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What Happened to Air Force ISR?

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ABSTRACT

Both past and current Governments of Canada have clearly established that security and sovereignty of the country is paramount. This emphasis on security and sovereignty is noted specifically in many of the previous Defence papers where the Government has assigned this role to the Canadian Forces. This importance continues to be stressed in all of the modern Canadian domestic and international security policy statements and most recently in the *Canada First* Defence Strategy. Unfortunately, these statements have not received adequate support in designating resources to conduct this role.

This paper argues that this lack of support and priority specifically not given to airborne intelligence, surveillance and reconnaissance (ISR) assets by the current and previous Governments, and the Canadian Forces (CF), has had a significant impact on the ability of the CF to conduct operations. This is especially true regarding the security and sovereignty of Canada where the impact is the most noticeable. This paper highlights how vital a robust airborne ISR capability is to military operations, shows how critical the CF situation has become, discusses how this affects domestic and expeditionary operations and proposes some possible solutions.

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INTRODUCTION

"By 'intelligence' we mean every sort of information about the enemy and his country – the basis, in short, of our plans and operations."

Karl von Clausewitz, *On War*, 1832[1]

The *Canada First* Defence Strategy clearly states what types of roles and missions the Canadian Forces (CF) is expected to do in support of the Government of Canada. These missions include "defending Canada, defending North America and contributing to international peace and security."[2] These are critical, no-fail missions that support existing foreign policy and national security objectives. As Clausewitz said, intelligence or information is the basis of military planning. In order to support these missions, the Department of National Defence (DND) Planning Guidance and CF operations doctrine includes dedicated intelligence, surveillance and reconnaissance (ISR) missions and tasks.

The first of these missions "defending Canada" is paramount. The CF must ensure security of Canadians and the Canadian public expects the CF to be there in times of crises to assist other government departments (OGD). These crises could include anything from natural disasters to terrorist attacks at the Vancouver 2010 Olympics. Within the *Canada First* Defence Strategy, the CF is specifically tasked to assist civil authorities in times of crises, conduct search and rescue as required on a 24 hours a day, seven days a week basis and provide surveillance of

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[1] Carl von Clausewitz, *On War*, Indexed edition, ed. and trans. Michael Howard and Peter Paret (Princeton: Princeton University Press, 1984), 117.

[2] Department of National Defence, *Canada First* Defence Strategy, (Ottawa: Government of Canada, 2008), 7-8.

Canadian territory and approaches both air and sea.[3] This surveillance includes helping to exercise sovereignty of Canada's Arctic.

The second of these missions "defending North America" involves working with our allies, especially the United States (US), both at home and abroad to ensure security of the continent. The most important aspect of this mission is our partnership with the US in the North American Aerospace Defence Command (NORAD).[4] NORAD is a bi-national US and Canadian organization that ensures aerospace warning and aerospace control for North America. Aerospace warning includes the monitoring of man-made objects in space, and the detection, and warning of attacks against North America whether by aircraft, missiles, or space vehicles. Aerospace control includes ensuring air sovereignty and air defence of the airspace of Canada and the US. As of May 2006, the NORAD role was expanded to include maritime surveillance and warning.[5] This is not a new role for the CF as it is included in the first mission of defence of Canada. However, sharing this role with the US within NORAD is a new, and necessary, responsibility as the threat from hostile surface vessels is not an idle one.[6]

"Contributing to international peace and security" is the last of the missions assigned to the CF by the Government of Canada. This is a potentially wide reaching commitment that indicates Canada is serious and dedicated to other statements made in its international and foreign policies including the use of military force if required. To be successful, the CF must "...

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[3] *Ibid.*

[4] Department of Foreign Affairs and International Trade (DFAIT), *Canada's International Policy Statement: A Role of Pride and Influence in the World: Defence,* (Ottawa: Government of Canada, 2005), 22-23.

[5] DND, *Canada First* Defence Strategy, 8.

[6] A worrisome, and difficult to prevent, scenario for NORAD is the detonation of a large tanker in the harbour of a major port city.

have the necessary capabilities to make a meaningful contribution across the full spectrum of international operations, from humanitarian assistance to stabilization operations to combat."[7]

In this modern Information Age, ISR is a critical requirement for any commander's decision-making process. Within all these roles directed by the Government of Canada, whether domestic or deployed, there is a requirement for the CF and its Commanders to have good situational awareness (SA) and "…be aware of anything going on in or approaching our territory."[8] In order to have good SA and make good decisions, commanders must have access to timely and accurate information. This information will have to come through intelligence collection conducted during reconnaissance and surveillance missions in order to be successful. Therefore, there is a definite requirement for the CF to have an ISR capability.

Security through the surveillance of Canada's approaches and sovereignty is not a new requirement for the CF. Historically, sovereignty has always been a CF mission and specific emphasis was placed on it as early as 1964 in the "White Paper on Defence."[9] This emphasis was included in all of the follow-on papers on Defence, including the 1987[10] and 1994[11] major updates, and continues today in the *Canada First* Defence Strategy. When this vital domestic requirement is combined with potential expeditionary requirements under Canada's long-standing commitments to the North Atlantic Treaty Organization (NATO) and the United

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[7] *Ibid., 9.*

[8] *Ibid., 7.*

[9] Department of National Defence, "White Paper on Defence 1964," (Ottawa: Government of Canada, 1964), 5.

[10] Department of National Defence, "Challenge and Commitment, A Defence Policy for Canada," (Ottawa: Minister of Supply and Services Canada, 1987), 23.

[11] Department of National Defence, "Defence White Paper 1994," (Ottawa: Government of Canada, 1994), 3.

Nations (UN), such as the ongoing efforts in Afghanistan or hostile submarine prosecution, a strong argument can be made for the CF to have a robust ISR capability.

However, these missions, tasks and roles are not conducted adequately and forecasted plans for equipment procurement do not fully address the existing or future deficiencies, especially regarding airborne platforms. Currently, the CF only has two dedicated ISR air assets. One is the "Aurora" Canadian Patrol (CP) aircraft designated CP140[12] and the other is the "Sperwer" uninhabited aerial system (UAS) designated CU161.[13] Other CF aircraft, such as the CH124 Seaking and the CH146 Griffon, also have limited ISR capability. So if the government puts so much emphasis on roles that require ISR resources, why does the CF have insufficient airborne ISR assets to conduct missions to support these roles? This paper will argue that the lack of priority given to airborne ISR assets by the CF and the Government of Canada has had a negative impact on the CF's ability to conduct operations. As a result, the CF cannot effectively conduct all the roles assigned.

This paper will argue this by first examining what ISR is by establishing baseline definitions for discussion. This will be followed by an analysis of Government of Canada policies and directions to determine the CF ISR requirements. Then these requirements will be compared to current capabilities and an assessment made of deficiencies. The paper will conclude with an analysis of the capability gaps and identifying the impact on CF operations.

A review of existing literature on the subject and related topics was conducted for this paper. While there are many books, articles, papers and documentaries on the subjects of security

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[12] This also includes the CP140A Arcturus. Department of National Defence, "CP-140," available from http://www.airforce.forces.gc.ca/site/equip/cp140/default_e.asp; Internet; accessed 21 January 2009.

[13] Department of National Defence, "CU-161," available from http://www.airforce.forces.gc.ca/-site/equip/cu161/default_e.asp; Internet; accessed 21 January 2009.

and sovereignty, especially in the Arctic, there are very few references that investigate the shortage of air ISR assets and the impact. There are at least seven Canadian Force College New Horizons papers that discuss maritime and Arctic surveillance and sovereignty. All of these papers highlight and agree with the need for a maritime surveillance manned aircraft and two suggest a coastal patrol aircraft (CPA) should have replaced the Trackers as will be discussed later. Additionally, two working papers by noted defence scientist and author Dr. George Lindsey also support manned aircraft surveillance. He notes that there is definitely a role for satellites and unmanned aerial vehicles (UAV) in the modern world of surveillance but he also notes that these new systems cannot replace manned surveillance entirely. Of note, the United States has limited literature on the subject as this nation has a plethora of air assets.

It must be highlighted that ISR air assets cannot be examined in isolation. There are many factors that have effects on the overall CF ISR capability and requirements. Although the focus of this paper will be on air assets, some of these other factors will be identified and highlighted out of necessity. Only by looking at the situation in its entirety, can the overall ISR picture be solidified and made clear.

ISR DEFINED

What is ISR?

Simply put, the ISR acronym stands for intelligence, surveillance and reconnaissance. However, ISR is not that simple. Depending on your training, background and organization, ISR means different things to different people. In order to understand the scope of the problem regarding ISR requirements, capabilities and deficiencies, it is important to have a common understanding of the definitions. This section of the paper will review the CF accepted definitions and concepts relating to ISR so that there is a clear and common understanding for discussion.

Intelligence is "the product resulting from the processing of information concerning foreign nations, hostile or potentially hostile forces or elements, or areas of actual or potential operations."[14] This is the more simple of definitions and refers to the processed information or overall intelligence products used for discussion or dissemination and related activities. The term intelligence is also applied "...to the activity that results in the product and to the organizations engaged in such activity."[15] To avoid confusion for the purposes of this paper, this activity will be referred to as either intelligence collection or intelligence gathering. This is one of the areas of confusion for the term "intelligence" and explains why problems can exist when different units and organizations are discussing this term.

Intelligence is an essential component that is required at all levels of command to support commanders and their staffs in making effective decisions. These levels of command cover the

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[14] Department of National Defence, B-GG-005-300/FP-000, *Canadian Forces Operations*, (Ottawa: Chief of the Defence Staff, 2005), 21-6.

[15] *Ibid.*

whole spectrum including strategic, operational and tactical. This is done by providing timely and accurate information regarding the adversary, potential adversaries, and the associated operational environment or battle space. Information is defined by NATO as “Unprocessed data of every description which may be used in the production of intelligence.”[16] An operation cannot be planned without timely, accurate and sufficient information that can be converted into usable intelligence. As this intelligence is never static, a continuous intelligence cycle must be maintained.

The first step of the intelligence cycle is direction, which means that the commander must drive the whole intelligence process. As a result, the intelligence cycle is "command led"[17] vice "intelligence driven." In order to ask the correct questions, a commander must have a firm understanding of the intelligence process. This understanding will enable him to direct appropriate requests. This accurate direction will ensure he receives intelligence that is responsive to his requirements for the given mission. Additionally, a good intelligence section will often anticipate a commander's requirements and "lean forward" on requests.

The next step of the intelligence cycle is the collection of information[18] which can be accomplished on both known friendly forces and potential enemy forces through surveillance or reconnaissance activities. The third step of the intelligence cycle is the processing of information stage which includes collation, evaluation, analysis, integration, and interpretation of information

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[16] NATO, AAP-6 *NATO Glossary of Terms and Definition,* (North Atlantic Treaty Organization: NATO Standardization Agency, 2008), 2-I-4.

[17] DND, *Canadian Forces Operations*, 15-1.

[18] Information may consist of a single fact or of a series or group of facts. It is a description of a state of affairs which exists, or has existed, at some point in time and space. It is unequivocal in nature and can relate to events in the past or the present; being historical or current. NATO, NATO Standardization Agency, AJP-2.0 *Allied Joint Intelligence, Counter Intelligence and Security Doctrine*, (North Atlantic Treaty Organization: NATO Standardization Agency (NSA), 2003), 1-2-1.

which is then fused[19] into intelligence. This intelligence may then be disseminated to the required users as the last stage of the cycle.[20] Therefore, the "I" in ISR refers both to the collected information and the processed or fused end product of the intelligence cycle. The remaining two letters in ISR refer to the second stage of the intelligence cycle, that being the actual information or intelligence collection or gathering. As stated above, this collection can be done through two activities: surveillance or reconnaissance.

Surveillance is "the systematic observation of aerospace, surface or subsurface areas, places, persons, or things, by visual, aural, electronic, photographic, or other means."[21] This activity implies a continuous or near continuous observation over an extended period of time. Depending on the activity, this could mean dedicated resources conducting continuous monitoring for a finite period of time. For other activities, such as polar ice monitoring, this surveillance could be done with days or weeks long gaps and still be termed surveillance. The task of surveillance can be thought of as a “go and watch” mission.

Reconnaissance is:

> A mission undertaken to obtain, by visual observation or other detection methods, information about the activities and resources of an enemy or potential enemy, or to secure data concerning the meteorological, hydrographic, or geographic characteristics of a particular area.[22]

Reconnaissance missions may be of short or long-duration, or be conducted over multiple missions. The task of reconnaissance can be thought of as a “go and look” mission.

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[19] Fusion in intelligence usage is defined as the blending of intelligence and/or information from multiple sources or agencies into a coherent picture. The origin of the initial individual items should then no longer be apparent. NATO, AAP-6 *NATO Glossary of Terms and Definition*, 2-F-8.

[20] DND, *Canadian Forces Operations*, 15-2.

[21] *Ibid.*

[22] *Ibid.*, 21-6.

These surveillance and reconnaissance missions collect information and data of every description and from multiple sources, which contributes to or produces intelligence. This intelligence contributes to Operational Information, which may be then used to improve a commander's SA and to contribute to the overall common operating picture (COP).

Operational Information is defined as:

> All information, including intelligence, associated with the commanders area of influence and interests in relation to the enemy and hostile forces, environment, friendly forces, neutral forces, and other aspects of the battle space, that includes information beyond the commanders area of influence and interest such as the media, industry, joint and combined forces, worldwide information grid, and perceptions by friendly, neutral and opposition elements.[23]

Intelligence collection conducted during surveillance and reconnaissance missions is vital, and often the major contributor, to Operational Information.

Situational awareness, or SA, is "the combined knowledge of friendly forces, hostile forces, environment and other aspects of the battle space."[24] The common operating picture, or COP, on the other hand, is much larger than SA alone and implies a grander scale. COP is defined as "A singular representation of Operational Information, based on common data and information shared by more than one command that can be tailored by users."[25] The COP represents both time and space relationships, known forces, and any environmental data. The COP allows collaborative planning, synchronization of resources and assists all commanders in achieving their desired or required level of SA.

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[23] *Ibid.,* 21-6.

[24] *Ibid.*

[25] *Ibid.*

The discussion above shows that the acronym and "concept" of ISR can easily be confused with or be visualized as replacing the intelligence cycle process for the purpose of discussion. There are also many other terms that are commonly used to refer to the same strategic, operational or tactical tasks and roles as that of ISR. These other terms, and the lack of a common understanding among commanders and other stakeholders, are causes of confusion. Two of the more common terms that mean almost the same thing as ISR are S & R and ISTAR.

S & R stands for “surveillance and reconnaissance.” This acronym is a left over from previous decades when the concept was that there were dedicated surveillance and reconnaissance assets and these assets had little to do with intelligence. Using current doctrine and definitions, the flaw in this way of thinking is obvious. The purpose of surveillance and reconnaissance is to gather information or collect intelligence and is an integral part of the intelligence cycle. Therefore, the acronym S & R should only be used to refer to the combined surveillance and reconnaissance activities.

ISTAR is another acronym that leads to confusion. It stands for “intelligence, surveillance, targeting acquisition and reconnaissance.”[26] This acronym is another example of archaic use or misunderstanding of the tasks. "Target acquisition" was added to the ISR designator with the good, although misguided, intention of clarifying and expanding the role of ISR. Using contemporary doctrine, "target acquisition" is a form of “systematic observation," and is therefore a sub-task of surveillance. The majority of CF and US doctrine has removed this term altogether but it is still the title of a Canadian Army doctrine manual exacerbating the situation.

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[26] Department of National Defence, B-GL-352-001/FP-001 *Intelligence, Surveillance, Target Acquisition and Reconnaissance (ISTAR)* (Ottawa: Chief of the Land Staff, 2004), iii.

There are also a few other terms or acronyms that include ISR in their title that can lead to confusion. These acronyms include the commonly used ones of: ISR&C, C2ISR, C3ISR and C4ISR. All of these acronyms are combinations that link related activities together.

ISR&C stands for “intelligence, surveillance, reconnaissance and control.” The “control” in this case refers to direction provided to supported units and may include the actual controlling of other airborne assets. This is normally done through the use of an airborne early warning and control (AWACS) aircraft.[27] These aircraft are equipped with search and height-finding radar and communications equipment for controlling weapon systems that allows them to conduct accurate air surveillance and control. These AWACS aircraft are often directly involved in offensive and defensive air events and provide safety of flight through direct control.

The acronym C2 stands for "command and control."[28] CF C2 doctrine provides the framework that allows different CF organizations to accomplish a common mission by operating effectively together. The "direction" step of the intelligence cycle comes from orders originating from C2. The acronym C2ISR is one that was commonly used during the initial doctrine conceptualization for the intelligence cycle. As stated above, intelligence is "command led" so therefore, ISR is not conducted without direction or C2 input.

C3 stands for "command, control and communications."[29] C3ISR was a natural progression from C2ISR. The "communications" inclusion, in relation to ISR, refers to the dissemination and direction parts of the intelligence cycle. As the timely dissemination of intelligence is a key component to allow commanders to make the required decisions, it is logical

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[27] NATO, AAP-6 *NATO Glossary of Terms and Definition,* 2-A-5.

[28] DND, *Canadian Forces Operations,* 2-1.

[29] DND, Defence Terminology Online Database. (2008); available from http://terminology.mil.ca/term-eng.asp; Internet; accessed 24 January 2009.

to include it and group these activities together. However, C3 in this instance must not be confused with “command and control communication systems” or C2CS.[30]

C4 stands for "command, control, communications and computers."[31] In this modern Information Age, the processing of information collected through ISR activities is done almost entirely by or through the use of computers. Computers are also a key component of the networks that allow communications or Information Management (IM) to take place. Thus the inclusion of "computers" in the C4ISR acronym was another natural progression to show the vital role which computers play in both the processing and dissemination stages of the intelligence cycle. The new definition of C4ISR proposed by the CF C4ISR Oversight Committee and accepted in 2008 for use is:

> C4ISR consists of the people, processes and tools, required to effectively support Command across the entire spectrum of CF operations through the timely gathering, presentation and exploitation of trusted and relevant operational information.[32]

The relationship between C2, C3 or C4 and ISR is clear. Without command and control direction, there would be no requirement for ISR missions. Without the computer processing power to fuse the ISR data and the communications to enable timely delivery to and access by all stakeholders, there would be no point in collecting information. Thus, all these seemingly separate components are inextricably linked.[33]

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[30] C2CS refers to a communication system which conveys information between military authorities for command and control purposes. NATO, AAP-6 *NATO Glossary of Terms and Definition*, 2-C-9.

[31] *Ibid.*

[32] Eloi Bossé and Pierre Valin, “Definition of Data/Information Fusion in the Context of the C4ISR Campaign Plan,” (unpublished Technical Note, Valcartier, PQ: Defence Research and Development Canada, January 2009), 2.

In summary, the “I” in ISR refers to the intelligence product used by commanders to improve SA and make decisions. The “SR” in ISR refers to surveillance and reconnaissance or intelligence collection activities. This collected intelligence is then fused into the final intelligence product. ISR both overlaps and is integrated into the four-step, intelligence cycle using C4 processes. As such, ISR directly focuses on supporting military operations. The C4ISR concept can be thought of as an integrated intelligence and operations function and can be described as "An activity that synchronizes and integrates the planning and operation of sensors, assets, and processing, exploitation, and dissemination systems in direct support of current and future operations."[34]

Intelligence Collection

Surveillance and reconnaissance activities require that information or knowledge be gained from a variety of sources especially airborne or Air Force assets. These sources are categorized by the type of sensor that obtains the information. These sources include signals, geospatial, imagery, human, documentary, acoustic, measurement and signals and technical as summarized and described in Table 1.

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[33] It must be noted that the C2, C3 or C4 relationships to ISR all deal with the first and last stages of the intelligence cycle. C4 does overlap with the third stage or processing and fusion step of the intelligence cycle. The ISR component addresses the second stage of the intelligence cycle in the intelligence collection or intelligence gathering activities. ISR activities overlap the third stage, along with computers, in the processing and fusion that results in the final intelligence product.

[34] Joint Chiefs of Staff, US JP 2-0 *Joint Intelligence*, (Washington: Joint Chiefs of Staff, 2007), GL-12.

Table 1 - Types of Intelligence

Intelligence Type and sub-categories	Definition[35]
Signals Intelligence (SIGINT) - communications intelligence (COMINT)[36] - electronic intelligence (ELINT)[37]	Is the term used to describe all intelligence derived from the electromagnetic spectrum (EMS).
Geospatial Intelligence (GEOINT)	Intelligence that exploits and analyses imagery and geospatial information to describe, assess, and visually depict physical features and geographically referenced activities on the Earth.[38]
Imagery Intelligence (IMINT)	Intelligence obtained by photographic, electro-optical, radar, infrared, thermal and multispectral sensors, which can be ground based, sea borne or carried by overhead platforms.
Human Intelligence (HUMINT)	The generic term for any intelligence derived from information collected from and provided by human sources. Every person, friendly, adversary or neutral is a potential source of HUMINT.
Documentary Intelligence (DOCINT)	Intelligence that is primarily based on the assessment of information derived from both published material and the broadcasting media.
Open Source Intelligence (OSINT)	Intelligence collected from open sources such as academia, newspapers, periodicals, media broadcasts, interagency or the internet.
Measurement and Signature Intelligence (MASINT) - Acoustic Intelligence (ACINT) [39]	Scientific and technical intelligence information obtained by quantitative and qualitative analysis of data (metric, spatial, wavelength, time dependence, modulation, plasma and hydro magnetic) derived from specific technical sensors for the purpose of identifying specific features associated with the source, emitter or sender and to facilitate subsequent identification and/or measurement of the sender and to facilitate subsequent identification and/or measurement of the same.
Technical Intelligence (TECHINT)	Intelligence which concerns foreign technological developments and the performance and operational capabilities of foreign materiel, which have or may eventually have a practical application for military purposes.

[35] As defined in *Canadian Forces Operations* except where noted. DND, *Canadian Forces Operations*, 15-5, 15-6.

[36] COMINT is Intelligence derived from electromagnetic communications and communication systems by other than intended recipients or users. NATO, AAP-6 *NATO Glossary of Terms and Definition*, 2-C-11.

[37] ELINT is Intelligence derived from electromagnetic non-communications transmissions, such as radar, by other than intended recipients or users. NATO, AAP-6 *NATO Glossary of Terms and Definition*, 2-E-2.

[38] Joint Chiefs of Staff, US JP 2-0 *Joint Intelligence*, B-1.

[39] ACINT is Intelligence derived from the collection and analysis of acoustic phenomena. DND, *Canadian Forces Operations*, 15-5.

All of these types and sources of intelligence collection can be based on land, sea or in the aerospace environment. It is only the method used or sensor for collection that varies. These sources of intelligence collection will be used in following sections to discuss and analyze requirements, capabilities and deficiencies.

The designation of missions or mission types can also lead to confusion regarding ISR. There are many mission types that on the surface, may not appear to be ISR related. However, any time intelligence is being collected, that part of the associated mission is either reconnaissance or surveillance. These missions may be dedicated to reconnaissance or surveillance, or possibly, the intelligence collection may be a secondary or tertiary tasking, which can also lead or add to the confusion. Some common examples of these types of controversial missions include: battle damage assessment (BDA), convoy escort, pattern of life (POL) monitoring, and target location and tracking. This confusion in terminology will be clarified in the following paragraphs.

Reconnaissance missions can be classified into three basic types: point, line, and area. Point reconnaissance is looking for and collecting information on a single small point or target that may be moving or stationary. Point reconnaissance includes such subtasks as: location and description of a target of interest (TOI) or high-value unit (HVU), characteristics of a man-made structure, attributes of an intersection, etc. Line reconnaissance is conducted along a dedicated track which may be along a natural track, such as a river or tree-line, an artificial line such as a country boundary or a man-made route such as power lines, railroad tracks or roads. Area reconnaissance is reporting on all things, or a specific list of things, in an area of interest (AOI).

Surveillance missions can also be classified into the same three basic types: point, line, and area. However, surveillance missions are usually of longer duration and are inherently more

difficult. Point surveillance is monitoring and/or reporting on a single point or target that may be moving or stationary. Point surveillance includes such subtasks as: POL, targeting, person or vehicle tracking, HVU monitoring or convoy escort and look out duties. Line surveillance is maintaining a continuous watch along a given line, boundary or natural or man-made track. This may include such things as a road, a river, a country border or a cease fire line. Area surveillance is maintaining a continuous watch over an area of given dimensions. Area surveillance can include such things as an area of land or ocean, a battlefield, an urban area or a three-dimensional section of subsurface water or aerospace.

Area surveillance can be difficult depending on the terrain, objects to be monitored and sensor employed so these key aspects must be considered carefully and area size chosen accordingly. For example, surface surveillance of a 100 nm^2 area of ocean is not that difficult using a maritime patrol aircraft (MPA) equipped with radar. If the same section of ocean required subsurface surveillance however, it would be almost impossible using a single MPA equipped with passive sonobuoys.[40]

As shown above, there are many mission types relating to reconnaissance and surveillance. The important thing to note is that any time intelligence collection is taking place it falls into one of these categories of missions. Even the “search” function of search and rescue (SAR) is really only a form of reconnaissance. It must also be noted that the task of BDA is often mistakenly classified as reconnaissance. A post-strike reconnaissance mission only allows intelligence to be collected to determine if the target was hit or not. The actual BDA can only be determined by a trained analyst.

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[40] Passive sonobuoys transmit underwater noise received through a hydrophone to a receiver on the aircraft. This noise must then be analyzed for its characteristics to determine what the source is. This analysis can be either automated or done manually or a combination.

In summary, there are still many differing definitions regarding surveillance and reconnaissance activities. The reason there are many definitions is there are different points of view depending on which organization, stakeholder or individual is speaking. This situation can become a significant problem causing critical errors. Fortunately, the situation has been steadily improving with the publication of CF, Allied and other joint “keystone” documents that are reducing the confusion.

Intelligence is a valuable resource and is the product resulting from the processing of information collected from many sources. These sources can be exploited using a variety of land-based, sea-based, airborne or aerospace sensors. This intelligence collection occurs during either reconnaissance or surveillance missions. These missions are vital to national security and are tasked to both military and OGDs as directed by national policy which will be discussed in the next section.

NATIONAL POLICIES AND GOVERNMENT REQUIREMENTS

The end of the Cold War and the demise of the Soviet Union brought a collective sigh of relief from Canada that was echoed around the world. The perception was that the world would now be free from conflict. This was a misperception as the world remains an unpredictable and dangerous place, where threats to Canadian interests and values persist.

As evidenced by the terrorists' attacks of September 11, 2001 in the US, global terrorism has become a stark reality.[41] These acts and future threats of terrorism have created widespread despair and regional instability. This instability has resulted in failed or failing states that provide a haven for terrorists and other criminals. Contributing to this sense of foreboding is the increasing trade of weapons, including weapons of mass destruction (WMD), on the black market.[42] These weapons both originate from, and are sold to, these failed and failing states. It is not even the massive killing power of these WMDs that represents the greatest threat. It is the psychological, strategic and political impacts of their use or potential use that can affect strategic objectives, and influence decision-makers at all levels.

In the wake of September 11 and these impending threats, the Government of Canada has not sat idly by and watched. It was recognized that, "A core responsibility of the government of Canada is to provide for the security of Canadians."[43] To this end, Canada produced its first ever national security policy in 2004, entitled *Securing an Open Society: Canada's National Security*

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[41] DFAIT, *Canada's International Policy Statement:... Defence*, 1.

[42] Department of Foreign Affairs and International Trade Canada, "Global Partnership Program: A Tangible Canadian Contribution to Reducing the Threat of Weapons of Mass Destruction", (Ottawa: Global Partnership Program, 4 February 2008), 17.

[43] Privy Council Office, *Securing an Open Society: Canada's National Security Policy*,(Ottawa: National Library of Canada, 2004), 1.

Policy. National security is fundamental to the Canadian way of life. The term "national security" is used to describe a wide range of concepts. These concepts range from domestic or internal security to international security to national strategy or even grand strategy. It is important to have a clear understanding in order to understand the scope. In 1980, Canada's National Defence College adopted the following definition:

> National Security is the preservation of a way of life acceptable to the Canadian people and compatible with the needs and legitimate aspirations of others. It includes freedom from military attack or coercion, freedom from internal subversion, and freedom from the erosion of the political, economic, and social values which are essential to the quality of life in Canada.[44]

This definition has stood the test of time.[45] It captures the essence of national security and why it is so important, not just to members of the CF, but to all Canadians.

Securing an Open Society introduced and highlighted "…three core national security interests: 1. protecting Canada and Canadians at home and abroad; 2. ensuring Canada is not a base for threats to our allies; and 3. contributing to international security."[46] In defining just what these three national security interests are, this policy identifies the need for a "fully integrated security environment" and "increased capabilities for intelligence collection and assessment" focusing on security.[47] Also noted is that the Government needs to be able to integrate and act upon intelligence in a collective manner, with all government agencies and stakeholders.[48]

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[44] W.D. Macnamara and Ann M. Fitz-Gerald, "A National Security Framework for Canada," In *Geopolitical Integrity,* edited by Hugh Segal, (Montreal: The Institute for Research on Public Policy, 2005), 83.

[45] Most recently repeated in *Canadian Forces Aerospace Doctrine*. Department of National Defence, B-GA-400-000/FP-000 *Canadian Forces Aerospace Doctrine.* (Ottawa: Chief of the Air Staff, 2007), 19.

[46] DFAIT, *Securing an Open Society..., vii.*

[47] *Ibid*., 9,15.

[48] *Ibid*., 16-17.

Included in this list of stakeholders is the CF. The policy highlights the vital role the CF plays in responding to national emergencies, defending Canada, helping to secure North America, and ensuring this security happens as far from Canada as possible. The policy also recognizes that."... the Canadian Forces are more than a national security capability…" and the CF is required both domestically and internationally to deal with threats.[49] This milestone document clearly highlights the CF requirement to have an ISR capability that is both standalone and interoperable with OGDs.

Following on the heels of the National Security Policy were the International Policy Statements in 2005 regarding Diplomacy, Defence, Development and Commerce. The policy document on Defence entitled: *Canada's International Policy Statement: A Role of Pride and Influence in the World: Defence* expanded on the initial statements made by the Government in the National Security Policy. This document was key as it indicated both political and public commitments to international security that included the CF. As Bland and Maloney stated:

> The defence policy is a set of interrelated decisions taken by political, military, and public service actors concerning the selection of defence-related goals and the means of achieving them and that they take these decisions within a formal and informal (but regularized) decision-making process.[50]

This political and public inclusion of the CF in the International Policy Statement leaves no doubt that defence and security are an integral part of Canada's international strategy.

Canada's International Policy Statement: A Role of Pride and Influence in the World: Defence highlighted, and continued the theme from the National Security Policy, that the CF must provide security at home and abroad. The International Policy Statement on Defence

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[49] *Ibid*., 50.

[50] Douglas L. Bland and Sean M. Maloney, "Finding a Defence Policy: The Never-Ending Dynamic," In *Campaigns for International Security: Canada's Defence Policy at the Turn of the Century*, edited by Douglas L. Bland and Sean M. Maloney, (Montreal: McGill-Queen's University Press, 2004), 33.

outlines three broad roles for the CF. These roles are: "protecting Canadians, defending North America in cooperation with the US, and contributing to international peace and security."[51] It further states that in order to do so the CF "… must be effective, relevant and responsive, and remain capable of carrying out a range of operations, including combat."[52] These are key statements that confirm the Government's inclusion of the CF in both national and international security requirements and commitments.

The first role of protecting Canada and Canadians is paramount and the International Policy Statement sets the Defence of Canada as the first priority of the military. It also directs that the CF, in addition to maintaining its traditional roles of search and rescue, disaster relief and support to OGDs such as Fisheries and Oceans and Environment Canada, will also contribute to the overall strategy of protecting Canadians against the threat of terrorism.[53] A key component of this mission is maintaining security. The Policy states, "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."[54] This Policy then directs several important activities for the CF.

The first of these activities is for the CF to work more closely with civil authorities, OGDs and increase interoperability with allied forces, particularly the US.[55] This includes all levels of government be it federal, provincial or local. The main focus of this activity is to prevent serious threats from materializing. In order to prevent threats the CF must first be aware

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[51] DFAIT, *Canada's International Policy Statement:... Defence*, 2.

[52] *Ibid.*, 2.

[53] *Ibid.*, 17.

[54] *Ibid.*, 16.

[55] *Ibid.*, 12.

that they exist and therefore must have a robust ISR capability. If prevention should fail, then countering or mitigating attacks, as a last resort, are also assigned as CF tasks. This interaction with civil authorities was directed through a significant transformation. This transformation included a new CF vision of a fully integrated and unified approach to operations.

This new vision, or transformation, included the stand up of dedicated commands responsible for Canada, expeditionary missions, special forces and operational support. This new vision emphasised jointness and teamwork. The CF was also directed to evaluate the force structure, and keep those capabilities that were valid, get rid of those that were not and acquire new ones if required. This new vision also included direction to invest in people, and that recruitment and retention were to remain one of the CF's top priorities.[56]

Additionally, the Policy directed that the CF update its C4ISR capability. Specific direction was given to acquire UAVs, pursue the use of satellites, expand and enhance the CF information and intelligence fusion capability, have a common information intelligence network, and complete the modernization of the Aurora aircraft.[57] These directives were truly visionary. Although emphasis had been placed previously on the importance of sovereignty, the Government now also acknowledged the requirement for timely and accurate intelligence. These directives also support the second and third activities required in the first role of protecting Canada and Canadians.

The second activity directed is to ensure security and sovereignty of Canadian territory, especially in the Arctic. This includes the aerospace and maritime approaches. The third activity is to improve intelligence collection, analyzing, integration and use of information by combining

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[56] *Ibid.,* 12.

[57] *Ibid.,* 14.

maritime, land, air and space surveillance systems.[58] The CF is to do this by increasing its efforts in this capability area. This effort requires investing in people, new assets, and C4ISR updates.

The last activity under the role of protecting Canada is for the CF to dedicate specific resources to improve its ability to carry out domestic roles. These resources include people, training and equipment.[59] These last three activities all indicate the need for a robust CF ISR or more all-encompassing, a C4ISR capability.

As noted in the Policy, the NORAD bilateral agreement remains central to the Canada-US defence relationship. Given that the US is Canada's number one trading partner, our lengthy shared borders, and mutual friendship this security relationship will continue.[60] This agreement was renewed in 2006 and included new directives that include maritime surveillance. The Policy directs that the CF improve the ability to work with our American allies and to contribute their Canadian aircraft and other assets to the NORAD mission.[61] Additionally, the Policy directed to improve CF capability in countering and controlling threats, especially in the maritime and air approaches to Canadian territory. These requirements to operate with the US to conduct surveillance of maritime and air approaches again highlight the necessity of a robust CF C4ISR capability.

The last role identified in the International Policy Statement is to "contribute to a safer and more secure world."[62] The Policy also states that the CF needs to continue to “participate in

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[58] *Ibid.*, 17.

[59] *Ibid.*, 17.

[60] Statistics Canada, "Imports, Exports and Trade Balance of Goods on a Balance-of-Payments Basis, by Country or Country Grouping,” (2008); available from http://www40.statcan.ca/l01/cst01/-gblec02a.htm; Internet; accessed 24 January 2009.

[61] DFAIT, *Canada’s International Policy Statement:... Defence*, 23.

international operations overseas to address threats at their source."[63] The Policy Confirms that Canada will continue to support the UN and NATO. To this end, Canada needs a fully deployable military force capable of all types of missions from disaster relief to providing military training assistance to combat. Specifically identified is the requirement to "have up to two Aurora aircraft to support land- and sea-based elements."[64] This last role solidifies the requirement for the CF C4ISR capability, and this capability must be deployable. By naming the Aurora, this last statement indicates a manned, control capable aircraft as well.

This concept of sovereignty and security of Canada, and the CF's contribution to it, is not a new one. The 1964 "White Paper on Defence" had as one of its three objectives "... to provide for the protection and surveillance of our territory, our airspace and our coastal waters."[65] This was later highlighted in the paper as one of the minimum requirements for the defence of Canada. Also included in this paper was direction to be a responsible member of NATO and contribute to defence of the continent.

The emphasis remained on Canadian sovereignty in the "Defence In The 70s" white paper. In fact, the CF assumed the "... general responsibility for surveillance and control of Canadian territory, waters and airspace." [66] This emphasis continued in both the 1987[67] and

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[62] *Ibid.*, 25.

[63] *Ibid.*, 23.

[64] *Ibid.*, 30.

[65] Department of National Defence, "White Paper on Defence 1964," (Ottawa: Government of Canada, 1964), 5.

[66] Department of National Defence, "Defence In The 70s," (Ottawa: Government of Canada, 1971), 8.

[67] Department of National Defence, "Challenge and Commitment, A Defence Policy for Canada," (Ottawa: Minister of Supply and Services Canada, 1987), 23.

1992[68] papers on Defence. Of note, the 1992 paper indicates the sovereignty role was to be greatly increased. As stated by the Minister of National Defence when speaking of the contribution of the Armed Forces, "We will intensify surveillance and monitoring operations in support of Canadian sovereignty."[69] Although the 1994 White Paper indicated drastic cuts for the CF, this paper still highlighted a need for CF surveillance and control of Canadian territory.[70]

As evidenced by the inclusion in all the previous Defence Policy papers, the CF or Canadian Armed Forces have always been involved in security and surveillance of Canada. Although not always directly stated, it is implied within these documents that intelligence collection must take place due to the very nature of surveillance. This historical role for the CF in ISR activities has always contributed directly to national security. This role was emphasized and restated in much more detail in the 2005 *Canada's International Policy Statement: A Role of Pride and Influence in the World: Defence*[71] and continues in the recent *Canada First* Defence Strategy.

Current National Policy

The *Canada First* Defence Strategy is the latest Defence Policy document. It provides direction from the Government of Canada regarding its intentions for the CF. The Government intends to have the CF become a well-equipped, modern military that is well-trained and "ready

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[68] Department of National Defence, "Defence Policy 1992," (Ottawa: Government of Canada, 1992), 29-31.

[69] *Ibid*., 31.

[70] Department of National Defence, "Defence White Paper 1994," (Ottawa: Government of Canada, 1994), 3.

[71] This document states that the CF will acquire, or ensure access to, the right mix of capabilities to meet increasing requirements including completion of the modernization of the CP140 Aurora, acquiring UAVs and pursuing the use of satellites. DFAIT, *Canada's International Policy Statement:... Defence*, 14.

to take on the challenges of the 21st century."[72] The Government does this by defining three roles for the CF and establishing a clear vision for the future by committing funding for equipment, infrastructure, personnel and readiness.

This document from the Government clearly defines three roles for the CF. These roles are: "defending Canada, defending North America and contributing to international peace and security."[73] The Government also requires the military to have the flexibility to respond to unplanned events such as regional conflicts, natural disasters, humanitarian crises and other contingencies. This response requirement is in addition to the essential day-to-day domestic missions. Within these roles, the Government has detailed six core missions for the CF.

The first of these missions is the day-to-day operations that will ensure the security of Canadians and help exercise sovereignty including in the Arctic.[74] This mission entails providing surveillance of Canadian territory and air and maritime approaches including NORAD events. This mission also includes maintaining a search and rescue capability on a "24/7"[75] basis anywhere in Canada. This mission also requires the CF to remain interoperable with the US military through practice exercises or bilateral training. This will enable the CF to respond to crises as a partner in the defence of North America. This mission is almost entirely in the ISR realm.

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[72] DND, *Canada First* Defence Strategy, 3.

[73] *Ibid*, 7.

[74] *Ibid.*, 8-10.

[75] 24/7 is a commonly used term that refers to a 24 hour day, seven day a week, and 365 days a year requirement. This is a continuous response capability.

The second mission is to “support a major international event in Canada, such as the 2010 Olympics."[76] This mission is closely related to a third mission of "support[ing] civilian authorities during a crisis in Canada such as a natural disaster"[77] and the fourth mission of being able to "respond to a major terrorist attack."[78] These three separate but interrelated missions all involve potentially providing assistance to civil authorities as required for threats to safety and security. These missions require accurate and timely intelligence and thus a responsive ISR capability.

The fifth mission of "lead and/or conduct a major international operation for an extended period" can be linked with the sixth mission that is "deploy forces in response to crises elsewhere in the world for shorter periods."[79] These two missions both require high-readiness, combat-capable, flexible military units. These operations will often be done as a "whole-of-government" effort and usually in support of the UN or NATO. These missions are a continuation of the original intent contained within *Canada's International Policy Statement: A Role of Pride and Influence in the World: Defence* which stipulated that the CF will continue to participate in international operations.[80] This Policy included recognition that there would be no decline in the demand for the CF from the UN and NATO. This Policy also highlighted that the focus of the CF would be on the "…complex and dangerous task of restoring order to failed and failing

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[76] DND, *Canada First* Defence Strategy, 8-10.

[77] *Ibid.*, 8-10.

[78] *Ibid.*, 8-10.

[79] *Ibid.*, 8-10.

[80] DFAIT, *Canada’s International Policy Statement:... Defence*, 26.

states."[81] In order to be prepared to conduct this task, the CF must be combat capable. An integral part of this combat capability is ISR.

All of these missions require timely and accurate intelligence in order for commanders to make sound decisions. The first mission of day-to-day operations for security and sovereignty of Canada is almost entirely an ISR tasking. Although some of this intelligence can and will come from a multitude of joint and OGD sources, the CF will require its own ISR capability in order to meet its mandate as assigned by the Government. Additionally, this capability must be both domestic and expeditionary.

Translating Policy into Operational Guidance

The CF is a military organization that follows a distinct chain of command. Therefore, merely reading about policy in a policy document is insufficient. The Chief of the Defence Staff (CDS) must interpret the policy from the Government and develop a strategic plan. The CDS passes the strategic plan by issuing his Commanders Intent and by issuing specific orders to the operational commanders, as the force employers, and the Environmental Chiefs of Staff (ECS), as the force generators.

These orders were previously issued from the CDS annually through the Defence Planning Guidance (DPG) document. In this document, specific defence tasks (DT) were assigned to each of the ECS. In conjunction with the transformation of 2006 and the stand up of the operational commands, this document was converted to the "Defence Planning & Management" (DP&M) database.[82] Now Program Activity Architectures (PAA)[83] and DTs are

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[81] *Ibid.*, 10.

assigned to both the ECS and the operational commands that include Canada Command (Canada COM), Canadian Expeditionary Force Command (CEFCOM), Special Operations Forces Command (SOFCOM) and Canadian Operational Support Command (CANOSCOM). The DTs assigned within the DP&M are numerous and account for all possible missions as specified within the six core missions of the *Canada First* Defence Strategy. Of course, not all of these tasks are related to ISR. Only the ones that are directly related and relevant to ISR will be discussed.

The most important PAA assigned to the CF is to "Provide ongoing specified services in accordance with Government of Canada and OGD agreements and demand from other levels of government; as well as search and rescue services to Canadians."[84] The expected strategic outcomes from this task include border security, fishery patrols, drug interdiction, very important person (VIP) transport and other agreed-upon services. This is a monumental tasking that includes securing Canada's perimeter and border and ensuring Canadians are rescued from harm's way in extreme outdoor environments.

The resultant DTs from this PAA includes maritime, land and aerospace surveillance and control. These DTs are assigned primarily to Canada COM as the force employer with the support of the force generators in the Chief of the Maritime Staff (CMS), the Chief of the Land Staff (CLS) and the Chief of the Air Staff (CAS) for their respective environments. This task

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[82] Department of National Defence, “Defence Planning & Management,” Vice Chief of the Defence Staff Website (2008); available from http://otg-vcd-webs016.ottawa-hull.mil.ca/FY0/-Structure_e.Asp?StructureID=7&SelectedDPMenu=1; Internet; accessed 11 January 2009.

[83] Program Activity Architecture (PAA) is part of the process used by the Treasury Board of Canada Secretariat to track assigned activities to all of the Government of Canada's departments. It is an inventory of all the programs and activities undertaken by a department or agency. The programs and activities are depicted in their logical relationship to each other and to the strategic outcomes to which they contribute. *Ibid.*

[84] *Ibid.*

includes planning, monitoring and controlling CF surveillance activity in the Canada COM area of responsibility (AOR) and AOI, with CF resources and in conjunction with other operational elements of OGDs and allies.[85] It should be noted that the Canada COM AOR includes all of North America. This is a vast area that requires extensive ISR coverage through a system of systems or assets, as will be discussed in the next section.

Other PAA directions to the CF include those to "maintain operational units for maritime, land and aerospace effects."[86] This is direction to the CMS, CLS and CAS, as the force generators, to provide operational forces that can act, shield and sense as required by the supported commanders. Specific direction in the DTs includes maintaining the capability to provide forces for contingency operations.[87] These forces may be tasked in support of any of the following missions: surveillance and control, search and rescue, humanitarian assistance, Aid of the Civil Power, evacuation of Canadians, assisting OGDs, UN operations, Defence of North America, and international security. To predict where and what to be ready for is a challenge in and of itself for the ECSs and supported force employers.

Of note, the CAS is specifically directed to be able to assist OGDs and other levels of government within eight hours.[88] This includes providing the capability to meet cooperative agreements in support of OGDs, in compliance with departmentally approved Memorandums of Understanding (MOU), especially the Solicitor General and Royal Canadian Mounted Police (RCMP). This is an important tasking that requires the Air Force to be ready to assist the RCMP with critical missions including: drug interdiction, counterterrorism and illegal migrants. These

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[85] *Ibid.*

[86] *Ibid.*

[87] *Ibid.*

[88] *Ibid.*

types of missions require highly-capable, specialized airborne ISR assets in order to be successful.

The Government of Canada has clearly provided policy direction to the CF. All the broad missions assigned to the CF in the *Canada First* Defence Strategy have been translated into specific tasks in the DP&M database. These specific tasks are further refined in clarifying directions and orders from the ECSs and various command commanders, through the chain of command, to supporting units. Many of the missions assigned to the CF require ISR activities and associated assets to complete. These missions are both domestic and expeditionary and most require airborne assets. This paper will now analyze and assess these requirements.

SURVEILLANCE AND RECONNAISSANCE REQUIREMENTS

Surveillance and reconnaissance is conducted to collect information and data which can be processed into usable intelligence. As stated above, ISR activities are conducted through a system of systems. In order to assess the airborne ISR assets requirement, the entire picture must be viewed. This section will discuss the domestic ISR requirements for Canada, the expeditionary ISR requirements for the CF and the related air assets.

Surveillance and reconnaissance activities for the CF can be divided into two capability areas: a domestic capability and a deployable or expeditionary capability. Although there are many similarities regarding sensors, weapons platforms and personnel training within these two areas, both have distinct differences that set them apart from each other. As well, information and data collected from surveillance and reconnaissance activities or missions in these two areas are analyzed and processed into different types of intelligence products. The reasons for this are relatively simple, domestic ISR is mostly used for defensive, humanitarian or law enforcement assistance, environmental monitoring or sovereignty purposes. On the other hand, ISR activities required during deployed operations can be for both offensive and defensive purposes.

Territory on a map is normally shown in only two dimensions. However, the surveillance and reconnaissance requirements for this territory are always three-dimensional. When discussing the surveillance and reconnaissance of a certain area or territory, it is can be divided into three separate elements or regions. For the purposes of this paper, these elements or regions will be called the aerospace region, the surface region and the subsurface region. These regions are described and summarized in Table 2.

Table 2 – Surveillance and Reconnaissance Regions

Type	Description	Examples of Potential Objects or Requirements for Surveillance and Reconnaissance
Aerospace region	The area above the land or water. This includes the entire atmosphere and the area beyond extending into space.	Aircraft, gliders, balloons, UAV, intercontinental ballistic missiles (ICBM), rockets, space shuttle, satellites, meteorites, space station, electronic emissions, weather systems.
Surface region	The area on the surface of the earth and includes both land and water.	Natural features of the land or water, vehicles, people, ships, natural disasters or environmental spills, infrastructure and other man-made features.
Subsurface region	The area below the surface of either water or land. For military ISR, this is normally limited to underwater.	Mapping of terrain, detection of earthquakes, detection of mineral or oil deposits, sea life monitoring, detection and tracking of submarines.

All of these regions will be analyzed when discussing the ISR requirements for the CF.

Domestic ISR

The first CF requirement to be discussed will be the domestic portion. Geography plays a major part in the domestic ISR requirements for the CF. Canada is a huge country encompassing a total area of 9,984,670 km^2 with almost 9.1 million km^2 being land.[89] This is just considering the landmass and internal waters. Under the latest UN Convention on the Law of the Sea,[90] Canada assumed responsibility for managing the natural resources of an area equal again in size to this entire landmass and internal waters. Additionally, Canada has a total of 202,080 km of

[89] Central Intelligence Agency, "The World Factbook." (2008): 24 January 2009, available from https://www.cia.gov/library/publications/the-world-factbook/; Internet; accessed 24 January 2009.

[90] Office of the Judge Advocate General, "United Nations Conventions on the Law of the Sea," In *Collection of Documents on the Law of Armed Conflict*, 2005 ed., ed. Directorate of Law Training, (Ottawa: DND, 2005), 274.

coastline. To put this in perspective, Russia has the next longest coastline at 37,653 km.[91] This coastline borders three oceans that also require surveillance, these being the Atlantic, the Pacific and the Arctic. Canada also shares an 8,893 kilometres border with the US.[92]

Conducting surveillance of such an extensive area is nothing less than a formidable task. It is important to note that, in addition to outlining a road map for CF modernization, the *Canada First* Defence Strategy highlights that there will be a whole-of-government approach to meeting future requirements.[93] The DND and the CF work closely with partners in OGDs in carrying out this role as the military domestic ISR contribution is only one component of this whole-of-government approach to Canadian sovereignty. These OGDs include Transport Canada (TC), Public Safety Canada (PSC), the RCMP, Canadian Border Services Agency (CBSA), the Department of Fisheries and Oceans (DFO), and the Canadian Coast Guard. Notwithstanding the multiple stakeholders, surveillance of Canada is vital to maintaining its security and must be done effectively.

It must also be noted that the CF does not conducted surveillance on Canadian citizens. The surveillance and investigation of citizens and illegal immigrants is a responsibility of the Canadian Security Intelligence Service (CSIS) and the RCMP.[94] However, the CF must be able to respond to requests for assistance from these organizations as MOUs exist between DND and both CSIS and the RCMP. Similar MOUs, or agreements for providing assistance, exist for the

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[91] Central Intelligence Agency, "The World Factbook."

[92] *Ibid.*

[93] DND, *Canada First* Defence Strategy, 4.

[94] Canadian Security Intelligence Service, “Role of CSIS,” (2008); available from http://www.csis-scrs.gc.ca/bts/rlfcss-eng.asp; Internet; accessed 14 February 2009.

other departments mentioned above as well although only the DFO has dedicated surveillance hours allocated from the CF.[95]

The responsibility for the processing and fusion of information and data into intelligence products within the CF resides with the Chief of Defence Intelligence (CDI). The CDI makes use of various information systems (IS) and IM systems to store, process, analyze and disseminate these products. The aim of IM is to get the right information to the right person, in the right format medium, at the right time. The intent is to contribute to the CF COP which is a snapshot in time of friendly, neutral and adversary forces and of the entire battlespace environment. The COP informs and updates the various commanders' SA which is their understanding of the operational environment in the context of the CF mission. Comprehensive SA is an effective aid to decision making and the CDI intelligence products are a primary feed, but not the sole one, to the COP.

The CDI C4ISR activities conducted through Network Enabled Operations (NEOps) uses an IS and IM system of systems. The NEOps consists of equipment, infrastructure and personnel. The CDI NEOps activities are a critical component of the CF C4ISR capability and the challenges within this area are many and well documented. The Chief of Force Development "C4ISR Strategy 2028" highlights many of these challenges which include: an inconsistent approach to interoperability, disjointed and disconnected COP, an uncoordinated approach to IM and an incomplete IT infrastructure, poor ability to fuse data information, limited and

[95] These agreements are called Service Level Agreements or SLAs. Hours are provided under the Total Aerospace Resource Management (TARM) process. Department of National Defence, *Air Force Plan (AFP) FY07/10,* (Ottawa: Chief of the Air Staff, 2007), Annex B.

disconnected collaborative tools, insufficient people and training, lack of coherence to architectural standards and an inconsistent approach to interoperability.[96]

The problems and challenges of the CF Intelligence community are of great concern and impact the overall CF C4ISR capability. These problems and challenges are important, and they could easily be the subject of a similar paper. In fact, one of the objectives of the C4ISR campaign plan remains the implementation of a CF-wide information and intelligence fusion capability, called the Joint Information and Intelligence Fusion Capability (JIIFC).[97] However, these issues really only impact air assets during the initial collection and communication of information process. Therefore, although the importance of this problem has been highlighted, and its significance should not be downplayed, it is not the subject of this paper and will not be discussed further.

Aerospace Surveillance and Reconnaissance

Canadian domestic aerospace surveillance is extremely important. The Defence and security of Canada and North America requires detection through effective surveillance of the approach of ballistic and cruise missiles and of hostile strategic bomber and other patrol aircraft as evidenced by Russia's renewed commitments to displays of military power. Also required is the ability to track these missiles and unidentified aircraft. This important task is reflected in the DP&M database as a requirement for Canada COM to maintain aerospace surveillance 24 hours a day, seven days a week or, in other words, continuously.[98] As mentioned above, this

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[96] Department of National Defence, "C4ISR Strategy 2028," (Ottawa: Chief of Force Development, 24 November 2008), iv.

[97] Eloi Bossé and Pierre Valin, "Definition of Data/Information Fusion in the Context of the C4ISR Campaign Plan," 2.

requirement is over a vast area including Canadian and the North American landmass and sea approaches.

Coupled with this aerospace surveillance security requirement is a civilian requirement to provide air traffic control (ATC) services for safety of flight. This is a requirement of the International Civil Aviation Organization (ICAO) "Convention on International Aircraft" of which Canada is a signatory.[99] This ATC service is required for all aircraft, not just those originating in Canada, and it is currently provided by NAV Canada in coordination with DND.[100]

Aerospace surveillance can be conducted using many methods and sensors. Primarily it is done through the use of radar which is a form of SIGINT. The use of radar can be combined with collected electronic emissions from unknown, unidentified aircraft using ELINT and MASINT to positively identify these aircraft as friend or foe. In some cases visual confirmation or IMINT is also used. The sensors that conduct this surveillance can be ground-based, sea-based, space-based or airborne.

NAV Canada and the CF combine to provide effective air traffic control services in Southern Domestic Airspace.[101] This airspace is positively controlled through the use of radar, aircraft transponders and human operators and includes an area encompassing the 10 Canadian provinces and the Yukon plus the immediate area around Yellowknife, Churchill, Ivujivik, Iqaluit and the Atlantic and Pacific approaches (Figure 1). A symbiotic relationship exists

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[98] DND, "Defence Planning & Management."

[99] ICAO, "Convention on International Aircraft," (1944); available from http://www.icao.int/-icaonet/dcs/7300.html; Internet; accessed 12 February 2009.

[100] NAV Canada is a private, non-share capital corporation that owns and operates Canada's civil air navigation service.

[101] Transport Canada, *TP1820E Designated Airspace Handbook,* (Ottawa: Minister of Transport, 2008), 154.

whereby aircraft are handed over from the CF to civilian controllers and vice versa. Information from this ATC system is used as one of the inputs to the NORAD system that tracks over 7,000 aircraft per day.[102]

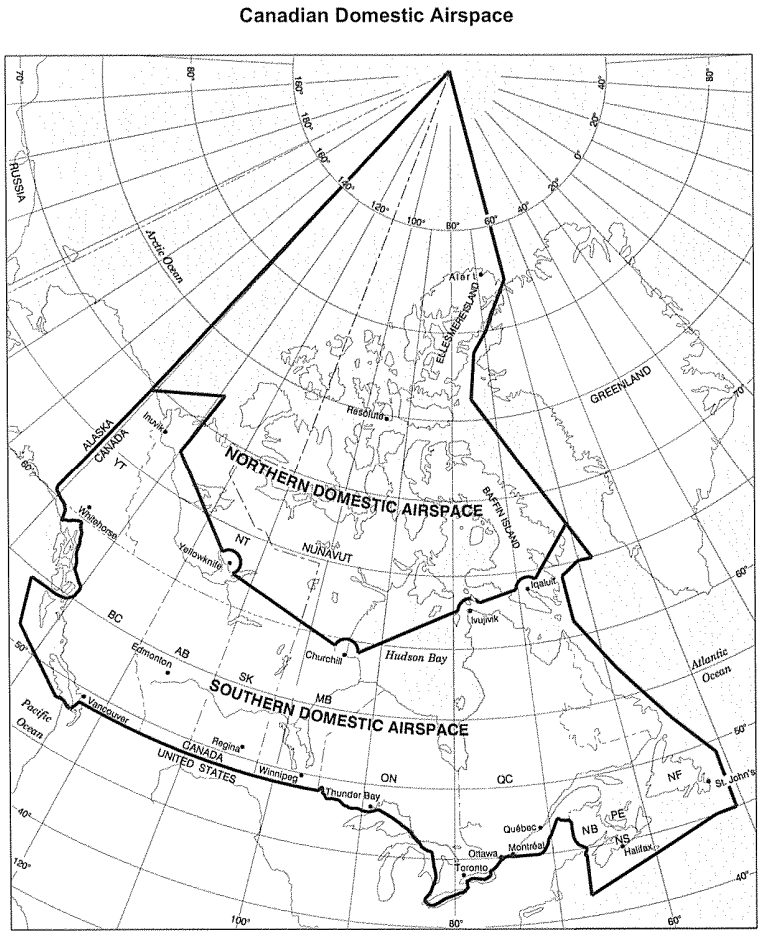

Figure 1 – Canadian Domestic Airspace[103]

The Northern Domestic Airspace is the area that includes all other airspace over Canada to the north. This area has limited radar coverage at low level and is therefore uncontrolled

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[102] Department of National Defence, "The Canadian Air Defence Sector: Home of Canada's Air Defence," (2008); available from http://cfd.mil.ca/websites/Resources/djfcplus/Intranet/DJCP7/OCB/OCB-JEC-JIIFC%20NORAD%20Brief.pdf; Internet; Accessed 3 April 2009.

[103] Transport Canada, *TP1820E Designated Airspace Handbook,* (Ottawa: Minister of Transport, 2008), M1.

below 19,000 feet. Surrounding the southern area and cutting across the northern area is the Canadian Aircraft Defence Identification Zone (ADIZ).[104] The Canadian ADIZ connects to a similar ADIZ established around the continental US and Alaska (Figure 2). These zones are key to the NORAD defence system as all airborne contacts approaching North America must be positively identified prior to crossing.

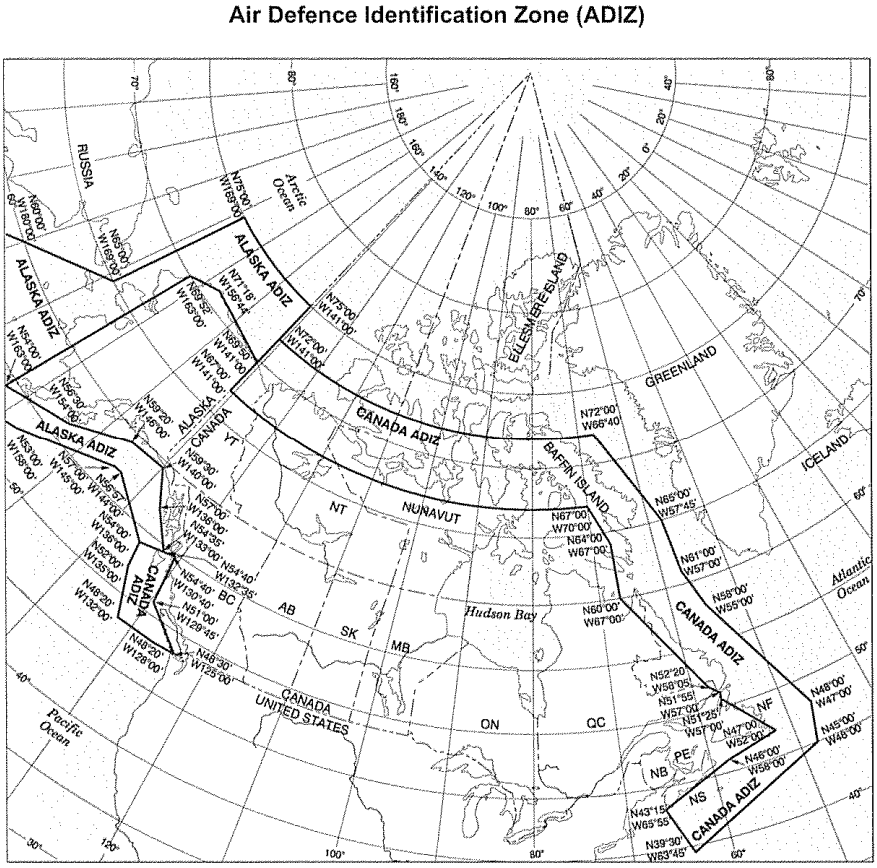

Figure 2 – Air Defence Identification Zone (ADIZ)[105]

Coverage of these ADIZ is provided mainly from military radar sites located on or near the coastlines of Canada and the US with the exception of the Arctic. The northern ADIZ are

[104] *Ibid.,* 149.

[105] *Ibid*., M6.

covered by the North Warning System (NWS). The NWS is a series of radar stations located across the top of Canada and Alaska. The NWS provides surveillance from potential incursions of unidentified aircraft or attacks from across North America's polar region. The system consists of long and short range radars (Figure 3) that form a 320 km wide by 4,800 km long barrier that is the ADIZ.[106]

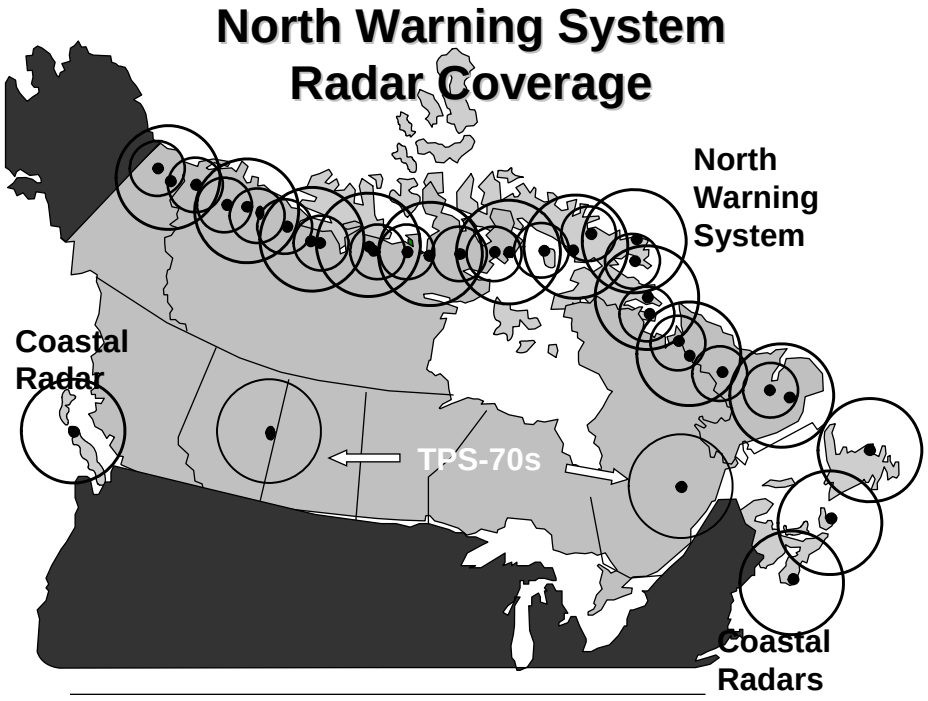

Figure 3 – North Warning System Radar Coverage[107]

The NWS was established as a more advanced and automated early warning system in 1985 when some older Defence Early Warning (DEW) Line stations were upgraded and combined with new stations. With the end of the Cold War in 1990, the US withdrew remaining

[106] The NWS consists of 15 long range AN/FPS 117 radars of which 11 are in Canada and 8 were previously DEW Line sites. The NWS also has 39 short-range AN/FPS 124 radars of which 36 are in Canada. The NWS is operated by CFB North Bay through the Canadian NORAD (CANR) region HQ at 1 Cdn Air Div HQ in Winnipeg.

[107] Department of National Defence, "CANR Introduction," Winnipeg, Manitoba: Commander 1 Canadian Air Division, 8 November 2008.

personnel from the DEW Line and handed over operation to the CF. This system combined with the ATC system and the Ballistic Missile Early Warning System (BMEWS) provides extremely effective aerospace surveillance coverage of Canada and North America.[108] The primary mission of the BMEWS is to provide tactical warning and attack assessment of Submarine Launched Ballistic Missile (SLBM) and ICBM attacks against the continental US and Canada. A secondary mission of the BMEWS is the surveillance of space.

On receiving cueing from these warning systems, NORAD provides a response using fighter aircraft to conduct reconnaissance of intruders. This air-to-air intercept is a specialized reconnaissance that directly contributes to the Air Defence of North America. It must be recognized that by conducting this Air Defence, CF-18 fighters and other US assets also contribute to the surveillance and reconnaissance of aerospace over North America.

Canada has no current independent capability to conduct surveillance and reconnaissance of space and space objects which is essential to space control.[109] However, Canada is protected by the US under agreements including NORAD.[110] The surveillance of space is conducted by the US using a combination of satellites and ground-based stations designed and operated specifically for this purpose.[111] Space surveillance is a critical part of the US Space Command's

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[108] The BMEWS consists of ground-based radars located at Clear Air Force Station, Alaska, Thule Air Base, Greenland, and Royal Air Force Station Flyingdales, UK. Gene McCall, "Space Surveillance," (2001): 23 January 2001; available from http://www.fas.org/spp/military/program/track/mccall.pdf; Internet; accessed 12 February 2009.

[109] LCol D.J. McCoubrey, Maj Steve DeLory, Capt Brad Fournier, and Capt Dave Hanak, *Space Indoctrination Handbook Fifth Edition*, (Winnipeg: Canadian Forces School of Aerospace Studies, August 1996), 14-1.

[110] Canada Treaty Information, "NORAD Agreement," (2008); available from http://www.treaty-accord.gc.ca/ViewTreaty.asp?Treaty_ID=105060; Internet; accessed 12 February 2009.

[111] United States Air University, "Space Surveillance," (2008): 29 August 2008; available from http://www.au.af.mil/au/awc/awcgate/usspc-fs/space.htm; Internet; accessed 12 February 2009.

mission and involves detecting, tracking, cataloguing and identifying man-made objects orbiting the Earth. This includes active and inactive satellites, spent rocket bodies, and debris.[112] The command accomplishes these tasks through its Space Surveillance Network (SSN) of US Army, Navy and Air Force operated ground-based radars and optical sensors at 25 sites worldwide. The SSN has been tracking space objects since 1957 when the Soviets opened the space age with the launch of *Sputnik I*. Future DND plans include launching the Sapphire System which will contribute to the SSN but have its own Sensor System Operations Centre.[113]

The CF also conducts aerospace surveillance and SIGINT of any emissions that originate from outside Canada and North America but reach the border. This SIGINT consists of both COMINT and ELINT and assists in providing early warning of potential security threats. The location and details of these facilities is classified.

In summary, the domestic aerospace surveillance defence task assigned to the CF is completed through the use of Canadian ground-based systems and through cooperation with civilian agencies and other allies. However, there are areas north and outside of the ADIZ that are blind to these systems. Often there is advanced cueing from other sources that a potential threat exists to penetrate the ADIZ but it is not until these threats are in radar range that they are detected. Therefore, there is a security requirement for an airborne asset, with air-to-air radar, to be capable of relocating to these areas and conducting reconnaissance or surveillance. This air asset could also be used for expeditionary roles. Canada has no such air asset and when this type

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[112] US Space Command is primarily interested in the active satellites, but also tracks space debris. The SSN uses a "predictive" technique to monitor space objects by spot checking them rather than tracking them continually using a combination of phased array and conventional radars along with telescopes. The SSN tracks space objects which are 10 centimeters in diameter (baseball size) or larger. About seven percent of the space objects are operational satellites, the rest are debris. *Ibid*

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[113] Defence Research and Development Canada, "Space Systems," (2009): 23 January 2009; available from http://www.ottawa.drdc-rddc.gc.ca/html/cb_ss-eng.html; Internet; accessed 12 February 2009.

of mission is required the CF must depend on AWACs support from the US. This requirement is not one that is needed for a continuous 24 hour, seven-day a week cycle. However, it is possible that probable missions could last as long as two weeks and therefore the CF should have sufficient assets to support this requirement.

Surface Surveillance and Reconnaissance

Surface surveillance and reconnaissance has always been an important aspect of military operations. Prior to advanced technology, commanders often sent scouts to the top of tall trees, hills or mountains to get a better view of the battlefield. With the invention of balloons, the concept of a "birds eye view" came into being and aerial reconnaissance was born. The invention of photography coupled with the balloon led to the first aerial IMINT reconnaissance photographs.[114] With the invention of the airplane, this capability took on a whole new importance during World War I and was the precursor to the modern day ISR requirement.[115] The ISR advantages provided by airborne assets are proven and recognized by all modern military commanders.

For security against foreign aggressors Canada needs to be able to detect the approach of uninvited military surface naval vessels or ground forces. Considering the vast expanses of the Arctic, this requirement must also include the ability to observe any suspicious activity in remote locations on the ground, nearby ice pack or ocean. This requirement can also be extended to security against illegal activity including terrorist acts, narcotic trafficking, illegal immigration,

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[114] Amrom H. Katz, *Some Notes on the History of Aerial Reconnaissance (Part 1),* (Santa Monica, CA: Rand Corporation, 1966), 6.

[115] *Ibid.,* 7-8.

illegal fishing or environmental violations such as polluting. These latter activities are normally handled by OGDs with assistance from the CF.

Domestic surface surveillance and reconnaissance can be divided into two subareas: land and maritime or overwater. As mentioned above, the CF does not conduct surveillance on Canadian citizens as this is a responsibility of the RCMP. However, the CF is responsible to provide Assistance to Law Enforcement Agencies (LEA) missions to support the RCMP when requested both for land and maritime requirements. The CF does conduct routine sovereignty patrols that include land and maritime surveillance and reconnaissance. These patrols are also carried out to demonstrate "presence" in areas of interest to national authorities. These presence missions are important because, similar to seeing a police car, seeing CF aircraft deters people from doing illegal activities. All of these ISR missions contribute directly to security and require air assets to be effective.

The domestic land surveillance and reconnaissance CF requirement is mostly support to OGDs on an as requested basis and is already conducted as an RCMP responsibility. However, the Arctic region is an exception where the CF conducts sovereignty patrols on a regular basis and reports to OGDs, including the RCMP, on any significant observations. As the RCMP looks after mostly the populated regions of the southern mainland of Canada, the CF priority for national security is mainly directed towards domestic maritime surveillance and reconnaissance including the Arctic Archipelago. This will be discussed later in this section.

The ability to control and influence what happens in its waters is fundamental to Canada's sovereignty and security. For the purposes of discussing maritime surveillance or Maritime Domain Awareness (MDA)[116], national and NORAD defence requirements suggest that four

separate areas or zones can be identified. These zones have been used by Defence Research and Development Canada (DRDC) to quantify surveillance requirements and can be described as: an inner zone from shore to 50 nm, a middle zone from 50 to 250 nm, an outer zone from 250 to 1000 nm and an Arctic zone.[117] Each zone has differing surveillance requirements stemming from the characteristics and usage.

The Arctic Zone containing the Canadian Arctic Archipelago is distinguished separately from the other zones as it is unique and presents different challenges. This zone, representing a fundamental portion of any claim of sovereignty, is vital to national security and must be protected.[118] Policing in this area is difficult and challenging for the RCMP that has neither the airborne nor maritime assets to deal with the problem. Therefore, a requirement for additional military support exists until such time as the RCMP possesses the resources to conduct surveillance in this area on their own. The fact that this proposal has never been mentioned in the media suggests that there is little possibility of it occurring any time soon.

One opinion expressed is that satellites could replace the aircraft as a method of surface surveillance and reconnaissance for both land and maritime missions. This is not the case. The choice of platforms for a specific role depends on a number of factors including: capability of the

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[116] MDA is a new term proposed to replace "maritime surveillance" as the latter term is deemed to be too threatening to Canadian citizens and does not pass the "*Globe and Mail* Test." John Orr, "New Era or False Dawn? AIMP Aurora and the Canada First Defence Strategy," In *Canadian Naval Review* Volume 3, Number 2 (summer 2007); Edited by Peter Haydon; available from http://naval.review.cfps.dal.ca/pdf/-summer2007-excerpt.pdf; Internet; accessed 16 February 2009.

[117] DRDC surveillance computer simulation and modeling results May 2008 for input into the Department of National Defence, *Air Force Plan (AFP) FY08/11*, (Ottawa: Chief of the Air Staff, 2008), Annex B.

[118] This zone has received much attention from the Government of Canada and the media. This newfound attention is a result of widespread, scientific predictions that changing weather patterns will soon make this zone more accessible to see traffic and economic activity. As a result new transportation routes are being considered, including the Northwest Passage. This increase in activity has important implications for Canadian security and sovereignty. DND, *Canada First* Defence Strategy, 6.

sensor, area to be surveyed, frequency of observation required, geometry and for satellites, kinematics or orbital properties.[119] In addition, for many years, the high level of power required to operate a radar system from a satellite, in order to overcome the ground clutter, made it impossible to get any usable data. With advances in technology, this shortcoming has recently been rectified. Satellites equipped with radar now exist, and in fact Canada has its second generation of radar capable satellite in the RADARSAT-2.[120]

RADARSAT-2 uses synthetic aperture radar to get detailed images of the Earth's surface or things on the surface.[121] One of the main applications of use to the CF is maritime surveillance, but RADARSAT-2 also provides mapping, disaster management, ice monitoring, geology data as well as agricultural and forestry monitoring. A drawback of the satellite is that it was designed to provide remote sensing for commercial around-the-clock, maritime ice surveillance and monitoring in support of commercial shipping.[122] Although proposed to provide additional ship detection in northern Arctic waters and the Northwest Passage, the satellite is actually designed for ice edge detection, detailing ice topography, type and structure discrimination. It does not have the full–range of military capabilities required to provide the type of Arctic security monitoring and surveillance needed for the DND to control the Canadian Arctic properly.

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[119] Dr. George Lindsey, "Surveillance from Space: A Strategic Opportunity for Canada," Working Paper Number 44, (Ottawa: Canadian Institute for International Peace and Security, 1992), 17.

[120] RADARSAT-2, "Marine Surveillance," (2008); available from http://www.radarsat2.info/-application/-marine/index.asp; Internet; accessed 17 February 2009.

[121] *Ibid.*

[122] David Reade, "Why Canada Needed to Upgrade the CP-140 Aurora," (Halifax: unpublished article, 2007).

Although the satellite can provide detailed images, it has some drawbacks. One drawback being that it only passes over a certain area once a day above 70° north latitude and, on average, only once every day and a half or more below that latitude. This means the satellite can be useful in detecting a TOI on the surface but is not capable of continuous surveillance. In order to provide continuous surveillance, an entire network of satellites would be required. This is currently not fiscally possible and therefore not planned. However, RADARSAT-2 is extremely good at land surveillance (referring to the actual physical surface and not the role). This surveillance can be conducted by the satellite with quick recognition of changes through automated MASINT of the radar information. Another drawback is that the satellite path over the Earth is extremely predictable and therefore can be evaded more easily by hostile forces or criminals.

The most effective platform for surveillance of surface ships or other surface targets is still an airborne asset equipped with radar.[123] The RADARSAT-2 satellite, or a similar system, is great for detecting changes on the surface be they geological, man-made structures, or vessels and vehicles.[124] Therefore, although a satellite can provide IMINT or SIGINT from sweeps of its path significantly faster than an aircraft, a satellite really only provides cueing, through reconnaissance, that a TOI has been detected.[125] A dedicated airborne asset must conduct additional reconnaissance or surveillance if required.

The inner zone surveillance requirement is ideally suited for small, slow moving, short range aircraft, UAVs or helicopters. This is because the littoral characteristics and high traffic

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[123] George Lindsey and Gordon Sharpe, "Surveillance Over Canada," Working Paper Number 31, (Ottawa: Canadian Institute for International Peace and Security, 1990), 13.

[124] George Lindsey, "Surveillance from Space: A Strategic Opportunity for Canada," Working Paper Number 44, (Ottawa: Canadian Institute for International Peace and Security, 1992), 17.

[125] *Ibid.*, 23.

volume makes it difficult to positively identify TOI. These "coastal patrol" missions were previously carried out in the 1980s by Tracker aircraft. As part of a maritime surveillance initiative unveiled by the Mulroney government, a new CPA, with medium-range and endurance, was intended to replace the Tracker. The Tracker was retired, as scheduled, in 1989 but the CPA initiative was cancelled as a result of budgetary constraints.[126] This was in addition to other Defence cuts totalling $3.4 Billion over two years.[127]

As a result of this gap in capability, the Canadian Government had to increase the flying rate of the Aurora fleet to compensate which drastically shortened the calendar date of its service life. This issue will be discussed in more detail later. This increase in the Aurora yearly flying rate (YFR) was insufficient for surveillance requirements and thus the Government turned to industry for a solution. In 1989, Provincial Aerospace Limited (PAL) based in Newfoundland was contracted to conduct primarily fisheries surveillance on the east coast using King-Air 200 aircraft. This contract continues today and PAL conducts missions mainly for the DFO but also some for various OGDs including DND, RCMP and the Atmospheric Environment Service.[128] These PAL aircraft are ideally suited for these missions and, although they have a civilian flight crew, there is a government representative on board. These aircraft fly approximately 5,000 hours per year in support of this mission.[129]

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[126] Martin Shadwick, “Aurora Renaissance," *Canadian Military Journal*, (Winter 2007-2008), 103.

[127] Department of National Defence, “Aerospace Capability Framework FY02/03: Annex F,” (2008): 5 July 2004; available from http://www.airforce.forces.gc.ca/site/vision/pdf/Aerospace/print/Aerospace_Annexes_e.pdf: Internet; accessed 07 April 2009

[128] Provincial Aerospace Limited, “Canadian Government Relationship,” (2008); available from https://www.provincialairlines.com/AMSDGovRel.htm; Internet; accessed 17 February 2009.

[129] *Ibid.*

Six Challenger aircraft were also reassigned by the CF to conduct this coastal patrol mission in 1992.[130] This was mainly a token gesture as these jet aircraft were ill suited for the task as they were too fast, had insufficient sensors and were minimally crewed.[131] This aircraft was also retired due to CF reductions caused by federal budgetary constraints. Currently, the CF has no dedicated CPA. If a coastal patrol mission is required, the Aurora, the Arcturus or, if at a close distance, the CH124 Seaking is utilized.

The Aurora can conduct these missions effectively as it is equipped with surface search radar, an electronic surveillance measures (ESM) system that allows counter detection of other vessels radar, an electro-optic, infra-red (EO/IR) full motion, recordable camera and a hand-held camera. The aircraft also has a large crew that are all trained observers and the capability to communicate real-time intelligence to ground stations. The Arcturus can also conduct these missions but is somewhat less capable having only a surface search radar and communications. However, this is an expensive way of accomplishing these types of missions especially with consideration of the limited YFR assigned to this fleet of aircraft. This problem will be discussed in more detail in the next section. Additionally, the Seaking could be used for these missions but it is slow and range limited so must be tasked accordingly. Although the civilian company PAL can conduct these missions, there is still a requirement for a military component. Certain security missions should not be the responsibility of the civilian company as the inherent dangers associated with these missions are what the CF or RCMP is established to deal with. For these

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[130] Department of National Defence, "434 Squadron History," (2008); available from http://www.airforce.forces.gc.ca/14w-14e/page-eng.asp?id=239; Internet; accessed 17 February 2009.

[131] The coastal patrol Challenger aircraft only had a two pilot crew.

reasons, the CF requires a CPA or medium-range patrol ISR air asset that would be less expensive to operate than the CP140.

This medium-range patrol ISR asset could be a UAV. However, there are still some missions that require control or decisions by actual people on scene. Additionally, the harsh Canadian environmental conditions sometimes preclude the use of UAVs as these platforms are not designed to operate in icing conditions.[132] For these reasons, a strictly UAV solution is not sufficient. A CPA is also required. However, UAVs and aircraft should not be seen as competing but as complementary to each other.

The outer and Arctic zones distances from airfields and large areas require a long range patrol aircraft (LRPA) capable of high speed and long endurance. This role is currently completed by the CP140 Aurora and CP140A Arcturus. The Arcturus was specifically purchased in 1994 to conduct Arctic surveillance and contribute to Arctic sovereignty. Unfortunately, the Arcturus has rarely been used in this role. This is due to the fact that high usage rates on the CP140 were compensated for by moving pilot proficiency training to the Arcturus.

The Aurora and Arcturus are the only CF domestic air assets that have the range, speed and endurance, coupled with adequate sensors, to carry out this vital role although the Arcturus is somewhat limited. The Sperwer UAV is currently in expeditionary use and will soon be retired. Its replacement, the Heron, could be re-tasked for this role. The Heron offers far greater endurance, altitude and speed than the CU161 Sperwer.

Although UAV capabilities have been proposed by DND for several years as the panacea for sovereignty, there is no currently available UAS that can withstand the harsh winter

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[132] Icing conditions refers to the condition of accumulating ice on surfaces of an airframe when atmospheric conditions result in super-cooled water droplets. These water droplets are below freezing and flash freeze on impact. This condition will eventually cause the air vehicle to be unable to maintain controlled flight if left unchecked.

environment present in the Canadian Arctic. There are also many problems to address regarding their operation in Canadian airspace including operator's permits, allocation of the dedicated communication frequencies required and training of the crews.[133] Additionally, UAS require line of sight communications with satellites or a system of ground repeater stations for control. Neither of these conditions adequately exists north of about 60 degrees latitude. So, given the line of sight and satellite communications requirements for their operation, UAVs cannot yet operate effectively in the far northern regions of the Canadian Arctic. Therefore, although highly desirable, the government proposed procurement of UAVs for usage in the Arctic, and their associated satellite components or alternate control systems, are still far in the future.[134] Their potential use for Atlantic and Pacific middle and outer zone maritime surveillance is a more realistic scenario and a goal the CF should aim to achieve as soon as possible.

Operational Research and Development staffs at DRDC have calculated the required amount of airborne reconnaissance and surveillance time to ensure detection of illegal or hostile surface targets to provide security of Canada. The concept of operations behind the calculations is that a layered approach to maritime reconnaissance and surveillance missions could ensure almost complete detection of surface vessels if the minimum recommended hours are spent patrolling these zones. This layered approach would involve a certain, minimum amount of time patrolling the outer areas, in a systematic but random approach to negate predictability, by LRPA

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[133] When considering a request for operating approval, the system as a whole will be assessed including an assessment of the operating personnel. Transport Canada, "The Processing of an Application for a Special Flight Operations Certificate for the Operation of an Unmanned Air Vehicle (UAV)"; available from http://www.tc.gc.ca/CivilAviation/general/recavi/Instructions/Unmanned/-section2.htm; Internet; accessed 19 February 2009.

[134] It is estimated that "The Polar Communication and Weather Satellite Constellation Project" will provide reliable communications in the high latitudes with an FOC of 2016. This project is still in the identification phase so this date might be optimistic. FOC date reprinted with permission. Chief of Force Development, "Space and the Defence and Security Agenda" (lecture, Canadian Forces College, Toronto, ON, 13 January 2009), with permission.

or UAVs. These air assets would detect a percentage of all vessels approaching North America. The next layer would have a CPA, LRPA or UAV patrolling the middle zone for another calculated minimum amount of time. These patrols would detect the majority of vessels that were undetected in the outer zone. The last layer would be a short range asset patrolling the inner area and detecting any remaining vessels that might have gotten through the first two shielding layers of defence. There would be potential that a few surface contacts might go undetected due to operator or sensor errors coupled with plain chance.[135] 1 Canadian Air Division staff estimated that a total of almost 12,000 flying hours annually would be required to patrol all four zones.[136] These hours could, eventually, be divided between manned and unmanned aircraft. The number of required hours for ISR will be discussed further in the next section.

The intelligence resulting from this layered surveillance approach can be fused with information from the new Automatic Identification System (AIS). AIS is intended, similar to aircraft transponders, to increase safety and allow authorities to track and monitor vessel movements. The AIS is used in navigation primarily for collision avoidance. The International Maritime Organization's International Convention for the Safety of Life at Sea requires AIS to be fitted aboard international voyaging ships with gross tonnage of 300 or more tons, and all tankers and passenger ships regardless of size.[137] The AIS is used by ships and Vessel Traffic Services (VTS) principally for identification and locating vessels. It provides a means for vessels to

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[135] This concept of operations was trialed by DRDC Atlantic using computer simulation and modeling. This simulation allowed for accurate estimations of the required patrol time for the different zones. This plan will require further analysis once satellite coverage is in further use with a UAS. DRDC surveillance computer simulation and modeling results May 2008 for input into the Department of National Defence, *Air Force Plan (AFP) FY08/11*, (Ottawa: Chief of the Air Staff, 2008), Annex B.

[136] Department of National Defence, *Air Force Plan (AFP) FY08/11*, (Ottawa: Chief of the Air Staff, 2008), Annex B.

[137] International Maritime Organization, "AIS Transponders," (2008); available from http://www.imo.org/Safety/-mainframe.asp?topic_id=754; Internet; accessed 17 February 2009.

electronically exchange ship data including: identification, position, course, and speed, with other nearby ships and VTS stations.

Special satellites can receive AIS signals and forward the data to national surveillance and security agencies. This allows vessels to be tracked almost continuously as positions are normally updated a minimum of every 12 hours. By using AIS data, a LRPA can separate radar contacts into knowns and unknowns. This allows for a better use of resources as priority can be placed on unknowns. Known AIS contacts can also be routinely verified to ensure the information passed through the various ISR systems is accurate and no illegal spoofing is taking place.

It must be noted that the Navy and the Coast Guard have a part to play in domestic surveillance and reconnaissance of these four zones. This is not an easy job as the Pacific, Atlantic and Arctic oceans surrounding Canada are some of the most challenging operating areas in the world.[138] However, naval assets are limited and a single ship or submarine cannot patrol a very large area. In fact, it takes quite a significant group of ships to maintain an active presence over an area of ocean. It states within *Leadmark: The Navy's Strategy 2020:*

> A naval surface task group of four modern frigates or destroyers and an operational support ship (AOR), with a combined helicopter capacity of eight, has a continuous surveillance coverage of some 192,000 square kilometers (an area equivalent to nearly half the Baltic Sea or roughly the total area of the five Great Lakes).[139]

While this may seem like a large area, a single Aurora can survey the same area in about four hours or less. Although this is not continuous surveillance, the revisit time of four hours makes it

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[138] Directorate of Maritime Strategy, *Leadmark: The Navy's Strategy for 2020*, (Ottawa: Chief of the Maritime Staff, 2001), 101.

[139] *Ibid.*, 107.

near continuous and almost impossible for a surface vessel to escape detection. Also of note, an Aurora would cost a fraction of the naval assets.

This does not mean the Navy does not have a role to play. The disadvantage of a LRPA is that it cannot conduct interdiction of surface vessels easily. LRPA can only direct ships to a port and follow them until they get there. Almost every time the aircraft will run out of fuel before the ship can reach a port. A Navy ship is much better suited for this task being able to intercept and board other vessels if required. However, the use of cueing by either AIS or aircraft allows for more effective interdiction operations by the Navy. So, aircraft and naval vessels should not be seen as competitors but as teammates conducting the same mission.

In summary, radar equipped satellites are great for TOI reconnaissance and geological surveillance. These satellites could also provide cueing to commanders to commit air assets for dedicated area or TOI surveillance. An aircraft or UAV is still more efficient as it can spend most of its airborne time over the AOI, and can be diverted in order to pay particular attention to a selected target. However, it must be noted that the satellite is in orbit 24 hours a day, which is far beyond the individual capacity of an aircraft.

Satellites and airborne assets should not be looked at as competing with each other. In reality, they are complementary systems and each has its place in an ISR system of systems approach to security and sovereignty. Similarly, aircraft and UAVs should not be seen as being competitors; again, these are complementary systems.

Sub-surface Surveillance and Reconnaissance

Sub-surface surveillance is one of the defence tasks assigned to Canada COM and CMS in the DP&M database. Sub-surface surveillance and reconnaissance is conducted by the military for security reasons and is really only required for one type of target, the submarine. One of the

main ways to do this is through the use of the properties of sound propagation through water. Sound can travel great distances underwater depending on the volume of the source. The sound can be used for detection either passively by listening or actively by using sonar using acoustics or ACINT. This task is extremely challenging as modern-day submarines use sound absorbing anechoic coating and make very little mechanical noise. These operating characteristics make them very quiet. Combine this quietness with manoeuvring tactics and submarines become very hard to detect.

The Canadian domestic sub-surface surveillance and reconnaissance area is the same size as described above regarding surface area. This is a huge area. Without the advantage of the extended ranges of radar and satellite cueing, surveillance is almost an impossible task. As Lindsey and Sharpe suggest, "Although difficult in the open ocean, surveillance of submarines is best carried out by bottom-mounted passive sonar, backed up by maritime patrol aircraft equipped with sonobuoys."[140] These bottom-mounted sonar systems are in use as Sound Surveillance Systems (SOSUS) and often form part of a network called the Integrated Underwater Surveillance System (IUSS).[141] SOSUS provides excellent cueing for air assets to conduct underwater target location and tracking, a form of surveillance, using sonar, sonobuoys or Magnetic Anomaly Detection (MAD) sensors. Therefore, long-range, high endurance air assets are required to respond to this SOSUS cueing and to conduct sub-surface surveillance and reconnaissance. The CP140, or a similar platform, is capable of fulfilling this role. On the other

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[140] Lindsey and Sharpe, “Surveillance Over Canada,” 13.

[141] United States Navy, Commander Undersea Surveillance, “History of IUSS,” (2008); available from http://www.cus.navy.mil/timeline.htm; Internet; accessed 17 February 2009.

hand, there are no UAV or UAS that are capable at this time as no UAV is fitted with sonobuoys, sonar or MAD.[142]

A secondary advantage of the SOSUS or IUSS arrays is that they are able to detect surface vessels as well using ACINT. The surface vessels, especially commercial ones, do not usually attempt to reduce sound noise levels from their equipment and engines. Therefore, these targets are detectable for long ranges. Using MASINT and ACINT, surface vessels can often be classified to type and even to the specific name if enough previous data is available. Using a process called Target Motion Analysis (TMA), a fairly accurate course and speed can be determined for surface targets. When this TMA ACINT is compared to the ELINT obtained from AIS, a correlation can be made to confirm known surface targets. This allows any targets not correlated with surface data to be identified as possible or probable unknown, underwater contacts. This is one area where the advantage of a robust C4ISR system of systems is evident. Analysis and fusion of the ACINT and ELINT, by intelligence specialists and analysts, can determine whether air assets need to be committed for a mission to conduct additional surveillance or reconnaissance. A commander can then review the overall COP and make a decision based on this timely and accurate intelligence.

The Canadian IUSS component is based in Halifax, NS. This component falls under the Commander, Undersea Surveillance who is the US Navy Commodore responsible for all SOSUS arrays in both the Atlantic and Pacific Oceans.[143] These arrays are used in conjunction with specialized Navy frigates or destroyers, equipped with towed sonar, to conduct reconnaissance

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[142] NATO, The Joint Air Power Competence Centre (JAPCC), *The JAPCC Flight Plan for Unmanned Aircraft Systems in NATO 2007*, Version 5.4, 15 March 2007, Annex D.

[143] United States Navy, Commander Undersea Surveillance, "IUSS Mission," (2008); available from http://www.cus.navy.mil/timeline.htm; Internet; accessed 17 February 2009.

and surveillance of the underwater maritime approaches to North America. These assets are insufficient to cover the entire area and are therefore are positioned in historical areas of high probability. However, the fact that no subsurface contacts are detected does not ensure that there are no contacts as these contacts could “slip through” other areas and go undetected. Therefore, operational planners use progressive search tactics to locate suspected underwater targets. High speed, long-range, high-time endurance air assets are a key component to these plans. Again, the CP140 or a similar type aircraft is capable of doing this role.

The mission of detecting and tracking submarines through reconnaissance and surveillance activities is more commonly referred to as Anti-Submarine Warfare (ASW). ASW is not an easy task and requires much practice to maintain proficiency. Certain water conditions also make sound propagation extremely limited and under these conditions even the most proficient crew will have difficulty. The CH124 Seaking and the CP140 Aurora are the CF's, and Canada’s, only air assets that are capable of ASW. The Seaking is a capable ASW platform that uses an active sonar ball to track submarines. Seakings rarely conduct missions independently and are normally embarked on Canadian frigates. The Aurora uses both passive and active sonobuoys, radar, an EO/IR camera and MAD to detect and track submarines.

One place where the concept of SOSUS providing an initial detection area of probability, and then air assets are dispatched to localize and track the underwater contact, is difficult is under the ice. A helicopter cannot dip its sonar through the ice, nor can an aircraft drop water activated sonobuoys. In order to partially overcome this problem, specialized geobuoys[144] have been developed to listen through the ice for the CP140. This poses a problem for Canadian

[144] These buoys stick into the ice and use sound propagation through the ice for detection and tracking of under-ice targets of interest.

sovereignty as one of the plans to maintain surveillance and sovereignty in the Arctic is through the use of SOSUS.

The Arctic Sub-surface Surveillance System (ARCSSS) is a sea-based surveillance system that was proposed by DND and the Government of Canada in 1987 for Arctic passive acoustic surveillance of submarines and surface vessels.[145] This ARCSSS was supposed to have sensors at three critical choke points in the Arctic installed by 1999.[146] ARCSSS would allow detection of most subsurface and surface targets passing through the Northwest Passage and around Ellesmere Island. Any targets that could not be classified through ACINT or TMA would require investigation by a LRPA. The reasons a LRPA is required are that the distances in the Arctic are great, UAVs cannot operate yet in the Arctic and helicopters do not have the speed or endurance. This pairing of SOSUS and LRPA is a proven tactic employed often and effectively during the Cold War.[147]

SOSUS monitoring and increased air surveillance is an option that would work in the Arctic quite effectively. Unfortunately, installation of ARCSSS has been delayed.[148] However, the concept of acoustic surveillance and responsive air patrols remains a viable solution. This

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[145] Canadian Arctic Resources Committee, "Policy Issues: Sovereignty over the Northwest Passage," (2008); available from http://www.carc.org/pubs/v23no2/mu-polic.htm; Internet; accessed 17 February 2009.

[146] These Arctic chokepoints included Barrow Strait (near Resolute), Jones Sound (near Grise Fiord site of the proposed Arctic deep water port) and Robeson Channel (near Wrangell Bay close to CFS Alert). Major E.R. Robinson, "Arctic Sovereignty: Changing Times, Changing Emphasis," (Toronto: Canadian Forces Command and Staff College Paper, 1994), 20.

[147] J. Matthew Gillis, "Viable Options for Securing Canadian Arctic Sovereignty," Canadian Naval Review, Volume 3, Number 1 (spring 2007).

[148] The 1987 White Paper did plan an underwater listening system. However, it was designed to operate *in tandem* with the proposed SSN at clear submarines rather than *independent* of them. When the SSNs were cancelled, so was the ARCSSS. Adam Lajeunesse, "Sovereignty, Security and the Canadian Nuclear Submarine Program," In *Canadian Military Journal*, (2008): 14 July 2008; available from http://www.journal.forces.gc.ca/vo8/no4/lajeunes-eng.asp; Internet; accessed 28 February 2009.

combined option provides a practical solution through available and existing technologies. It may even be more fiscally responsible than constructing numerous, multi-million dollar Arctic patrol vessels or deploying CF submarines into this dangerous area. Aircraft have the additional advantage of being able to respond to vessels in distress in this harsh region of the world.

In summary, the CF requires air assets that are capable of subsurface surveillance, reconnaissance and ASW. The CF currently has Seaking helicopters and all-weather Aurora LRPA that are able to fulfill this role. There is no UAV capable of fulfilling this role yet so manned ISR aircraft are definitely required. Considering the huge area involved and the Government's commitment to security and Arctic sovereignty, these aircraft will be required for the foreseeable future.

Expeditionary or Deployed ISR

Peacetime surveillance in areas of geo-strategic importance is essential and is achieved through the routine presence of Allied forces in those areas. In peacetime, NATO relies heavily and primarily on the intelligence provided by member nations. For the CF on international deployments, the AOI will likely be smaller, but rarely as familiar. Deployed operations include military operations in support of overseas alliance partners, peacekeeping, operations other than war including non-combatant evacuation operations and warfighting operations, such as the Gulf and Afghanistan Wars. Such deployments will require versatile and easily deployed ISR systems.

Furthermore, when deployed, the CF must have access to integral and independent intelligence to avoid over-dependence on foreign sources. Differences between national and international ISR requirements emphasize the need for careful consideration of new sensor systems and platforms. Deployed forces often cannot easily or rigidly establish surveillance zones. The Task Force Commander must establish surveillance zones based on multiple factors

which could include: the threat direction, the adversary's offensive capability, own force defensive capability, geographical constraints and the environment.

The intelligence cycle of direction, collection, analysis and fusing, and dissemination will be critical to anticipating and, possibly, preventing or containing conflicts during deployed operations. Intelligence processes may include agencies not traditionally associated with military operations, for example LEA, and non-traditional sources, such as informal contacts with non-governmental actors. A complete understanding of the operating environment and a proactive approach in the early stages of emerging crises will be required. A key component of this understanding will be the early identification of commanders' critical intelligence requirements. This assessment will allow commanders to make sound decisions by having increased SA through supporting secure intelligence networks. Improvements in all aspects of the intelligence cycle will be necessary so that the time between anticipation of a risk or threat, and the definition and execution of a course of action can be shortened. [149]

For a deployed operation, ISR assets are required for aerospace and surface areas and may be required for sub-surface as well. Although mobile, ground-based radar are available for aerospace surveillance, they are limited by line of sight. For this reason airborne ISR assets capable of aerospace control are required such as an AWACS or similar type aircraft. The CF has no such asset and must rely on US or other allies to provide this capability.

Surface ISR requirements can be fulfilled from a number of sources. These sources could include land-based imaging systems or human observers, however, the majority of surveillance and reconnaissance intelligence collection requirements are conducted using airborne platforms such as aircraft, UAVs or helicopters. This is especially true for tactical level ISR. Strategic and

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[149] NATO, NATO Standardization Agency, AJP 2.1 *Intelligence Procedures*, (North Atlantic Treaty Organization NATO Standardization Agency (NSA), 2002), 2-8.

operational level ISR can often be provided through the use of IMINT or ELINT provided from satellites. The majority of ISR taskings in Afghanistan are being fulfilled through the use of UAVs including the CF's Sperwer. In fact, the Sperwer's approved YFR of 1900 hours is all flown in theatre. However, the CF is still lacking vital capability so modified CH146 Griffin helicopters have recently been re-roled and deployed to contribute to the ISR requirement using an EO/IR camera. The access to timely and accurate intelligence is such a critical requirement that most operations or missions will not be conducted if this critical piece of the puzzle is missing.

A sub-surface ISR capability is also required as Canada still has commitments to NATO to assist in hunting hostile submarines. Even though the Cold War is over, this expeditionary ASW requirement still exists. Over 80 countries of the world operate submarines and the majority of these countries are potentially hostile.[150] One of the best responses to this threat is multiple LRPAs capable of working in a joint ASW environment.

The Seaking is ASW capable but is "tethered" to a ship so normally it only assists the associated naval fleet. The city class frigates and new Victoria class submarines are also ASW capable, however, both are speed and radius-of-action limited. The CP140 is the CF's only other ASW capable air platform. Previous to April 2007, it was depended upon to fulfill NATO commitments to our allies to conduct ASW operations. The decision to cutback this capability will be discussed in the next section.

ISR is a critical requirement for deployed operations as will be discussed in the next section. If the CF does not want to be dependent on allies or wants to conduct independent

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[150] Janes Fighting Ships, "Submarines," (2009): 7 April 2009; available from http://jfs.janes.com/public/jfs/index.shtml; Internet; accessed 7 April 2009.

operations, it must possess ISR assets. As the majority of these ISR missions require airborne assets, and the Government of Canada has highlighted “international peace and security” as one of the CF's primary missions, a strong argument can be made for the CF to possess air ISR platforms that are deployable in an expeditionary role.

LACK OF ISR PRIORITY AND THE EFFECT ON CF OPERATIONS

Current State of Capabilities

The Government of Canada has clearly articulated that a priority be placed on national security and sovereignty. The *Canada First* Defence Strategy and both historical and recent policy statements have stated that the CF will contribute directly to this priority. The problem is these words have not been reflected in the actual deeds of the CF nor the Government. Canadian military and government decision-making regarding maritime or coastal patrol, Arctic surveillance and ISR platforms in general has been for decades "...characterized by a monotonous proclivity for indecisiveness, ill-considered qualitative and/or quantitative reductions, false starts, false economies and ill-conceived business plans."[151] A distinct lack of priority on maintaining existing and obtaining new airborne ISR assets has had a negative impact on the ability of the CF to conduct operations, especially the paramount mission of the Defence of Canada.

This lack of priority has persisted in spite of the fact that as early as 1991, in response to the more than 50% reduction in fixed wing aircraft surveillance capability gap identified as a result of the Tracker retirement,[152] the Standing Committee on National Defence and Veterans Affairs had recommended "…the air surveillance capability of the Canadian Forces be increased."[153] This committee also recommended "... that the Government consider improving

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[151] Martin Shadwick, "Aurora Renaissance," *Canadian Military Journal*, (Winter 2007-2008), 102.

[152] Martin W. Shadwick, *Who's Watching the Oceans?* (Toronto: York University Centre for International and Strategic Studies, December 1989), 19.

surveillance in Canada's Arctic. In particular, the Government should ... examine the possibility of acquiring additional long range patrol aircraft."[154] The response from the Government was "The additional Long Range Patrol Aircraft announced in 1987 are no longer affordable in this period of fiscal restraint."[155] This indifference indicated the Government's continued lack of support for CF ISR assets in support of national security and sovereignty in spite of policies to the contrary.

In fairness, as noted above, the Government did approve the purchase of three Arcturus aircraft, and the CF did re-role six Challengers, to address this surveillance gap. As argued previously, airborne assets are a key component to conducting ISR activities for the CF. In order to effectively conduct these ISR activities to maintain Canadian security and sovereignty, contribute to the defence of North America and contribute to international peace and security, sufficient resources must be applied. As will be discussed, these resources have been, and still are, insufficient. It must also be noted that these resources need to include not only equipment, but personnel as well.

As identified above, Air Division staff calculated the number of flying hours required to support Canada COM in conducting adequate national and NORAD surface surveillance as 12,000 based on probabilities of detection. If this number is combined with the almost 1,900 Sperwer hours and the total other requested CP140 ISR hours, the total is: 18,550 hours.[156]

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[153] Government of Canada, "Recommendations of and Comprehensive Government Response to the Third Report of the Standing Committee on National Defence and Veterans Affairs Entitled 'Maritime Sovereignty'," (Ottawa: Clerk of the Standing Committee on National Defence and Veterans Affairs, 1991), recommendation X.

[154] *Ibid.*, recommendation II.

[155] *Ibid.*

These are only force employment (FE) and force generation (FG) hours for supported commanders. In order to prepare to conduct operations, aircrew or UAV operators must spend a certain amount of time on internal FG training as well.

ISR training requires practice to develop and maintain proficiency on the aircraft or UAV itself, tactics, techniques and procedures. Even with modern day flight simulators, a certain amount of training must be done in real world scenarios. This is especially true of NATO and Allied joint operations. Based on LRPA readiness doctrine, if an average crew does mostly simulator training, two five hour missions per month of training on the actual aircraft or air vehicle should suffice, so an extra 10 hours per month can be estimated. To ensure inter-operability with Allies, joint training must also be conducted. A normal NATO minor exercise work-up of one week consumes approximately 40 hours for four sorties of six to seven hours each plus transit time. If the 10 hours per month local training is combined with two minor exercises with NATO and Allied forces, a total of 190 hours per year per crew can be assumed for training time.[157]

If simulator, training and operations requirements are compared with the number of work days in a year, crews can conduct a FE mission, on average, every five calendar days. If a seven hour mission is assumed based on average flight time of ISR aircraft or swap of UAV operators, then a crew could conduct approximately 500 mission hours annually.[158] The result is that 37

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[156] The CP140 requests consist of: 2800 by CEFCOM for deployed operations, 1300 by CMS for fleet support force employment (FE) and force generation (FG), 300 by CLS for FG, and 250 by the other supported commanders for reconnaissance and Special Forces operations. Department of National Defence, *Air Force Plan (AFP) FY08/11,* (Ottawa: Chief of the Air Staff, 2008), Annex B.

[157] These numbers based on the requirements contained within the *CADM 30-300 CP-140/A Long Range Patrol Combat Training Directive* 1 December 2007.

[158] This number is based on assumptions of average endurance calculations of a typical CP140, AWACs or new P8 type mission. Work load and fatigue are the critical factors for analysis. An in depth study of individual

ISR crews would be required to conduct the currently requested flight hours on air platforms, either aircraft or UAVs. With the inclusion of readiness FG training, this results in the total airframe or air vehicle hours required as approximately 25,580 annually.

The number of aircraft or UAVs required to support this flying rate would depend on engineering defined maintenance cycles. If a history similar to the CP140 is assumed, i.e. mid-life structural refit and replaced after 30 years, an 800 hour YFR could also be assumed resulting in the requirement for 37 airframes.[159] This estimate is well off the *Canada First* Defence Strategy proposal of 10 to 12 MPA.[160]

The number of operational CP140 and CU161 crews currently is only 8, with 5,200 hours assigned for FE hours plus 3,200 additional hours for training. Therefore, not only are there not enough crews to fly the requested hours, there are not even sufficient crews to fly the assigned hours. There is definitely a shortage of crews and the Air Force has put no priority on regenerating them. In fact, the CP140 fleet has only recently undergone a drastic force reduction from 13 crews to 8 as a result of a YFR reduction to 6,500 hours.[161] This shortfall in crews has had an effect on CF operations as there are not enough crews to fly the surveillance and reconnaissance hours required to ensure the security of Canada and the maritime surveillance commitment to NORAD.

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airframes or UAVs would be required for more accurate calculations and confirmation. The numbers of crews per aircraft and annual flying rates are sources of continually debate.

[159] The number of air platforms required would require a detailed engineering study prior to committing to an acceptable YFR as this rate differs greatly between platforms. This study would have to take into account things such as: cost per hour, third line maintenance, complexity, national procurement funding, technician capacity and the planned replacement cycle of any air platform to name but a few. If a history similar to the CP140 is assumed, i.e. mid-life structural refit and replaced after 30 years, an 800 hour YFR could also be assumed resulting in the requirement for 37 airframes.

[160] DND, *Canada First* Defence Strategy, 17.

[161] Department of National Defence, *Air Force Plan (AFP) FY07/10,* (Ottawa: Chief of the Air Staff, 2007), 23.

This deficiency has been created mostly due to historical decreases in aircraft and flying hours. When the CP107 Argus was procured from 1958 to 1961, a total of 33 aircraft were delivered.[162] At the time, a total of 28 crews were flying on average 24,000 hours on the aircraft on two coasts. In addition, the Royal Canadian Navy had 101 CP101 Tracker CPA that were purchased, in 1956, to fly off the HMCS Bonaventure aircraft carrier.[163] When the carrier was retired in 1969, the Trudeau government tried to retire the Tracker as well. This decision was overturned by the 1971 white paper and 30 Tracker aircraft were transferred to the Air Force, flying approximately 4,500 surveillance hours annually.[164] These aircraft continued to fly coastal patrol missions until 1990.[165] Considering the technology at the time of both the aircraft and the targets to be surveyed, these numbers of aircraft were sufficient to conduct security of Canada and North America.

It is surprising then, that when the CP140 was chosen by the Trudeau Government as the LRPA to replace the Argus in the 1970s, that only 18 aircraft were procured. This number was much less than required and even Canadian industry seemed to have a better idea of the requirement. In order to counter a Lockheed proposal, Canadian industry proposed that Canada should "…upgrade 16 of the surviving *Argus* aircraft for anti-submarine warfare and acquire eight de Havilland Dash 7s and four Boeing 707s for coastal and Arctic surveillance."[166] This

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[162] Department of National Defence, "Argus Years," (2008); available from http://www.airforce.forces.gc.ca/14w-14e/page-eng.asp?id=258; Internet; accessed 17 February 2009.

[163] Department of National Defence, "de Havilland Grumman CP-121 Tracker," (6 April 2004); available from http://www.airforce.forces.gc.ca/site/equip/historical/trackerlst_e.asp; Internet; Accessed 23 February 2009.

[164] Major C.J. Toner, "Exercise New Horizons: The Tracker Replacement-Circa 1985," (Toronto: Canadian Forces Command and Staff College Paper, 1986), 5.

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

[166] *Ibid.*

would have meant a total of 28 aircraft, in addition to the Trackers, vice only 18. This Trudeau Government decision resulted in a distinct cutback in capability that impacted CF operations then and continues to this day.

The effect this reduction had started as early as the mid 1980s and was highlighted by two separate incidents. In 1986, 152 Sri Lankans were rescued from two lifeboats off the Newfoundland coast, and in 1987, 173 Sikhs from India walked out of the ocean near Yarmouth, NS after being dropped off a freighter.[167] Both of the drop-off vessels involved in these incidents were undetected by Canadian surveillance efforts. If the DRDC proposed methodology to surveillance described previously was being used, these vessels, and many others, would probably have been detected prior to the incidents. Luckily, these people were just illegal immigrants and not a more hostile force.

This lack of capability was exacerbated by the retirement of the Trackers in 1990. This deficiency was recognized and, as mentioned above, attempts were made to ameliorate it by assigning six Challengers to coastal patrol and purchasing the Arcturus aircraft. This was a weak effort by the CF and Government to bridge the gap. As Shadwick noted in 1989:

> Nor, with only three aircraft programmed, can the Arcturus be pegged as the definitive solution to the Tracker and coastal patrol problem. The Arcturus will help, admittedly, but its raison d'être will be the sovereignty-surveillance missions performed by the Aurora, not the Trackers. No one should be under any illusion that three Arcturus aircraft are a fair exchange for 18 or so Turbo-Trackers or a new coastal patrol aircraft. [168]

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[167] Tom Fennell, "Immigration/Refugee Controversy," *Maclean's* August 23, 1999; available from http://www.thecanadianencyclopedia.com/index.cfm?PgNm=TCE&Params=M1SEC704435; Internet; accessed 3 April 2009.

[168] Shadwick, *Who's Watching the Oceans?* 23.

This was really just a Band-Aid solution as the sheer reduction of numbers caused a reduction in surveillance and reconnaissance activities to an unsatisfactory level requiring the contracting of PAL. This included an initial Arctic sovereignty patrol reduction from 28 to 23 patrols per year in 1979 and a further reduction to 21 by 1987. These Northern Patrols (NORP) continued their downward spiral reaching rock-bottom in 1999 when there was only one. This situation of only one or two NORPs annually continued until 2005.[169]

This reduction to one or two NORPs annually was a legitimate reprioritization by the CF. Due to high flying rates early in its lifecycle, the Aurora YFR had to be reduced. A decision had to be made amongst surveillance of the Atlantic and Pacific approaches to North America, support to DFO, support to CMS and the Arctic. The Arctic lost. This situation was further exacerbated post 9/11 by Canada's commitment, in 2002, of two Auroras in support of Operation Apollo.[170] This lack of NORPs, in spite of Government policies and promises to increase Arctic sovereignty, highlights the negative effect a lack of CF ISR air assets has had on CF operations.

With an acquisition date of 1981, the original estimated life expectancy (ELE) of the CP140 aircraft was 2001. As Canada's only LRPA, the fleet was flown at a high YFR initially of 19,200 hours. The Air Force recognized with such a high flying rate, the aircraft would not make it to 2001. Thus in the early 1990s, it was proposed that the Aurora should undergo structural

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[169] These flights conducted originally by Argus aircraft, then converting to CP140 Aurora and CP140A Arcturus. Major R.J. Walker, “Argus/Aurora Flights in the Arctic 1960-Present”, (Unpublished Briefing Note for the Commander 1 Canadian Air Division Headquarters, 13 November 2007), 2.

[170] Operation Order, Operation Apollo, March 2002.

refurbishments under the Aurora Structural Life Extension Project (ASLEP).[171] This would extend the ELE until 2010, allowing sufficient time for a replacement LRPA to be procured.

This project was not well supported by the Air Force and definition was delayed until 2000, however the ELE extension went forward.[172] The only way to compensate for this new ELE and lack of progress on the ASLEP was to reduce the YFR of the Aurora and Arcturus fleets. The initial YFR of 19,200 hours was reduced to 14,780 by 1998 and then further reduced to 11,500 by 1999 even though the Arcturus had recently been purchased.[173] This number was further reduced to 10,000 by 2001 (Figure 4). These reductions in YFR further negatively impacted CF operations and the ability to conduct ISR activities.

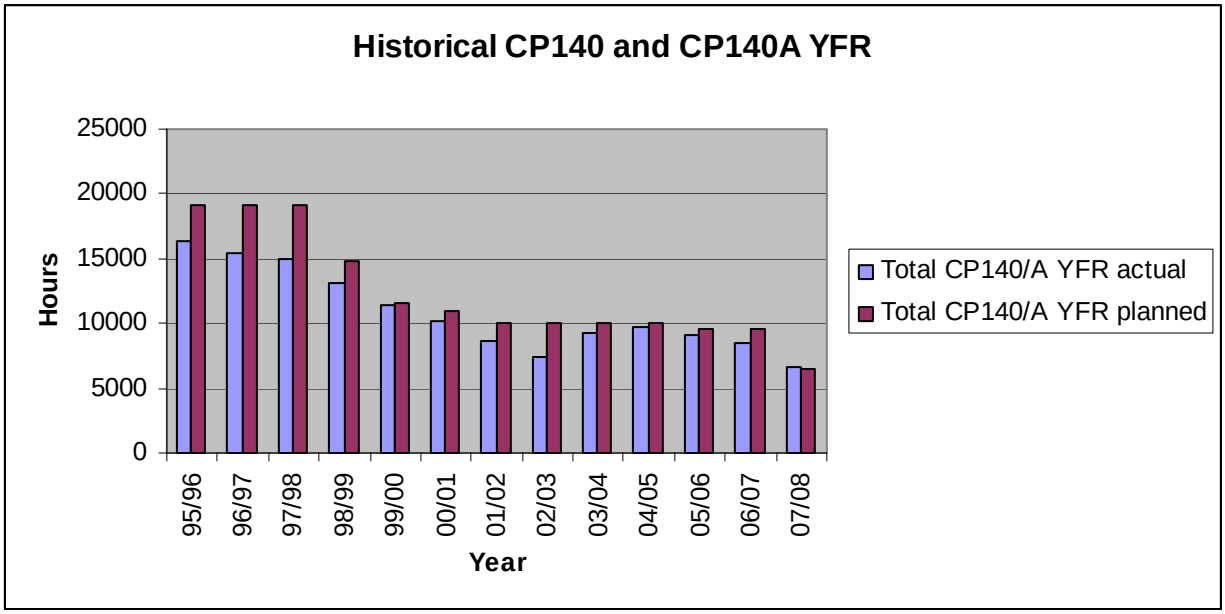

Figure 4 – Historical CP140 Aurora and CP140A Arcturus Yearly Flying Rate

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[171] Department of National Defence, "Statement of Requirements: Aurora Life Extension Project," (Ottawa: Chief of the Air Staff, 2000), 1.

[172] *Ibid.*

[173] Major R.J. Walker, "CP-140 YFR Historical Summary," (Unpublished Briefing Note for the Commander 1 Canadian Air Division Headquarters, 30 May 2008).

Also in the early 1990s, it was recognized by the Air Force that the CP140 avionics and mission systems were quickly becoming obsolete. The CP140 had been designed in the 1970s based on a Lockheed P3 airframe and S-3 Viking avionics. The initial proposal, at the half way mark of the CP140 ELE, for a replacement LRPA was not well received by the fiscally restrained Government. Nevertheless, by 1992, a Statement of Requirements (SOR) for an Aurora Update Project had been drafted.[174] This project proposal included upgrades to avionics, sensors, communications, mission computer and weapons. This project also was not supported initially by the Air Force, or other ECS, as it was competing with other high profile projects such as: the CF-18 replacement, new fixed wing and rotary SAR aircraft, and the Seaking replacement.

The Government would not commit to funding the upgrade until late 1999 and only then as an incremental project. The Aurora Incremental Modernization Project (AIMP) was to be done in four blocks vice in its entirety.[175] Even then, only limited support was received as the fourth block, consisting of a self-defence suite and air-to-surface weapon, was only acknowledged and no actually commitments, fiscal or otherwise, were approved. This ongoing lack of priority and support for Canada's only strategic airborne ISR asset is mystifying given the Government's repeated policy statements on national security and sovereignty.

With the approval of this piecemeal approach, it was initially understood and assumed by Air Force staff, that ASLEP would also be approved. After all, it would make no sense to modernize the aircraft and then not replace the structural components. This was not the case as

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[174] Department of National Defence, "Statement of Operational Requirement (SOR), A1677 Aurora Update Project," (Ottawa: Chief of the Air Staff, 22 June 1992).

[175] Department of National Defence, "Master Implementation Plan For the CP140 Aurora Incremental Modernization Project (CP140 AIMP MIP)," (Ottawa: Chief of the Air Staff, 28 February 2001).

the politicians did not completely understand the problem and thought that AIMP and ASLEP were included together. In 2002, as AIMP suffered the first of many delays, this incorrect assumption of the funding of ASLEP was confronted. The Vice Chief of Defence Staff (VCDS) and Assistant Deputy Minister of Material (ADM[Mat]) refused to support the cost of ASLEP and it was not taken before Treasury Board (TB) initially.

For unknown reasons, the VCDS and ADM(Mat) were not supportive of ASLEP in the beginning. This can only be assumed to be because of higher priorities and possibly delays of TB meetings due to numerous federal elections in the following years. It does however beg the question, what could be more important than national sovereignty and security? During the period from 1999 until the present, Air Force and CF priorities have been placed on: the Maritime Helicopter Program (MHP) to replace the 60 plus year old Seaking, the ongoing problems with the Cormorant as a replacement for the Labrador helicopter for SAR, a Hercules wing box structural repair and aircraft replacement, the CF18 replacement, UAV procurement, C17 purchase for strategic lift and Fixed Wing SAR procurement to replace the Hercules, Buffalo and Twin Otter in this role. No small shopping list, but of all these projects, only the CF18 replacement and MHP actually contribute to national security.

The continued delay in getting approval for ASLEP resulted in a "stop work"[176] order on the AIMP Block III upgrade in December 2006, as in the opinion of ADM(Mat), there was no sense upgrading aircraft just to retire them. As the ELE was still 2010 due to a structural 24,500 hour limit on the CP140 airframe, a plan to replace the CP140 with the Canadian Multi-mission Aircraft (CMA) was finally put forth by the Air Force and assigned to the Director of Air Requirements to investigate. It was determined that the CMA could not be fast-tracked, like the

[176] This "stop work" order effectively ceased all fiscal and personnel commitments to Block III. This also meant that industry would be entitled to compensatory financial payments.

C17 had been, so a plan to extend the CP140 ELE by reducing the flying rate was directed by the Commander of 1 Canadian Air Division. This resulted in the Aurora YFR being reduced to a mere 6,500 hours in 2007.[177] This was another blow effecting CF surveillance and reconnaissance operations.

As the hours available were now so few, the Commander also directed that the CP140 fleet also reduce ASW training.[178] The Commander assessed that training for ASW was a waste of hours as there was no longer a legitimate submarine threat. This assessment was flawed as many potentially hostile countries still operate submarines.[179] Unless dedicated surveillance is conducted to monitor sub-surface activity, a nation has no way of knowing if submarines are threatening its security or might even have violated its territorial waters. The effect of this cessation of LRPA ASW capability is significant and Canada is becoming one of these nations.

In conjunction with the YFR reduction, the Commander directed a force structure reduction to support other Air Force initiatives, primarily the introduction of the C17 fleet. As a result, the CP140 fleet lost almost a third of its aircrew. These decisions had a profound effect on CF operations relating to security and surveillance. According to DTs, the CP140 is supposed to maintain a 24/7 maritime response capability for 14 days, on eight hours notice on both coasts. With the crew reductions, this has been reduced significantly to 24/7 for only seven days, on 12 hours notice on a single coast.[180] Additionally, the CP140 fleet is no longer capable of

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[177] Department of National Defence, *Air Force Plan (AFP) FY07/10*, (Ottawa: Chief of the Air Staff, 2007), 23.

[178] *Ibid*., 23.

[179] Some non-NATO countries that operate submarines include: Algeria, Brazil, Chile, China, Columbia, Ecuador, Egypt, India, Israel, Iran, Japan, North Korea, Russia, South Africa, South Korea, Syria and Venezuela. Janes Fighting Ships, "Submarines," (2009): 7 April 2009; available from http://jfs.janes.com/public/jfs/index.shtml; Internet; accessed 7 April 2009.

expeditionary ASW.[181] This goes against long-standing agreements with the UK, US, Norway and other NATO Allies to assist with submarine prosecution.[182]

This decision was a Strategic level decision made by an Operational Commander and was arguably short-sighted. The most difficult mission the CP140 fleet conducts is ASW. By being proficient at ASW, other missions are easier. By not training for ASW, and cutting back on the amount of surveillance in support of security of Canada due to YFR reductions, the experience and proficiency levels of personnel has also decreased. This has had, and will continue to have, an impact on the readiness of the CP140 forces to do actual security patrols, FE missions in support of OGDs and, more importantly, in expeditionary roles in hostile areas. This situation has negatively effected operations and indicates the Air Force lack of priority on the CP140 fleet and the non-NORAD, ISR mission in general.

The lack of CF priority on ISR air assets came dramatically to the forefront when the Government decided to commit forces to the conflict in Afghanistan. The Army quickly identified the requirement for air support to including extensive ISR requirements. The Air Force could not respond as no tactical ISR assets existed in the inventory. The Air Force tried to compensate by directing the CP140 fleet to develop an Overland capability to support the Army. However, the only CF strategic ISR asset, the CP140, has not been used to date. This is due to two primary reasons.

The first being that the Aurora lacks a self-defence suite to guard against surface-to-air missile attacks, especially on take-off and landing. This means the aircraft and crew are at high

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[180] Department of National Defence, *Air Force Plan (AFP) FY08/11*, (Ottawa: Chief of the Air Staff, 2008), Annex B.

[181] *Ibid.*, Annex B.

[182] These agreements are classified.

risk of being destroyed, which impacts basing options.[183] A self-defence or self-protection suite was identified in the required upgrades, as part of AIMP Block IV, but this Block was neither approved nor funded. Once again, the CF and Government had put no priority on CF ISR air assets and it impacted the CF's ability to conduct operations.

Secondly, the CP140 has no excess capacity to fly expeditionary missions with its now extremely limited YFR. The amount of YFR is already insufficient to conduct effective domestic surveillance and support for other stakeholders. Canada COM reviewed cutting back on domestic surveillance to support the Afghanistan mission but decided against it in the end. So, with no help from the Air Force forthcoming, the Army decided to buy its own UAV.

The Army committed to purchase the CU161 Sperwer to fulfill its expeditionary ISR requirements. There were many problems with this plan but two significant ones are worth mentioning. First, the air vehicle was not reviewed or tested properly prior to purchase commitment and has been crash-prone and underpowered for the operating altitude. These failings would probably have been detected by Air Force staff, experienced in reviewing SORs for aircraft, if they had been involved in the process. The second problem is the Army did not realize a special permit is required to fly a UAV in airspace with other aircraft and it must have a qualified operator. The Army had no operators and since most of the world's UAVs are still flown remotely by pilots, the Sperwer was transferred to the Air Force to operate. This extra tasking for CF pilots, at a time when the CF was already short pilots, of course came with no additional personnel. This is another example of the CF not putting priority on the operation of air ISR assets.

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[183] This effectively makes basing in Afghanistan, or any other hostile area, unlikely unless the Commander of 1 Canadian Air Division decides to accept this risk.

This short fall of ISR and other Air Force assets was noted by the Independent Panel on Canada's Future Role in Afghanistan. In particular the Panel identified:

> The Panel has also heard that the safety and effectiveness of Canadian Forces in Kandahar would be markedly increased by the acquisition and deployment of new equipment. In particular, added helicopter airlift capacity and advanced unmanned aerial surveillance vehicles are needed now. No equipment can perfectly protect Canadian soldiers against improvised explosive devices. But helicopters can save lives by reducing reliance on transporting troops by road, and aerial surveillance can more effectively track insurgent movements.[184]

The negative effect caused by the lack of ISR air assets is a reduced capacity to track insurgents. As noted by the Panel, this shortfall has directly affected the safety of CF ground forces in Afghanistan and some deaths might have been prevented with more aerial surveillance. The historical lack of priority by the Government, the CF and Air Force has led to this situation. Fortunately, as a result of this Panel's recommendations, the Heron UAV has been in service since late 2008 conducting ISR missions in Afghanistan and helping to protect lives. However, the use of the Heron will not possibly, if ever, contribute to domestic surveillance until the conflict in Afghanistan is over.

Another airborne ISR asset shortcoming that has been noted in Afghanistan is a lack of ability to conduct mapping. The forces on the ground have a cyclical need to have detailed updates of the local terrain. The CF does not have an ISR asset capable of terrain mapping so this requirement was contracted out twice to the US Naval Research Laboratory (NRL) using, ironically, a P3 aircraft.[185] CF operations were effected when the second NRL serial was delayed

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[184] Independent Panel on Canada's Future Role in Afghanistan, "Final Report of the Independent Panel on Canada's Future Role in Afghanistan," (Ottawa: Independent Panel on Canada's Future Role in Afghanistan, 2008), 31.

nine months. To compensate, CF decided to develop its own capability in this area and the CP140 fleet was directed to do this using an Applanix camera.[186] This project is one of the few ISR success stories as the first scheduled mission in Afghanistan using this new equipment is planned for April 2009.

It must be noted that the ASLEP was finally approved by TB in December 2007 but only for 10 aircraft. This approval came as a result of the fact that the new MPA or CMA promised in the *Canada Defence* First Strategy could not be delivered any earlier than 2017.[187] Therefore, in order to have any ISR air asset and Canadian domestic surveillance capability at all, the CP140 ELE needs to be extended to 2020. So, ADM(MAT) and the VCDS forwarded the ASLEP to TB. Once it was approved, ADM(MAT) removed the stop work order on AIMP Block III. The stop work order will result in severe delays in the AIMP, however, a combination ASLEP and AIMP production line is planned for the CP140. The CP140 ELE extension of 10 aircraft will result in a limited CF airborne ISR capability until at least 2020. However, this capability will be woefully inadequate for the needs of the CF and Canada as identified in the *2008 Air Force Plan*.[188]

In summary, past Government, CF and Air Force decisions have left the CF ISR capability in dire straits. Unquestionably, there are insufficient air assets, and the associated personnel, to conduct all of the assigned surveillance and reconnaissance missions effectively.

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[185] US Naval Research Laboratory, "NRL's Rampant Lion II Survey Builds on Success of Rampant Lion I," (2009); available from http://www.nrl.navy.mil/pressRelease.php?Y=2009&R=14-09r, Internet; accessed 23 February 2009.

[186] Applanix is based in Richmond Hill, Ontario and produces a variety of Digital Sensor Systems (DSS).

[187] DND, *Canada First* Defence Strategy, 4.

[188] Department of National Defence, *Air Force Plan (AFP) FY08/11*, (Ottawa: Chief of the Air Staff, 2008), Annex B.

Domestic and continental aerospace surveillance is the only capability area that is in good shape with extensive radar coverage. However, this does not apply to expeditionary aerospace surveillance which is still lacking.

The CF surface and subsurface ISR capability is deficient due to the lack of air assets. This fact was highlighted in the "C4ISR Strategy 2028" document. As suggested in this document, a truly unified whole-of-government approach to domestic ISR is required if this deficiency is to be overcome. Until that time, the CF will continue to have a questionable domestic and expeditionary aerial ISR capability.

Proposed Solutions

Given the huge areas of Canadian sovereignty responsibility, limited resources and increasing demands on those resources, it is essential that a proper balance of surveillance capability be allocated to correspond with the level of interest and importance associated with the area being surveyed. The CF must develop a synergistic approach towards future surveillance needs, looking beyond the traditional military aspects of surveillance in the development of a single, integrated COP. As stated in the CF Joint Force Protection manual:

> Regional and intrastate conflicts can rapidly spill over political and geographic boundaries. Canada is not immune from such threats. Canada's international activities, global transportation and communications connections, information dependencies, long borders and coastlines, and many multicultural communities make separating the domestic and global security environments extremely difficult.[189]

To respond to these threats, the CF needs a medium-range coastal and overland patrol fleet of air assets in addition to the proposed CMA. These assets could and should be a

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[189] Department of National Defence, *CF Joint Force Protection,* (Ottawa: Chief of the Defence Staff, 23 February 2006), 1-4.

combination of manned aircraft and UAVs. These air assets should be all weather capable,[190] have adequate range and endurance, be able to take off and land from gravel airstrips, and have for equipment an embedded GPS navigation system and all methods of communication including VHF FM and AM, UHF, HF and SATCOM to allow operation in the Arctic. Additionally, mission equipment should include real-time digital imagery datalink, an EO/IR camera and radar for both surveillance and weather. These air assets would be excellent for conducting domestic surveillance against potential military threats and could also be tasked to conduct other LEA tasks such as fisheries protection, counter narcotics, border monitoring and Arctic sovereignty in support of OGDs. More importantly, these smaller medium-range ISR assets would prove invaluable in the expeditionary role. To be effective for deployed operations, these air assets must also have a self-protection suite and could be combined with an air-to-surface strike capability for a truly "Multi-mission" aircraft.

By increasing CF ISR assets, the CF could increase support to OGDs including taking over current PAL commitments. This would have the added advantage of increasing CF personnel experience and expertise in surveillance and reconnaissance missions. This experience would result in increased confidence for operations and more effective use of resources overall. This experience would also increase the CF's overall state of readiness for both domestic defence and expeditionary deployments in support of international security.

Additionally, the CF should have an AWACS type of air asset. This asset could be used both in a northern security role and for deployed operations. This specialized type of ISR&C air asset would be invaluable for force protection and offensive strikes.

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[190] All weather meaning capable of flight in cloud or at night and in icing conditions. The SPERWER is not able to fly in icing conditions which is severely limiting for use in the Arctic and Canadian winter conditions.

Manned aircraft are still required. No matter what sort of imagery you use for surveillance or reconnaissance, it is still just imagery. The human eye and human brain can still process some types of information firsthand better than any sensor. Additionally, some missions require command and control which is better conducted on scene in certain situations. Although not a direct ISR task, it would be a function of the CMA type aircraft. Therefore, it is important that the CF have a combination of manned and unmanned surveillance and reconnaissance airborne assets to support ISR requirements.

CONCLUSION

History has shown the value and need for reliable, accurate, and timely intelligence, and the harm that can result from its inaccuracies and absence.[191] Today the advent of new forms of communications and imaging technology has led to the rethinking of war making and strategy. Timely and accurate intelligence has become a critical requirement for conducting military operations. This intelligence can only come from a mature and effective ISR system and the associated IM systems that fuse collected information with other known data and factors. As technology has advanced, new methods of collecting intelligence have also emerged. These new methods have improved the battlefield awareness and SA of both our commanders and soldiers. C4ISR has allowed the integration of these new inputs through network enabled operations. However, a problem exists where technological advancements of weapons and vehicles of air power are being developed in a manner that quickly makes systems obsolete.

A significant portion of this technological progress is being made in the military area of surveillance and reconnaissance systems. The employment of these technologies is moving warfare further towards a greater utilization of air assets for gathering of intelligence and higher accuracy through availability of better target information. C4ISR gives a military force the ability to locate targets with accuracy, conduct surveillance or carry out attacks that significantly enhance combat power. The use of ISR systems, aircraft, AWACs, UAVs and their integration into a C4ISR system has enabled the use of sophisticated weapons, like precision guided munitions, which are extremely accurate and reduce civilian casualties.

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[191] Joint Chiefs of Staff, *Joint Operations: JP 3,* (Washington, DC: Joint Chiefs of Staff, 17 September 2007), III-27.

A robust C4ISR capability is what provides commanders with the SA they require to make time critical decisions. This SA also allows for integration and coordination of joint manoeuvres and sensor to shooter connectivity for weapons employment. C4ISR is the essential capability for binding the CF, CSIS, OGDs, and private organisations into a viable, coherent security or fighting force for both domestic and international needs. The resultant information superiority fundamentally changes the way operations are conducted.

As identified in this paper, the current Air Force assets required for a robust CF C4ISR capability are lacking. This lack of assets problem did not develop all of a sudden and was shown to have been caused by many historic decisions by the Government, the CF and the Air Force in particular. Most of these decisions were made as a result of fiscal restraints and the perception that, with the end of the Cold War, the impending threat of conflict was all but over. This situation led to the misconception that Air Force ISR assets were not required, especially for expeditionary reasons. Thus, for over 20 years, little emphasis has been placed on CF airborne ISR assets which has had a significant negative effect on this capability. This perception could not have been more further from the truth as the collapse of the Soviet Union, and the end of the Cold War, has only resulted in increased regional instability. This instability requires more “eyes on” ISR assets than ever before.

The “C4ISR Strategy 2028” document was produced as the capstone doctrine for advancing the state of CF C4ISR capability. Within this document, the C4ISR Oversight Committee identifies one of the main challenges as insufficient surveillance and reconnaissance capability. This is directly contributable to the lack of Air Force ISR air assets. The “C4ISR Strategy 2028” indicates the approach to future CF ISR capabilities will be by a consolidated approach to, and understanding of, the domain awareness requirements of the tactical,

operational and strategic levels of the CF. It further states that new CF ISR capabilities will be developed with interoperability and integration as the two main priorities. This proposed strategy is sound, and would avoid the duplication of effort and redundancies that have occurred in the past. However, this is not what is reflected in the *Canada First* Defence Strategy.

The *Canada First* Defence Strategy highlights the critical requirements of national security and sovereignty. It also commits significant resources to rebuilding the CF. This commitment comes as a result of recognizing that more than 20 years of neglect has significantly degraded the effectiveness of the CF and its equipment. Unfortunately, this document is still based on an old, fiscally restrained strategy and stovepiped requirements. This strategy is to push through Treasury Board what will be acceptable fiscally, vice what is actually required. As a result, the numbers of replacement Air Force assets has already been stated. This goes against the plan proposed in "C4ISR Strategy 2028" that indicates a consolidated approach is crucial. To truly be a consolidated approach, with an interoperability and integration priority, the assets proposed as replacements for existing air assets should be reviewed by the C4ISR Oversight Committee, with a whole-of-government approach to ISR, so the CF gets what it actually needs vice what may be deemed affordable or politically acceptable. No commitments to procure assets should be made until the Committee endorses whatever plan is conceived.

The essential truth, though, is inescapable: Canada’s security and sovereignty status quo will not suffice, and current deficiencies cannot be corrected through Band-aid solutions. Additionally, Canada has no choice but to remain engaged on the international stage. A purely domestic focus would ignore the need to deal with emerging security challenges that could attack national interests at home and abroad. Given these facts, Canada must possess credible, deployable forces that are relevant to the nation’s security needs. As information and accurate

intelligence are crucial to these forces, the CF must have sufficient air ISR assets to support them.

A dedicated review of all CF and OGD ISR assets needs to be conducted and a master plan or grand strategy needs to be developed in order to fulfill Canada's national, continental and international security and CF ISR requirements. Although modern space-based surveillance systems, land-based radar and underwater sensor systems can detect aerospace, surface and subsurface targets of interest, these systems really only provide cueing for further investigation. Dedicated airborne assets are still required for positive identification, and detailed intelligence collection of these targets. These assets must be procured, and supporting personnel assigned, now if Canada is to dig itself out of the ISR hole it has created.

The lack of priority by the Government and CF on air ISR platforms has had a profound, negative impact on the ability of the CF to conduct ISR operations in support of Defence commitments both at home and abroad. This situation is paramount and needs to be improved as it has resulted in the lack of the required reconnaissance and surveillance of Canada's borders and boundaries to ensure its security and sovereignty. Any nation that cannot enforce the sovereignty and security of its boundaries will be seen as weak and inviting invasion by military or criminal hostile forces. Canada has become one of these nations.

BIBLIOGRAPHY

Bland, Douglas L. and Sean M. Maloney. “Finding a Defence Policy: The Never-Ending Dynamic.” In *Campaigns for International Security: Canada’s Defence Policy at the Turn of the Century*, edited by Douglas L. Bland and Sean M. Maloney. Montreal, Quebec: McGill-Queen’s University Press, 2004.

Bossé, Eloi and Valin, Pierre. “Definition of Data/Information Fusion in the Context of the C4ISR Campaign Plan.” Unpublished Technical Note. Valcartier, PQ: Defence Research and Development Canada, January 2009.

Canada. Canada Treaty Information. “NORAD Agreement.” http://www.treaty-accord.gc.ca/ViewTreaty.asp?Treaty_ID=105060; Internet; Accessed 12 February 2009.

Canada. Defence Research and Development Canada. "Space Systems." (2009): 23 January 2009. http://www.ottawa.drdc-rddc.gc.ca/html/cb_ss-eng.html; Internet; Accessed 12 February 2009.

Canada. Department of Foreign Affairs and International Trade. *Canada’s International Policy Statement: A Role of Pride and Influence in the World: Defence*. Ottawa, Ontario: Government of Canada, 2005.

Canada. Department of National Defence. “434 Squadron History.” http://www.airforce.forces.gc.ca/14w-14e/page-eng.asp?id=239; Internet; Accessed 17 February 2009.

Canada. Department of National Defence. “Aerospace Capability Framework FY02/03: Annex F.” (2008): 5 July 2009. http://www.airforce.forces.gc.ca/site/vision/pdf/Aerospace-/print/Aerospace_Annexes_e.pdf: Internet; accessed 07 April 2009.

Canada. Department of National Defence. *Air Force Plan (AFP) FY07/10.* Ottawa, Canada: Chief of the Air Staff, 2007.

Canada. Department of National Defence. *Air Force Plan (AFP) FY 08/11*. Ottawa, Canada: Chief of the Air Staff, 2008.

Canada. Department of National Defence. “Argus Years.” http://www.airforce.forces.-gc.ca/14w-14e/page-eng.asp?id=258; Internet; Accessed 17 February 2009.

Canada. Department of National Defence. “Aurora Incremental Modernization Project (AIMP) Master Implementation Plan (MIP).” Ottawa, Canada: Chief of the Air Staff, 1999.

Canada. Department of National Defence. B-GA-400-000/FP-000, *Canadian Forces Aerospace Doctrine*. Ottawa, Ontario: Chief of the Air Staff, 2007.

Canada. Department of National Defence. B-GG-005-004/AF-010, *CF Information Operations*. Ottawa, Ontario: Chief of the Defence Staff, 1998.

Canada. Department of National Defence. B-GG-005-027/AF-021, *The Law of Armed Conflict at the Operational and Tactical Level –Annotated-*. Ottawa: DND Canada, 2001.

Canada. Department of National Defence. B-GJ-003-200/FP-000, *Joint Intelligence Doctrine*. Ottawa, Ontario: Chief of the Defence Staff, 2003.

Canada. Department of National Defence. B-GG-005-300/FP-000, *Canadian Forces Operations*. Ottawa, Ontario: Chief of the Defence Staff, 2005.

Canada. Department of National Defence. B-GJ-005-500/FP-000, *Canadian Forces Operational Planning Process*. Ottawa, Ontario: Chief of the Defence Staff, 2005.

Canada. Department of National Defence. B-GL-352-001/FP-001 *Intelligence, Surveillance, Target Acquisition and Reconnaissance (ISTAR).* Ottawa, Canada: Chief of the Land Staff, 07 Jan 2004.

Canada. Department of National Defence. "C4ISR Strategy 2028." Ottawa, Canada: Chief of Force Development, 24 November 2008.

Canada. Department of National Defence. CADM 30-300 *CP-140/A Long Range Patrol Combat Training Directive.* Winnipeg, Manitoba: Commander 1 Canadian Air Division, 1 December 2007.

Canada. Department of National Defence. "CANR Introduction." Winnipeg, Manitoba: Commander 1 Canadian Air Division, 8 November 2008.

Canada. Department of National Defence. *Canada First Defence Strategy*. Ottawa, Ontario: Government of Canada, 2008.

Canada. Department of National Defence. "Challenge and Commitment, A Defence Policy for Canada". Ottawa, Canada: Minister of Supply and Services Canada, 1987.

Canada. Department of National Defence. *Collection of Documents on the Law of Armed Conflict* (Hague conventions, Geneva Conventions and Additional Protocols, Charter of the United Nations, UNCLOS, Other treaties and Related Canadian Statutes). Ottawa: DND Canada, 2005.

Canada. Department of National Defence. "CP-140" (2007): 26 March 2007. http://www.airforce.forces.gc.ca/site/equip/cp140/default_e.asp; Internet; accessed 21 January 2009.

Canada. Department of National Defence. “CU-161” (2007): 26 March 2007. http://www.airforce.forces.gc.ca/site/equip/cu161/default_e.asp; Internet; accessed 21 January 2009.

Canada. Department of National Defence. "Defence In The 70s". Ottawa, Ontario: 1971.

Canada. Department of National Defence. *Defence Planning Guidance 2001*. Ottawa, Ontario: Chief of the Defence Staff, 2001.

Canada. Department of National Defence. “Defence Planning & Management.” Vice Chief of the Defence Staff Website. http://otg-vcd-webs016.ottawa-hull.mil.ca/FY0/-Structure_e.Asp?StructureID=7&SelectedDPMenu=1; Internet; accessed 11 January 2009.

Canada. Department of National Defence. “Defence Policy 1992.” Ottawa, Ontario: Government of Canada, 1992.

Canada. Department of National Defence. “Defence White Paper 1994.” Ottawa, Ontario: Government of Canada, 1994.

Canada. Department of National Defence. “de Havilland Grumman CP-121 Tracker.” (6 April 2004) http://www.airforce.forces.gc.ca/site/equip/historical/trackerlst_e.asp; Internet; Accessed 23 February 2009.

Canada. Department of National Defence. *Shaping the Future of the Canadian Forces: A Strategy for 2020*. Ottawa, Ontario: Government of Canada, 1999.

Canada. Department of National Defence. “Statement of Operational Requirement (SOR), A1677 Aurora Update Project.” Ottawa, Canada: Chief of the Air Staff, 22 June 1992.

Canada. Department of National Defence. Terminology Online Database. (2008). http://terminology.mil.ca/term-eng.asp; Internet; accessed 24 January 2009.

Canada. Department of National Defence. “The Canadian Air Defence Sector: Home of Canada’s Air Defence.” http://cfd.mil.ca/websites/Resources/djfcplus/Intranet/-DJCP7/OCB/OCB-JEC-JIIFC%20NORAD%20Brief.pdf; Internet; Accessed 3 April 2009.

Canada. Department of National Defence. “White Paper on Defence 1964.” Ottawa, Ontario: Government of Canada, 1964.

Canada. Directorate of Maritime Strategy. *Leadmark: The Navy's Strategy for 2020.* Ottawa: Chief of the Maritime Staff, 2001.

Canada. Foreign Affairs and International Trade Canada. “Global Partnership Program: A Tangible Canadian Contribution to Reducing the Threat of Weapons of Mass

Destruction." Ottawa, Ontario: Global Partnership Program, 4 February 2008. http:/geo.international.gc.ca/cip-pic/library/GPX_AnnualReport_07en.pdf; Internet; accessed 26 August 2008.

Canada. Government of Canada. "Recommendations of and Comprehensive Government Response to the Third Report of the Standing Committee on National Defence and Veterans Affairs Entitled 'Maritime Sovereignty'." Ottawa, Canada: Clerk of the Standing Committee on National Defence and Veterans Affairs, 1991.

Canada. Independent Panel on Canada's Future Role in Afghanistan. "Final Report of the Independent Panel on Canada's Future Role in Afghanistan." Ottawa, Ontario: Independent Panel on Canada's Future Role in Afghanistan, 2008, http://dsp-psd.pwgsc.gc.ca/collection_2008/dfait-maeci/FR5-20-1-2008E.pdf; Internet; accessed 24 January 2009.

Canada. Privy Council Office. *Securing an Open Society: Canada's National Security Policy.* Ottawa, Ontario: National Library of Canada, 2004.

Canada. Transport Canada. *TP1820E Designated Airspace Handbook.* Ottawa: Minister of Transport, 2008.

Canadian Arctic Resources Committee. "Policy Issues: Sovereignty over the Northwest Passage." http://www.carc.org/pubs/v23no2/mu-polic.htm; Internet; Accessed 17 February 2009.

Canadian Security Intelligence Service. "Role of CSIS." (2009): 09 January 2009, http://www.csis-scrs.gc.ca/bts/rlfcss-eng.asp; Internet; Accessed 14 February 2009.

Central Intelligence Agency. "The World Factbook." (2008): 24 January 2009, https://www.cia.gov/library/publications/the-world-factbook/; Internet; Accessed 24 January 2009.

Chief of Force Development. "Space and the Defence and Security Agenda." Lecture, Canadian Forces College, Toronto, ON, 13 January 2009, with permission.

Fennell, Tom. "Immigration/Refugee Controversy." *Maclean's* August 23, 1999. available from http://www.thecanadianencyclopedia.com/index.cfm?PgNm=TCE&Params=M1SEC704435; Internet; accessed 03 April 2009.

Gillis, J. Matthew. "Viable Options for Securing Canadian Arctic Sovereignty." Canadian Naval Review, Volume 3, Number 1 (Spring 2007).

Girard, LCol John. "Defence Knowledge Management: A Passing FAD?" In Canadian Military Journal Summer 2004. http://www.journal.forces.gc.ca/vo5/no2/doc/-knowledge-connaisanc-eng.pdf ; Internet; accessed 11 January 2009.

International Civil Aviation Organization. “Convention on International Aircraft.” (1944). http://www.icao.int/icaonet/dcs/7300.html; Internet; Accessed 12 February 2009.

International Maritime Organization. “AIS Transponders.” http://www.imo.org/Safety/-mainframe.asp?topic_id=754; Internet; Accessed 17 February 2009.

Janes Fighting Ships. “Submarines.” (2009): 7 April 2009. http://jfs.janes.com/public/jfs/-index.shtml; Internet; Accessed 7 April 2009.

Katz, Amrom H. *Some Notes on the History of Aerial Reconnaissance (Part 1).* Santa Monica, CA: Rand Corporation, 1966.

Lajeunesse, Adam. “Sovereignty, Security and the Canadian Nuclear Submarine Program.” In *Canadian Military Journal,* (2008): 14 July 2008; available from http://www.journal.forces.gc.ca/vo8/no4/lajeunes-eng.asp; Internet; accessed 28 February 2009.

Leachtenauer, Jon C. and Driggers, Ronald G. *Surveillance and Reconnaissance Imaging Systems: Modeling and Performance Prediction.* Norwood, MA: Artech House Inc., 2001.

Lindsey, George. “Surveillance from Space: A Strategic Opportunity for Canada.” Working Paper Number 44. Ottawa: Canadian Institute for International Peace and Security, 1992.

Lindsey, George and Sharpe, Gordon. “Surveillance Over Canada.” Working Paper Number 31. Ottawa: Canadian Institute for International Peace and Security, 1990.

Lombardi, B., ed. *Strategic Assessment 2006-2007*. Ottawa, Canada: Directorate of Strategic Analysis, Department of National Defence, 2006.

Macnamara, W.D. and Ann M. Fitz-Gerald. “A National Security Framework for Canada.” In *Geopolitical Integrity,* Edited by Hugh Segal. Montreal: The Institute for Research on Public Policy, 2005.

Maskell, P. and Oram, L. “Sapphire: Canada's Answer to Space-Based Surveillance of Orbital Objects.” In *Proceedings of the Advanced Maui Optical and Space Surveillance Technologies Conference*, Edited by S. Ryan. The Maui Economic Development Board, 2008.

McCall, Gene. “Space Surveillance.” (2001): 23 January 2001. http://www.fas.org/spp/-military/program/track/mccall.pdf; Internet; Accessed 12 February 2009.

McCoubrey, LCol D.J., DeLory, Maj Steve, Fournier, Capt Brad, and Hanak, Capt Dave. *Space Indoctrination Handbook Fifth Edition.* Winnipeg: Canadian Forces School of Aerospace Studies, August 1996.

NATO. NATO Standardization Agency. AAP-6 *NATO Glossary of Terms and Definitions.* North Atlantic Treaty Organization NATO Standardization Agency (NSA), 2008.

NATO. NATO Standardization Agency. AJP-2.0 *Allied Joint Intelligence, Counter Intelligence and Security Doctrine.* North Atlantic Treaty Organization NATO Standardization Agency (NSA), 2003.

NATO. NATO Standardization Agency. AJP-2.1 *Intelligence Procedures.* North Atlantic Treaty Organization NATO Standardization Agency (NSA), 2002.

NATO. The Joint Air Power Competence Centre (JAPCC). *The JAPCC Flight Plan for Unmanned Aircraft Systems in NATO 2007.* Version 5.4, 15 March 2007.

Nguyen, Hung P. *Submarine Detection from Space: a Study of Russian Capabilities.* Annapolis, Maryland: Naval Institute Press, 1993.

Orr, John. “New Era or False Dawn? AIMP Aurora and the Canada First Defence Strategy.” In *Canadian Naval Review* Volume 3, Number 2 (summer 2007). Edited by Peter Haydon. http://naval.review.cfps.dal.ca/pdf/summer2007-excerpt.pdf; Internet; Accessed 16 February 2009.

Provincial Aerospace Limited. “Canadian Government Relationship.” https://www.provincialairlines.com/AMSDGovRel.htm; Internet; Accessed 17 February 2009.

RADARSAT-2. “Marine Surveillance.” http://www.radarsat2.info/application/-marine/index.asp; Internet; Accessed 17 February 2009.

Robinson, Major E.R. “Arctic Sovereignty: Changing Times, Changing Emphasis.” Toronto: Canadian Forces Command and Staff College Paper, 1994.

Royal Air Force Historical Society. “Air Intelligence Symposium: Bracknell Paper No 7.” Brighton, UK: Fotodirect Ltd, 1997.

Shadwick, Martin. “Aurora Renaissance." *Canadian Military Journal*. Winter 2007-2008.

Shadwick, Martin W. *Who's Watching the Oceans?* Toronto, Ontario: York University Centre for International and Strategic Studies, December 1989.

Statistics Canada. "Imports, Exports and Trade Balance of Goods on a Balance-of-Payments Basis, by Country or Country Grouping." http://www40.statcan.ca/l01/cst01/gblec02a.htm; Internet; accessed 24 January 2009.

Toner, Major C.J. “Exercise New Horizons: The Tracker Replacement-Circa 1985.” Canadian Forces Command and Staff College Paper. Toronto, Ontario: Canadian Forces College, 1986.

Transport Canada. “The Review and Processing of an Application for a Special Flight Operations Certificate for the Operation of an Unmanned Air Vehicle (UAV).” http://www.tc.gc.ca/CivilAviation/general/recavi/Instructions/Unmanned/section2.htm; Internet; Accessed 19 February 2009.

United States. Joint Chiefs of Staff. US JP 2-0 *Joint Intelligence.* Washington, DC: Joint Chiefs of Staff, 2007.

United States. Joint Chiefs of Staff. US JP 2-01.1 *Joint Tactics, Techniques and Procedures for Intelligence Support to Targeting.* Washington, DC: Joint Chiefs of Staff, 2003.

United States. Joint Chiefs of Staff. US JP 2-03 *Geospatial Intelligence Support to Joint Operations.* Washington, DC: DoD, 2007.

United States. Joint Chiefs of Staff. JP 3-0. *Joint Operations.* Washington, DC: Joint Chiefs of Staff, 2007.

United States. Joint Chiefs of Staff. US JP 3-13 *Joint Doctrine for Information Operations.* Washington, DC: Joint Chiefs of Staff, 1998.

United States. United States Air University. “Space Surveillance.” (2008): 29 August 2008. http://www.au.af.mil/au/awc/awcgate/usspc-fs/space.htm; Internet; Accessed 12 February 2009.

United States. US Naval Research Laboratory. “NRL's Rampant Lion II Survey Builds on Success of Rampant Lion I.” (2009): 26 January 2009. http://www.nrl.navy.mil-/pressRelease.php?Y=2009&R=14-09r, Internet; Accessed 23 February 2009.

United States Navy. Commander, Undersea Surveillance. “History of IUSS.” (2008) http://www.cus.navy.mil/timeline.htm; Internet; Accessed 17 February 2009.

von Clausewitz, Carl. *On War* Indexed edition. Edited and translated by Michael Howard and Peter Paret. Princeton: Princeton University Press, 1984.

Walker, Major R.J. “Argus/Aurora Flights in the Arctic 1960-Present.” Unpublished Briefing Note for Commander 1 Canadian Air Division Headquarters, 13 November 2007.

Walker, Major R.J. “CP-140 YFR Historical Summary.” Unpublished Briefing Note for Commander 1 Canadian Air Division Headquarters, 30 May 2008.