It is understood that most, if not all, of the contracts for the Block III AIMP conversion have been awarded. ASLEP is unfunded but given the fact that the aircraft have operated for more than 25 years in a high corrosion environment, the requirement for a life extension project cannot be in doubt if the Aurora is to be maintained as an operational weapons system.

In his article, Pugliese also noted that the draft Canada First Defence Strategy states that replacing the Aurora for “domestic surveillance and overseas operations” will be 12 aerial drones or Uninhabited Aerial Vehicles (UAVs) to be located at Comox, BC, and Greenwood, NS. It is suggested that the first of these UAVs will be operational in 2008 with the purchase of further long-range drones to be considered in the future.

There have been no official announcements concerning the fate of Block III of AIMP or ASLEP. Accordingly, it can be concluded that the fate of the AIMP Aurora in the Canada First Defence Strategy is being vigorously debated inside the Department of National Defence.

This article is intended to contribute to that debate; not by descending into a squabble about the trade-off of one platform for another but rather by examining the theoretical underpinnings of both AIMP Aurora and UAVs in ‘domestic surveillance and overseas operations.’ The intention is to demonstrate that rather than being considered as competing weapons systems, the AIMP Aurora and UAVs are, in fact, complementary systems necessary for the conduct of missions essential to Canada’s security.

The Theory of Maritime Surveillance

Maritime surveillance (now termed ‘marine domain awareness’) of the surface, sub-surface (and air) approaches to Canada is imperative. Being able to control and influence what happens in its waters is fundamental to a state’s sovereignty and security. Recent challenges to Canada’s sovereignty in the high Arctic bring this issue into sharp relief.

In any system of marine domain awareness (MDA), there is a requirement to perform three basic functions: surveillance, patrol and response.

- Surveillance requires the detection of the ‘known knowns,’ the ‘known unknowns’ and even the ‘unknown unknowns’ to a reasonable degree of...
confidence. Any MDA surveillance system will likely be a layered system of systems with each sub-system supporting the other. Once the various inputs have been assessed from the surveillance sensors, a ‘recognized’ picture is prepared and disseminated, highlighting any anomalies that require further investigation.

- Patrons are carried out to demonstrate ‘presence’ in areas of interest to national authorities. They can be random but are likely to be tied to areas in dispute, choke points or seasonal activity such as fishing.
- Response relates to the action carried out to counter a threat to national security or violations of sovereignty or regulations.

Like any state, Canada has long been mindful of the importance of knowing what is happening off its coasts and indeed the requirement for MDA has existed in varying degrees since Confederation. However, the impetus for the current greater emphasis was a 1990 Treasury Board study led by Gordon Osbaldeston.

This study, entitled All the Ships that Sail: A Study of Canada’s Fleets (now referred to as the Osbaldeston Report), created the Interdepartmental Program Coordination and Review Committee (IPCRC) which in turn established subordinate coastal sub-committees concerned with, among other things, coordination of surveillance (MDA) across the various federal departments with marine security and enforcement mandates. Unfortunately, IPCRC withered due to a lack of bureaucratic support and, in a supreme irony, was shut down in September 2001 immediately prior to the terrorist attacks in New York and Washington.

The Osbaldeston Report established a preliminary framework for MDA in Canada. In more recent and formal statements through the Ocean’s Act (1997) and the subsequent Ocean’s Strategy (2002), the federal government has affirmed the necessity to establish “a coordinated system of surveillance and monitoring” to ensure that Canada is aware of what is happening in its marine environment.

Despite the demise of IPCRC, improvements in MDA have been taken by the government, mainly in the aftermath of the attacks of 11 September 2001. At the national strategic level, steps have included the promulgation of the National Security Policy (Securing an Open Society, 2004), the reorganization of federal security agencies into a Public Security Department and the formation of a Cabinet-level Foreign Affairs and National Security Committee.

**Recommendation 1. Continue with Block III of AIMP. It provides critical operational capability in the near term and is already contracted.**

At the federal interdepartmental/interagency level, an Interdepartmental Marine Security Working Group (IMSWG) has been established and presented Cabinet with various ‘gap analyses’ concerning marine security including measures designed to improve MDA. These include increased funding to the Department of Fisheries and Oceans (DFO) for civilian-manned surveillance flights, additional funding for DND’s High Frequency Surface-Wave Radar project and the establishment of interdepartmental Marine Security Operations Centres (MSOCs) on both coasts.
A National Plan for Marine Domain Awareness

While considerable progress has been made in the Canadian approach to MDA, a vital element is missing – a national plan for marine domain awareness. Such a plan would provide a doctrinal basis for MDA and outline the responsibilities of the various players along the lines of the National Counter-Terrorism Plan. MDA touches a variety of federal, provincial and municipal governments as well as private enterprise, but without an agreed national focus, MDA is a mission that belongs to everyone yet belongs to no one.

Ultimately, a national plan for marine domain awareness must address the following five questions:

- What information is required?
- In which geographic area will it focus?
- To what level of confidence will it operate?
- By whom will the information be acquired and assessed?
- To whom will the assessed information be provided?

Through the respective coastal MSOCs, Canada currently has the ability to handle effectively the ‘known knowns’ (vessels which comply with national and international conventions regarding their routing, cargoes and ports of call). In many cases, it is also possible for the MSOCs to deal with the ‘known unknowns’ usually through patrols or detailed analysis of related information. What cannot be dealt with at the present time is the ‘unknown unknowns’ which can only be handled by a broad area sensor system.

There was some expectation that the High Frequency Surface Wave Radar Project would address the broad area sensor requirement and thus it was provided with funding through the IMSWG. However, the project has been quietly returned to research status and there is no obvious replacement system available, although Project Polar Epsilon, using data from the Canadian RADAR-SAT 2 satellite and slated for completion by May 2009 holds out some promise. Unfortunately, while satellites have an obvious application as broad area sensors, they are expensive and several satellites must be operated in a constellation for continuous coverage. Consequently, Canada lacks a broad area sensor capability in its exclusive economic zone (EEZ) and over the high Arctic. While those responsible for MDA are aware of this weakness, the lack of a national plan for MDA allows this deficiency to continue since there is no identifiable requirement to provide this capability.

Recommendation 2. Continue with ASLEP but stretch it out over a longer time-frame to fit available funding.

With respect to patrol and response capabilities, Canada is in somewhat better shape. Patrol functions can be carried out by a variety of surface, air and even sub-surface platforms belonging to various federal departments. Response missions are principally carried out by fixed wing aircraft. They have the necessary speed of reaction, loiter time and equipment fit to resolve ambiguities that may appear in the ‘recognized’ picture. Depending on the range and endurance of the aircraft, they may also perform the patrol mission. However, while it is possible to perform the broad area surveillance mission with fixed wing aircraft, this is generally seen to be a misemployment of a valuable asset.

In Canada, fixed wing aircraft are operated by or contracted to the Department of National Defence, Fisheries and Oceans Canada, the RCMP, Transport Canada and the Atmospheric Environment Service. The Aurora is the only Canadian long-range fixed wing aircraft engaged in this activity and, in the past, a certain number of flying hours have been allocated by the air force to the navy, DFO and the RCMP to support their respective missions.

Provincial Aerospace Ltd. (PAL) operates three modified King Air aircraft, principally under contract to DFO, for missions on both coasts. The PAL aircraft fly standard patrols in the EEZ and have developed considerable expertise in this area. Transport Canada operates a modified Dash 8 in the pollution surveillance role.

The Aurora, with its higher speed and considerably longer endurance, augments the PAL aircraft in the DFO mission when necessary, especially at the extremities of
the EEZ. It is, however, in the open ocean and high Arctic that the Aurora excels. Missions such as those involved with Canada’s contribution to countering high seas drift-net fishing in the northern Pacific can only be handled by the Aurora and covert operations, such as those in support of civilian law enforcement authorities, are also unique to the Aurora.

**UAVS in Marine Domain Awareness**

Uninhabited Aerial Vehicles (UAVs) are relative newcomers to MDA and while there are a number of different types in existence, the discussion here will be limited to those platforms classified as High Altitude, Long Endurance (HALE) or Medium Altitude, Long Endurance (MALE).

Generally, UAVs are most useful in ‘dull, dirty or dangerous’ roles. Surveillance is a ‘dull’ role par excellence with the additional possibility of ‘dirty’ added in certain areas such as the Gulf of Alaska or the North Atlantic. HALE/MALE UAVs have the ability to loiter on station at high or medium altitude for a significant time and have sufficient payload to carry a broad array of sensors. Due to their ‘persistence,’ they are ideally suited to covering a large area for prolonged periods of time.

A Flight International report of June 2006 indicates that DND “is formally establishing a project office to oversee a planned acquisition of up to five medium-altitude, long-endurance (MALE) unmanned aircraft systems to enter operational service between 2009 and 2012.” DND efforts to acquire this capability fall under the Joint Unmanned Surveillance and Target Acquisition System (JUSTAS) project managed by the air force. An April 2007 report in the Ottawa Citizen indicates that the 2009 to 2012 time-line may slip as plans for sole-source acquisition of 10 to 18 Predator UAVs have been turned down by Cabinet.

Although operational experience with UAVs in the MDA role is limited, through the Canadian Forces Experimentation Centre, Canada has trialed their employment in two exercises – the Pacific Littoral ISR Experiment (PLIX) in July 2003 and the Atlantic Littoral ISR Experiment (ALIX) in August 2004.

While official press releases evaluated ALIX as a success, others were more critical. As illustrated by this exercise, the challenges to the employment of UAVs in a MDA role can be categorized as environmental, geographic and regulatory. First, despite the fact that the exercise took place in August from Goose Bay, Labrador, the weather imposed a number of difficulties. In one flight, strong cross-track winds significantly decreased the endurance of the UAV (an Altair UAV) due to the drag of the belly-mounted radar. In another flight, high winds caused the UAV to arrive on station on the Grand Banks in four hours but spend 10.5 hours returning to base. Finally, despite forecasts of relatively clear air for a flight over the North Atlantic, the UAV was unable to visually identify targets because it was incapable of operating in icing conditions that unexpectedly appeared.

Second, in the high latitudes above the Arctic Circle, communications with the UAV for command and control had to be handed off from the high capacity satellite...
networks in near geo-synchronous orbit (and therefore at low line of sight angles above 66 degrees) to the Iridium satellite network which had insufficient bandwidth to handle the data stream.

And third, difficulties were also encountered with airspace control coordination between Canadian Flight Information Regions despite extensive pre-exercise coordination with Transport Canada. Additionally, air traffic control authorities (NAV Canada) were uncomfortable with the way in which the UAV shifted between modes of control and one scenario was terminated early as a result.

While ALIX demonstrated that a UAV makes a poor choice as a patrol/reaction vehicle, due mainly to its relatively slow speed and inability to handle icing conditions, UAVs undoubtedly have a role to play as a broad area sensor given their mission sensors, persistence and ability to operate well above civilian air traffic flows. Developing a national HALE/MALE MDA capability into an operational system will, however, be a slow process, particularly if Canada decides to go it alone. And, as a further caution, a DND air force website warns, “Caution should be exercised when declaring UAVs as a cheap alternative to manned platforms. As with manned systems, the cost of a particular class of UAV is directly proportional to capability, size, complexity as well as the required support infrastructure.”

Recommendation 3. Establish a national plan for marine domain awareness in order to establish a national (as opposed to departmental) requirement for each of the surveillance, patrol and response missions.

The utility of UAVs as broad area sensors has been recognized by the US Navy which is now pursuing the Broad Area Maritime Surveillance (BAMS) Unmanned Aircraft System (UAS) Project. The objective of BAMS is to have five stations or orbits around the world permanently manned by a UAV to support the major USN fleet commanders and to operate in conjunction with the USN Maritime Patrol and Reconnaissance Force which will perform the patrol/response function. Initial operational capability for BAMS is scheduled for Fiscal Year 2013 and, intriguingly, the USN has partnered with Australia in this project.

The benefits to Canada of joining such a program include mitigation of technical risk and interoperability with two traditional allies as well as the overriding utility of a Canadian broad area surveillance capability in the Arctic, Pacific and Atlantic areas of Canadian responsibility. Perhaps this could even be the basis for the much-discussed ‘Naval NORAD’ with the sharing of sensor information along the lines of the shared data from the radars of the North Warning System. The main drawback from a Canadian perspective would be that deployment of an operational system depends on the BAMS time-line which will achieve operational capability after that proposed for the JUSTAS Canadian UAV project.

Expeditionary Intelligence, Surveillance and Reconnaissance

The broad requirements of marine domain awareness in the domestic role – i.e., surveillance, patrol and response – apply equally to intelligence, surveillance and reconnaissance (ISR) operations in the expeditionary role. The principal difference, of course, is the increased possibility of hostile action.

As in MDA, fixed wing aircraft are best employed in the response and patrol roles. In this capacity, they are normally part of a coalition effort to perform ISR functions in the theatre of operations. Due to their autonomous nature and onboard sensors, fixed wing aircraft have the ability to work with a number of coalition partners in a variety of roles of differing complexity. Fixed wing aircraft, particularly long-range patrol aircraft, are, however, at a disadvantage in expeditionary ISR due to the requirement to carry capable self-defence equipment and the necessity, in some cases, to operate at suitable stand-off ranges.

During Operation Apollo, Aurora aircraft flew patrols in just such an expeditionary ISR role over the Arabian Sea and Gulf of Oman operating under the operational control of coalition authorities. Unclassified reports indicate that these operations were highly successful and it is precisely for missions such as these that the proposed improvements in the Aurora’s sensor capability (Block III of AIMP) are intended.

Once again, as in the case for MDA, HALE/MALE UAVs are best employed in the surveillance role. They are especially useful in expeditionary ISR since the role is not only dull and sometimes dirty, it can also be quite dangerous.

As for fixed wing aircraft, UAV expeditionary ISR operations will likely be conducted in conjunction with a coalition force. Given the degree of sophistication required
for and sensitivity of such operations, the lead state will undoubtedly be the United States. Integration of UAVs into a coalition ISR effort, a critical combat capability, will require an extremely high degree of interoperability if not commonality. ‘One-off’ national systems will either be relegated to unimportant tasks or simply not invited to participate.

While Canada has had experience in Afghanistan of operating tactical UAVs, there is no information publicly available that indicates that Canada has employed or experimented with HALE/MALE UAVs in the expeditionary ISR role.

**Conclusion and Recommendations**

Within the Canadian Forces and even within the air force, the Aurora is tainted with the reputation of being a manpower-intensive Cold War relic, useful only for hunting submarines. UAVs, on the other hand, are seen as the modern answer to the requirement for domestic surveillance with the added benefit of possible employment in expeditionary ISR operations. This makes replacing the Aurora with a HALE/MALE UAV seem very attractive. As discussed above, the reality is that the Aurora and UAVs perform different functions in both MDA and expeditionary ISR. They are complementary not competing systems, at least for the near and medium term.

**Recommendation 4.** Given Canada’s lack of a primary broad area surveillance sensor and its need to cooperate with the United States, Canada should participate in BAMS.

The unforeseen consequences of eliminating key capabilities – as illustrated by the decision to dispose of Canada’s Chinook helicopters now desperately needed in Afghanistan – should lead to caution in any similar decision regarding the Aurora especially since there is no keystone national plan for marine domain awareness to establish an operational requirement for the patrol/response function.

Fielding a DND UAV capable of conducting ‘domestic surveillance and overseas operations’ means making a significant investment in terms of equipment, time and personnel as well as a degree of technological risk. The ALIX experiment revealed that HALE/MALE UAVs such as Altair, face challenges in contributing to marine domain awareness, principally in their inability to operate in harsh climates and the difficulties of integration into civil airspace. There is much work to be done before maritime UAV surveillance systems evolve from the conceptual realm to reality.

In this regard, the USN Broad Area Maritime Surveillance (BAMS) project, which combines both UAVs for surveillance and fixed wing aircraft for patrol/response missions, appears to offer a realistic solution to the dilemma facing the Canadian Forces. The active participation of Australia in this project is a positive sign for Canada and likely reflects both Australia’s more acute appreciation of the national requirement for MDA and the willingness of the USN to seek partnerships with other states.

There can be no doubt that DND is facing a critical shortfall in funding for capital projects and difficult decisions have to be made. It flies in the face of logic, therefore, that an already contracted project, such as Block III of AIMP, should be cancelled since any potential cost savings will undoubtedly prove to be illusory. Furthermore, there is simply no other platform available to fulfill the patrol/response mission in the distant reaches of Canada’s EEZ and the high Arctic or to conduct expeditionary ISR in the near term. The first recommendation, therefore, is:
Operation Active Endeavour during a patrol in the Mediterranean

Greenwood, NS, works in the tactical compartment of a CP-140 Aurora en route to Naval Air Station Sigonella, Italy, after a patrol in the Mediterranean during Operation Active Endeavour.

- **Recommendation 1.** Continue with Block III of AIMP. It provides critical operational capability in the near term and is already contracted.

Admittedly, ASLEP is an unfunded liability and will have to be addressed but it would be wasteful in the extreme to have the updated Aurora grounded for structural defects. This leads to the second recommendation:

- **Recommendation 2.** Continue with ASLEP but stretch it out over a longer time-frame to fit available funding.

Beyond platform-specific issues, the lack of a national plan for marine domain awareness is a critical weakness in establishing national requirements and responsibilities. It is unfortunate but true that no operational requirement equals no priority and may lead to unilateral cuts in capability by one department that are sorely needed by another. This leads to the next recommendation:

- **Recommendation 3.** Establish a national plan for marine domain awareness in order to establish a national (as opposed to departmental) requirement for each of the surveillance, patrol and response missions.

Under BAMS, development of a Canadian HALE/MALE UAV operational capability can be achieved in the medium to long term. Furthermore, participation with the United States (and Australia) will mean that Canada will not face the significant costs and technological risk associated with developing a unique national capability. BAMS would also address issues relating to interoperability and compatibility in expeditionary ISR operations. This leads to the final recommendation:

- **Recommendation 4.** Given Canada’s lack of a primary broad area surveillance sensor and its need to cooperate with the United States, Canada should participate in BAMS.

Together, an updated Aurora and BAMS will meet Canada’s requirement for an effective system for marine domain awareness as well as provide a capability to carry out expeditionary intelligence, surveillance and reconnaissance missions.

**Notes**

2. Details of Blocks I and II of AIMP can be found on the air force website at CP-140 Aurora Future Plans <http://www.airforce.forces.gc.ca/equip/CP-140/future_e.asp>.
3. To avoid confusion with the policing aspects of ‘domestic surveillance,’ the term ‘marine domain awareness’ is now used to define the activity associated with the collection, analysis and dissemination of information relating to activities on, under or above a defined marine area.
4. While the concept of ‘known knowns,’ ‘known unknowns’ and ‘unknown unknowns’ is associated with Donald Rumsfeld, it was popular in intelligence circles well before being reported as a ‘Rumsfeldism.’
6. The status of the agreements between the air force and navy for the provision of Aurora support is not clear since the establishment of Canada Command and its assumption of responsibilities previously exercised by CAS and CMS. The agreements with other government departments remain in place. Of note, the initial phases of the AIMP project have removed the number of operationally available aircraft from the fleet causing a reduction in the number of flying hours to half that available in the early 1990s.
10. The Predator MALE can also be used to carry weapons but that is beyond the scope of this paper.

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