance and control requirements would also dictate the use of CMA, given that UAVs are not currently capable of operating 'north of 60'. This indicates that a fleet size of 15-17 aircraft is defendable and that a fleet of only 10-12 aircraft will result in the minimum force employment requirements not being met.

The sub-surface and weapons capabilities are significant cost drivers. An ASW capability requires specialized equipment and sensors, in particular air dropped sonobuoys. A weapons capability requires underwing hardpoints or a bomb bay, each of which would require significant engineering changes to existing aircraft designs. The CFDS is quite clear on this subject, mandating that the CF must not only have the "ability to identify threats, but also the capacity to address them."[210] This would indicate that the CMA weapons capability must be made a mandatory requirement, which brings the budget into question. The CMA Project Management Team have assessed that an aircraft

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[209] This information was taken from a PowerPoint presentation prepared in 2009 by DAR staff in Ottawa working on the CMA project. To note the *Aurora* fleet is currently unable to meet these requirements. The current *Aurora* fleet readiness posture is two aircraft available at 12 hours notice-to-move, one on each coast, and one aircraft and two crews available to deploy.

[210] DND, *Canada First* …, 7.

capable of surface surveillance only would cost between $80M and $120M each. The sub-surface and weapons capabilities could raise the unit price to as much as $250M. Given the budget of $3B, and the infrastructure and equipment costs associated with a new fleet, it is doubtful that even the planned 10-12 aircraft are affordable. Assuming that 10 aircraft were purchased, 4 to 6 would be available on any given day.[211] This would likely restrict the CMA to domestic operations only unless risks were taken in the level of coverage maintained over the domestic AOR. Concentrating the fleet at one of the two current Main Operating Bases (MOBs) would generate some savings but would also result in an increased threat reaction time on the opposite coast. It is hard to imagine that the CF surveillance and control capabilities would be improved in any significant way by this model.

5.5 - Joint Unmanned Surveillance Target Acquisition System (JUSTAS)

The JUSTAS project is intended to provide the CF with a modern multi-mission MALE UAV system to replace and increase the capabilities found in Project NOCTUA. JUSTAS is divided into two phases, the first providing an overland domestic and deployed capability and the second, a maritime and Arctic capability. Planned IOC for Phase I was 2012 with Phase II by 2015.[212] These dates have since been delayed due to the fact that JUSTAS has not yet been contracted but revised IOC dates have not yet been determined. Immediately, this identifies a gap between the current leased UAV, a contract that ends in 2010 with a possible extension of one year, and its planned

[211] This information was taken from a PowerPoint presentation prepared in 2009 by DAR staff in Ottawa working on the CMA project. It assumes an 80% serviceability rate with standard periodic requirements to determine the number of available aircraft.

[212] This information was obtained in discussions with DAR staff on 18 March 2009 in Ottawa, ON.

replacement.[213] A key assumption of the project is that a single air vehicle will meet the requirements of both phases, achieving savings in support and infrastructure costs and increasing overall flexibility.

	MALE - A	MALE - B	HALE
Max Speed	110-130 kts	240-260 kts	350 kts
Endurance	30+ hours	30+ hours	36 hours
Take-Off Weight	2,000 lbs	10,000 lbs	23,000 lbs
Weapons	Predator-A – yes; Heron - no	Predator-B – yes; Heron TP - planned	Global Hawk - no
Cost[214]	$3-6M	$7-10M	$40M

Table 1 – Representative MALE/HALE UAV classes (Information taken from various Internet sites)

The Draft JUSTAS Concept of Operations (CONOPS) details possible characteristics of the proposed UAV system that are instructive. The system may be armed, capable of carrying at least two 500-lb. weapons. It may be powered by a turbo-prop engine, thereby placing it in the 'larger, faster, higher' category of MALE UAVs. This category of UAV is much larger than the current *Heron* leased under the NOCTUA project, and is capable of carrying more powerful, multiple sensors and a large external payload. The new UAV must also be fully interoperable with allied datalink systems, and capable of operating safely in civil-controlled airspace and in light icing conditions. The last two characteristics are the main obstacles to domestic UAV operations and have yet to be successfully addressed. Significant challenges exist in convincing Canadian civil air regulators to allow any UAV operations in domestic airspace. Presumably these

[213] "Canadian Air Force Takes Delivery of First Heron UAV System," Unattributed, *Deagl.com*, 15 October 2008 [Article on-line]; available from http://www.deagel.com/news/Canadian-Air-Force-Takes-Delivery-of-First-Heron-UAV-System_n000005178.aspx; Internet; accessed 24 April 2009.

[214] The cost of UAVs varies greatly based on their sensor fit and what the specific contract includes. One source claims that a single Global Hawk can cost as much as $120M.

concerns can be overcome by developing an autonomous aircraft avoidance system for the air vehicle, and by mandating a certain level of redundancy in communications and control links. Equally significant are the challenges posed by Canadian weather conditions, particularly those on the East Coast and in the Arctic. Icing conditions and turbulence are common occurrences and current families of UAVs have demonstrated little tolerance of either.[215] Satellite coverage for the downlink of surveillance data and, more importantly, for the control of the air vehicle does not exist north of approximately 65 degrees of latitude.[216] UAV operations in the Arctic would therefore have to be pre-programmed or controlled via LOS control systems deployed to the area. These issues put the domestic, maritime, and Arctic roles of JUSTAS into some question. The fact that Phase II IOC remains undetermined adds to the conclusion that the project will not contribute significantly to domestic maritime surveillance for some time to come.

The long endurance of UAVs sets them apart from manned aircraft. The Heron is easily capable of 24-hour missions while the JUSTAS aircraft will remain aloft for more than 35. This advantage is somewhat reduced when range and reaction times are considered. The maximum speed of the Heron is 113kts while JUSTAS will reach speeds as high as 240kts. An *Aurora*, by contrast, cruises at 350kts and one of the potential CMA candidates, the P-8 *Poseidon*, cruises at 440kts. When responding to an event at the extremes of the Canadian AOR these differences can become significant. The

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[215] Matthew L. Wald, "Safety Fears on No-Pilot Airplanes," *New York Times*, 17 October 2007 [Article on-line]; available from http://www.nytimes.com/2007/10/17/business/17safety.html?_r=1; Internet; accessed 24 April 2009.

[216] This information was taken from a PowerPoint presentation prepared in 2009 by DAR staff in Ottawa working on the CMA project.

advantage of a UAV is that, once it arrives, it can remain ‘on-top’ for a significantly longer period of time.

In terms of manpower requirements there are some savings to be had but they are not as significant as one might first assume. A JUSTAS operational crew ranges from 5-8 persons, including data analysts, while an *Aurora* crew ranges from 7-10. In terms of aircrew duty day and crew rest regulations the two operations would be very similar. The concept of deployed detachments conducting UAV launch and recovery operations, and then passing control of the vehicle to an operating crew based in Canada, will reduce the already small personnel advantage.

JUSTAS represents another significant leap forward for the CF but it does not promise immediate solutions to the domestic surveillance problem. In fact, there are real obstacles to it having any effect at all. The linking of the domestic overland, maritime, Arctic and deployed requirements may be a mistake and could result in the purchase of an air vehicle that is not optimized for any of these roles. It seems obvious that the demands of the Canadian AOR will be far different from those of a deployed location. Two different air vehicles are likely the better approach for Canada.

5.6 - Maritime Helicopter Project (MHP)

It is important to include MHP in this discussion of the future CF ISR ‘system of systems’. In terms of capability, the CH-148 *Cyclone* represents a significant leap forward from the current *Sea King*. It is not unrealistic to consider this helicopter the equal of the most modern maritime patrol aircraft or to say that it will expand the surveillance capabilities of Canada’s frigates significantly. These aircraft will be fully integrated with the ship’s combat system and will possess advanced ASW and ASuW

capabilities, including subsurface weapons. That said, the *Cyclone's* range and endurance are still relatively short, and so it will remain restricted in terms of the total area that it can dominate with its sensors. After a particularly gruelling procurement process, delayed and manipulated by the Chretien government, a fleet of 28 *Cyclones* was ordered in 2004.[217] Technical delays have pushed IOC from 2008 to the 2010 timeframe, with the possibility that this will slip further to 2011.

5.7 - Summary

Canada's current aerospace surveillance capability is insufficient in light of the mandate presented in the CFDS. It is also clear that the gap identified earlier will not be addressed in any significant way before 2014. The *Aurora* fleet is both over-stretched and undermanned. The recent decisions taken on AIMP and ASLEP were necessary and are a step forward, but they address only one part of the problem. The manning issue is equally important and a plan is required now that will ensure that the CF retains a minimum level of surveillance expertise. CMA, JUSTAS, and to a lesser extent MHP, will all draw on the same personnel which adds another level of complexity to the discussion.

The NASP and DFO-contracted surveillance aircraft are a significant presence in the Inner-Middle Zone, but their activities are not yet fully integrated or coordinated with those of the CF. Expanding these capabilities and creating stronger interdepartmental links through the MSOC project would be a logical first step in addressing Canada's maritime surveillance weaknesses. Project NOCTUA represents a leap forward in

[217] Hobson, "Plain Talk…", 39.

deployed ISR capability, and the much-delayed deployment of an *Aurora* to Afghanistan in the overland ISR role is a very positive development.

New technologies, in particular AIS, will increase the effectiveness of individual aerospace assets and reduce the gap further. CF involvement in Polar Epsilon is proving worthwhile and promises Canada's first true surveillance capability through Polar Epsilon II and the Radarsat constellation. CMA is problematic in that, without additional funding, Canada will either have to accept fewer airframes or reduced capabilities. Also, the intended 10-12 aircraft fall below the minimum number required to address the defence tasks assigned to the capability. A dependence on UAVs to close the surveillance capability gap is premature, particularly in the domestic role

Chapter 6 – Conclusion

> Only by knowing what is happening and where, can a state respond to and formulate strategies to address security issues.[218]

The 2008 *Canada First* Defence Strategy states that "first and foremost, the Canadian Forces must ensure the security of our citizens and help exercise Canada's sovereignty."[219] Surveillance capabilities are inextricably linked to these mandates. Sovereignty is exercised by knowing what is going on in a given area and by having the ability to affect or control an event. The interrelationship between national sovereignty, national security and national defence has been reinforced in the post-9/11 era and the foundational nature of surveillance efforts reinforced. Recent and perceived security threats, combined with Canada's economic interests, bilateral responsibilities and international relationships make current weaknesses in surveillance capabilities unacceptable. From the CF point-of-view these weaknesses are most evident in the maritime domain. Current surveillance capabilities are insufficient and the projects aimed at correcting this, as envisioned and funded, will fall short of the mark.

The examination of government policy identified the security of Canadians and the sovereignty of Canada as the first national security and Defence priority. Why then, given this focus over a period of almost 40 years, have governments in Canada failed to follow through on their commitments? Were these policies just knee jerk reactions to isolated events? Were they intended simply to appeal to a domestic audience or are they an honest focus on the security challenges facing Canada?

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[218] Herbert and Crickard, eds, *Canada's Three Oceans* …, 54.

[219] DND, *Canada First* …, 7.

Direct threats to Canada have always been sufficiently hypothetical that Governments have not been forced to address the obvious weaknesses in the national security framework. Sovereignty protection has, for the most part, been achieved through the residual capability inherent in the equipment purchased to meet Canada's international commitments. This has occurred despite policy statements that suggest that the reverse should be the case. The current threat environment is much different than it was, and Canada's economic livelihood is now tied in many ways to its ability to secure its perimeter. It can be argued that failing to improve the national security framework in the past has not cost Canada a great deal. Given the changing world and Canada's place in it, the penalties associated with this approach are increasing dramatically.

The withdrawal from Europe and overall reduction of the CF was represented as a 'peace dividend'. Despite this the residual force was committed internationally to a greater extent then ever before, placing a great strain on CF members and equipment. Significant budget cuts meant that the CF had to make choices, with the result that surveillance capabilities were dramatically reduced. The CF chose to emphasize those capabilities that would allow it to undertake the missions the Government was actually assigning to it, rather than those to which the Government had given theoretical primacy. While the CF retained the ability to contribute to international coalitions, it lost a large part of its ability to act independently within the confines of Canada. The *Canada First* Defence Strategy places this ability first and foremost. It remains to be seen what real effect this focus will have.

Surveillance capabilities are a significant part of the new Defence Strategy. Without knowledge of an incident or potential threat the Government loses the ability to

control and manage the event to the benefit of Canadians. A significant capability gap has been identified and there is a need to fill that gap. This requires a viable fleet of LRPA with the ability to respond quickly over long distances with the full range of capabilities. The possible purchase of less than 10-12 aircraft planned for in the CMA project would affect viability. The purchase of a less capable surveillance platform in the interest of saving money or placating the Canadian aerospace lobby would result in a loss of flexibility and control over the AOR. This is the critical weakness of the proposed ISR 'system of systems'.

Another weakness is the current focus on JUSTAS as an answer to the capability gap. While UAVs have an enviable record on deployed operations their use in the maritime domain is unproven. The unique challenges of the Canadian AOR cannot be minimized in this discussion and it seems very premature to assume that these will be easily overcome. The main focus of JUSTAS is on deployed operations, and rightly so. Expanding the requirements in order to address a possible maritime and Arctic application does not make sense.

The other elements of the new ISR 'system of systems' cannot be forgotten. The model used to assess surveillance requirements must be revised to include the effect of all current and proposed surveillance assets. This would provide a more accurate picture of the interrelationships between the diverse parts of the system and provide decision-makers with clear choices. Efforts to leverage new satellite capabilities will form the basis for Canada's surveillance network and MHP will supplement CMA in the ASW role and on deployed operations. The contribution made by surveillance activities conducted by TC and DFO must be captured and, once fully integrated into Common Operating

Picture, will significantly reduce the capability gap in the Inner-Middle Zone. Leveraging new technology is also critical, in particular the full integration of AIS into surveillance activities.

Manning these capabilities will also be challenging. The viability of the future ISR 'Systems of systems' hinges on people and the CF is not developing the critical mass required to accomplish the task. CMA and JUSTAS will compete directly for the same personnel and, given the poor health of the LRPA community, both will end up short of experience. The CONOPs for each project must take into account the effect its personnel demands will have on the system as a whole and be adjusted in order to minimize this effect.

Expanding the 'system of systems' concept to include other aircraft fleets could mitigate some of these issues. One in particular that could contribute significantly to the maritime surveillance task is the Fixed-Wing Search and Rescue (FWSAR) aircraft. For a relatively small investment, capabilities such as AIS and EW could be added to the 17 aircraft of the new FWSAR fleet. Traditionally, Canada's SAR aircraft spend a large portion of their time over the coastal regions, so giving them a secondary role of surface surveillance would be very logical. Installing 'hands-off' AIS on Canada's tactical and strategic transport aircraft would make sense if the system were designed to report AIS information automatically to a ground station. One should also not forget the significant surveillance capabilities of the Next-Generation Fighter Capability (NGFC), and the fact that many fighter missions are flown in Canada's northern regions.

The creation of an effective ISR 'system of systems' hinges on the ability to integrate and share surveillance data in a timely, and preferably semi-automatic fashion.

The legal barriers affecting the smooth operation of the MSOCs, whether real or imagined, must be dealt with in a decisive manner. The fact that TC has only just published an MDA Strategy Framework highlights the very slow progress that is being made at the interdepartmental level. Government must provide clear direction with respect to priorities and requirements and the creation of a National MDA Plan accelerated. Mandates must also be clarified. The fact that DFO is the 'lead' for increasing surveillance flights is confusing given that, of the three departments involved in aerial surveillance, DFO is the only one that does not own its capabilities.

In conclusion, while each of the ISR projects has enormous merit, the fact remains that they will not meet the requirements outlined in the CFDS. While a number of measures have been suggested in this paper to mitigate this problem there is still an obvious and significant gap. The fundamental problem lies within the CMA project. As conceived and funded CMA cannot meet the goals that have been laid out for it. The fleet will either be too small or the aircraft will lack critical capabilities. The argument put forth in some circles that JUSTAS can address this deficiency is premature at best. The future ISR 'system of systems' is a critical capability for Canada and its effectiveness should not be left to chance.

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Glossary of Terms

AEW – Airborne Early Warning

AIMP – Aurora Incremental Modernization Program

AIS – Automatic Identification System

AOR – Area of Responsibility

ASLEP – Aurora Structural Life-Extension Program

ASTOR – Airborne Stand-Off Radar

ASTRA – Air Force Structure Analysis

ASW – Anti-Submarine Warfare

ASuW – Anti-Surface Warfare

AWACS – Airborne Warning and Control System

C2 – Command and Control

CIED – Counter Improvised Explosive Device

CBSA – Canadian Border Service Agency

CCG – Canadian Coast Guard

CF – Canadian Forces

CFDS – Canada First Defence Strategy

CIDA – Canadian International Development Agency

CMA – Canadian Multi-Mission Aircraft

COMINT – Communications Intelligence

CONOP – Concept of Operations

COP – Common Operating Picture

CSIS – Canadian Security Intelligence Service

DAR – Director of Air Requirements

DEW – Distant Early Warning

DFAIT – Department of Foreign Affairs and International Trade

DFO – Department of Fisheries and Oceans

DND – Department of National Defence

DRDC – Defence Research and Development Canada

EEZ – Economic Exclusion Zone

EO/IR – Electro-Optical / Infrs-Red

EROC – Expedient Route Opening Capability

FE – Force Employment

FG – Force Generation

FMV – Full-Motion Video

FOB – Forward Operating Base

FWSAR – Fixed-Wing Search and Rescue

GMTI – Ground Movement Target Indicator

HFSWR – High Frequency Surface Wave Radar

HLMC – High Level Mandatory Requirements

IMSWG – Interdepartmental Marine Security Working Group

INGRESS – Interoperable Griffon Reconnaissance Escort Surveillance System

IOC – Initial Operating Capability

IPS – International Policy Statement

ISR – Intelligence, Surveillance, Reconnaissance

ISR&C – Intelligence, Surveillance, Reconnaissance and Control

ISTOP – Integrated Satellite Tracking of Pollution

JSTARS – Joint Surveillance Targeting Attack Radar System

JTF – Joint Task Force

JTFA – Joint Task Force Atlantic

JTFN – Joint Task Force North

JTFP – Joint Task Force Pacific

JUSTAS – Joint Unmanned Surveillance Target Acquisition System

LOC – Line of Communication

LOS – Line of Sight

LRPA – Long-Range Patrol Aircraft

MALE – Medium Altitude Long Endurance

MARLANT – Maritime Forces Atlantic

MARPAC – Maritime Forces Pacific

MDA – Maritime Domain Awareness

MDA – MacDonald, Dettwiler and Associates, Ltd.

MHP – Maritime Helicopter Project

MOB – Main Operating Base

MPA – Maritime Patrol Aircraft

MSOC – Maritime Security Operations Centre

NASP – National Aerial Surveillance Program

NATO – North Atlantic Treaty Organization

NGFC - Next-Generation Fighter Capability

NORAD – North American Aerospace Defence

NORPAT – Northern Patrol

NSP – National Security Policy

NSS – National Surveillance Study

NSWG – National Surveillance Working Group

OAP – Ocean Action Plan

OGD – Other Government Departments

PAL – Provincial Aerospace Ltd.

PSEP – Department of Public Safety and Emergency Preparedness

R2 – Radarsat 2

RCM – Radarsat Constellation Mission

RCMP – Royal Canadian Mounted Police

RMP – Recognized Maritime Picture

SAR – Search & Rescue

SAR – Synthetic Aperture Radar

SAR/GMTI - Synthetic Aperture Radar/Ground Moving Target Indicator

SCTF – Standing Contingency Task Force

SIGINT – Signals Intelligence

SOA – Speed of Advance

SOF – Special Operations Force

SPSS – Self-Propelled Semi-Submersible

SSN – Nuclear-powered attack submarine

TC – Transport Canada

TEU – Twenty-Foot Equivalent Unit

TTPs – Tactics, Techniques, and Procedures

TUAV – Tactical Unmanned Aerial Vehicle

UAV – Unmanned Aerial Vehicle

UNCLOS – United Nations Convention on the Law of the Sea

USSR – Union of Soviet Socialist Republic

YFR – Yearly Flying Rate