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AIRBORNE EARLY WARNING AIRCRAFT AS A SOLUTION TO ARCTIC SURVEILLANCE AND CONTROL

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Exercise *Solo Flight*

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By Major Stephen Buckley

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AIRBORNE EARLY WARNING AIRCRAFT AS A SOLUTION TO ARCTIC SURVEILLANCE AND CONTROL

Canada is an arctic nation. The Canadian Arctic covers 40% of Canadian territory and is home to over 200,000 people, of which over half are Indigenous Canadians.[1] It is a region that is rich in natural resources, steeped in Canadian culture and history, and one that has remained strategically significant since the height of the Cold War. Climate change has opened this once economically inaccessible region to resource development and global commercial trade which has caused world governments to re-examine their Arctic policies and priorities.[2] The past protections to Canadian Arctic sovereignty afforded to Canada by the extremes of the Arctic environment are waning. Without a strong Canadian presence in the Arctic, others are beginning to move in. In the summer of 2017, a Chinese scientific research icebreaker travelled through the Northwest Passage to prove the route's viability for Chinese commercial shipping.[3] When China, a nation who has no need to clear ice domestically, is building and sending icebreakers through the Canadian Arctic, their international Arctic ambitions are clear. Additionally, on May 1st 2019, when testifying in front of the U.S. Senate Appropriations Subcommittee on Defense, Secretary of the Navy Richard Spencer stated that the U.S. Navy intends to send ships through the Northwest Passage in a freedom of navigation exercise to assert American maritime rights in the area.[4] With both global competitors and our own allies vying to encroach upon Canadian

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[1] Global Affairs Canada, "Canada and the circumpolar Arctic." Last modified 14 September 2018, https://international.gc.ca/world-monde/international_relations-relations_internationales/arctic-arctique/index.aspx?lang=eng

[2] Government of Canada, "Statement on Canada's Arctic Foreign Policy." Last modified 12 May 2017, https://international.gc.ca/world-monde/international_relations-relations_internationales/arctic-arctique/arctic_policy-canada-politique_arctique.aspx?lang=eng.

[3] Globe and Mail. "China used research mission to test trade route through Canada's Northwest Passage." Last modified 10 September 2017. https://www.theglobeandmail.com/news/politics/china-used-research-mission-to-test-trade-route-through-canadas-northwest-passage/article36223673/.

[4] Alaska Public Media, "Navy plans to be more active in the Arctic." Last accessed 5 May 2019, https://www.alaskapublic.org/2019/05/02/navy-plans-to-be-more-active-in-the-arctic/.

Arctic sovereignty, it should be clear to Canadians that Canada must take swift action otherwise it runs the danger of losing control over the Canadian Arctic region in all but a symbolic status.

How then does Canada exert control and enforce sovereignty over its northern reaches? As the legal basis for Arctic sovereignty, the Government of Canada relies on the historic and continued occupation of the Arctic by the Inuit people.[5] This historic title has sufficed in the past when thick multi-year Arctic sea ice made international exploitation of the Arctic impractical. Will it still pass international legal muster when other nations, through their own economic activities in newly opened Arctic waters, can also claim a continued presence?

Recognising the requirement to do more to defend our Arctic sovereignty, the Government of Canada, through its "Statement on Canada's Arctic Foreign Policy," and the current defence policy of Strong Secure Engaged (SSE), has declared that to defend Canada and Canadians, it must exercise sovereignty and maintain "surveillance and control of Canadian territory and approaches, with an increased focus on the Arctic."[6] This renewed emphasis on Arctic surveillance and control will require a commensurate investment in new and existing capabilities to fulfil Canada's strategic aims. The vastness of the Arctic makes a ground-based system impractical and current and planned future space-based systems provide some wide area surveillance but lack the ability to provide the required command and control (C2). Therefore, to uphold the Canadian Government's Arctic aims of exercising sovereignty through an increased focus on surveillance and control, the addition of an airborne early warning (AEW) aircraft, like the Boeing E-7A Wedgetail, to provide surveillance and C2 is needed to augment existing and

[5] Government of Canada, "Statement on Canada's Arctic…"
[6] Ibid: Canada, Department of National Defence, *Strong Secure Engaged: Canada's Defence Policy*, Ottawa: DND Canada, 2017, 83.

future Canadian Arctic capabilities. The necessity of AEW aircraft for Arctic sovereignty will be made clear through a discussion of the capabilities that the E-7 brings, the current state of Canadian Arctic surveillance and C2, how the addition of AEW augments the current system in line with government policy, the additional benefits to the Canadian Armed Forces (CAF) outside of the Arctic realm, and potential procurement synergies available if the purchase of the E-7 is aligned with other new platforms identified in SSE.

The E-7 is the most recent iteration of Boeing's early warning and control fleet of aircraft which include both the E-3 and E-767 AWACS. It utilizes a multi-role electronically scanned array radar system and a passive electronic support measure/electronic intelligence (ESM/ELINT) system to provide airborne surveillance of air and maritime targets as well as emissions in the electromagnetic spectrum over a published detection range of 200 NM.[7] It compliments this surveillance capability with a full communications suite of radios and tactical data links to provide friendly forces with C2 over the local area of operations and backlink connectivity with national or coalition command agencies.[8] With this plethora of advanced capabilities the E-7 offers a great deal, but is it necessary for the continued maintenance of Canadian Arctic sovereignty? To understand this question, we need to look at how Canada currently provides surveillance and C2 over the Arctic.

Historically, Canadian surveillance and C2 capabilities in the Arctic were enough to maintain sovereignty over the region. The Arctic was largely inaccessible to commerce due to

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[7] Boeing, "737 Airborne Early Warning and Control," last accessed 21 May 2019, https://www.boeing.com/defense/airborne-early-warning-and-control/#/capabilities: Royal Australian Air Force, "E-7A Wedgetail," last accessed 22 May 2019, https://www.airforce.gov.au/technology/aircraft/intelligence-surveillance-and-reconnaissance/e-7a-wedgetail: Defence Aerospace, "Elta Wins US$ 60m Contract for the Royal Australian Air Force "Wedgetail" AEW Aircraft," Last modified 29 August 2001, http://www.defense-aerospace.com/article-view/release/6397/elta-wins-australian-ew-contract-%28aug.-29%29.html.

[8] Ibid.

year-round ice with the main threat to Canadian Arctic sovereignty coming from Soviet/Russian aircraft and submarines. Today, surveillance of the Canadian Arctic continues in the same way despite a changing climate and increased activity. Canadian Arctic surveillance and C2 rely upon the ground-based air search radars of the North Warning System (NWS), airborne maritime surveillance aircraft from the RCAF and Transport Canada, and space-based sensors owned by the Canadian Space Agency. With both SSE and the "Statement on Arctic Foreign Policy" requiring the CAF to increase its capabilities for operating in the Canadian Arctic, to increase its long term Arctic presence, and to tailor surveillance capabilities for the Arctic environment, the status quo will no longer suffice and additional capabilities are required.[9] Determining what capabilities though requires an understanding of how the current Canadian capabilities fall short.

To monitor and control the air, the NWS, which replaced the Distant Early Warning Line radar chain in 1986, acts as a trip line to warn against incursions into North American airspace. It consists of 11 AN/FPS-117 long range radars and 36 AN/FPS-124 short range radars in a chain along the Canadian coastline from Alaska to Labrador. This chain of radars provides a 500 NM wide band of air surveillance through which all aircraft entering North American airspace must pass. The data from these radars is broadcast via satellite to the Canadian Air Defence Sector at 22 Wing North Bay who use a series of radio sites collocated with the NWS to provide C2 over Arctic airspace.[10] Whereas the North Warning System provides excellent air coverage, it cannot detect maritime or surface contacts, will not cover the expansion of the Canadian Air Defence

[9] Canada, Department of National Defence, *Strong Secure Engaged… 57, 60, 64.*
[10] National Defence and the Canadian Armed Forces, "North Warning System: Backgrounder." Last modified 6 July 2017. http://www.forces.gc.ca/en/news/article.page?doc=north-warning-system/hgq87x9w; Lockheed Martin, "AN/FPS-117: Long Range Air Surveillance Radars." Last accessed 14 May 2019, https://www.lockheedmartin.com/content/dam/lockheed-martin/rms/documents/ground-based-air-surveillance-radars/FPS-117-fact-sheet.pdf.

Identification Zone (CADIZ) over the entire Arctic archipelago as planned in SSE,[11] and is nearing the end of its operational lifespan. Furthermore, since the provision of C2 either via ground sites or a yet undeveloped space-based system relies on satellite communications for the link that connects C2 agencies with their remote sites; the effects of the ionosphere over the high Arctic can interfere with this communications link and further complicate remoted C2.[12] Presently, two contracts have been awarded to research either a space-based surveillance solution using a network of microsatellites, or an over the horizon backscatter radar as the North Warning System replacement.[13] Neither system is proven, and the contracts are only set as feasibility studies to determine the suitability of each technology as a potential solution to Arctic Surveillance. Therefore, to meet the governments intent of increased patrols and monitoring of the Arctic, Canadian air surveillance and C2 will have to be augmented from its present state to cover the entire Arctic archipelago in addition to what is already covered. Importantly though, whereas air surveillance must be persistent, C2 of airborne assets would only be required during periods of activity.

The maritime surveillance and C2 of the Arctic are not as developed as the surveillance of the air. Arguably this is owing to the only recent maritime navigability of the region to most commercial and economic maritime traffic. The year round RCAF surveillance sorties by CP-140 Aurora aircraft to patrol the region are augmented during the summer months by a single Dash-7 aircraft from Transport Canada as part of the National Aerial Surveillance Program.[14]

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[11] Canada, "Strong Secure Engaged…" 80.
[12] Canada, "Strong Secure Engaged…" 64.
[13] Air Force Technology. "Canada awards two contracts to boost Arctic surveillance." Last modified 5 February 2019. https://www.airforce-technology.com/news/canada-arctic-surveillance/.
[14] Canada. "Strong Secure Engaged…" 65: Transport Canada, "National Aerial Surveillance Program," Last modified 4 June 2018, http://www.tc.gc.ca/en/programs-policies/programs/national-aerial-surveillance-program.html.

These aircraft can provide surveillance over limited areas but cannot provide meaningful C2 at the same level as Canada can project C2 in the air. Additionally, unlike the southern maritime regions in Canada where the Canadian Coast Guard regulates maritime traffic through a network of remote radar and radio sites, the Arctic does not have any maritime radars stations and the Coast Guard relies solely upon radio communications for vessel traffic management.[15] This surveillance shortfall will be partially solved by the RADARSAT Constellation Mission (RCM) which will be launched in June 2019 by the Canadian Space Agency. This constellation of three Earth observation satellites will provide daily synthetic aperture radar scans of the entirety of Canada and the surveillance of cooperative maritime contacts using Automatic Identification System (AIS) technology.[16] This system will assist with the problem of Arctic surface surveillance but will not address the shortfalls of Arctic C2. It will also rely on the already limited airborne patrols to identify any non cooperative maritime traffic and unknown surface contacts. The RCN's forthcoming Arctic Offshore Patrol Vessels (AOPV) will assist with the provision of persistent localized C2 and the identification of surface contacts within their immediate area, but cannot project that C2 or surveillance capability over the vast Arctic region.[17] Accordingly, Canada will require the ability to project C2 over the surface of the Arctic and increase its capability to conduct surface surveillance of non-cooperative contacts to meet the Arctic aims of the Canadian government.

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[15] Canadian Coast Guard, "Marine Communications and Traffic Services MCTS," Last modified 29 April 2019, http://www.ccg-gcc.gc.ca/Marine-Communications/Home.
[16] Canadian Space Agency, "What is RCM," last modified 14 May 2019, http://www.asc-csa.gc.ca/eng/satellites/radarsat/what-is-rcm.asp.
[17] Royal Canadian Navy, "Arctic and Offshore Patrol Ship Project," Last modified 9 April 2019, http://www.navy-marine.forces.gc.ca/en/fleet-units/aops-home.page: Department of National Defence, *Harry DeWolf-Class Arctic/Offshore Patrol Ship – Fact Sheet* (Ottawa, Royal Canadian Navy Public Affairs, 2015).

The E-7, as a proven AEW platform, is uniquely suited to bridge the gap between how Canada envisions exercising Arctic sovereignty and the current capability shortfall. In increasing air and surface surveillance, the E-7 will be able to use its active and passive sensors to cover areas outside of the current coverage. If staged from northern bases to increase time on station, it could provide surveillance and ELINT coverage over 4 million square kilometers of the Arctic archipelago during a single standard 10-hour sortie.[18] Its ability to provide C2 to both air and surface units across a wide area via its radios and tactical data link, to include over the horizon by HF, will alleviate the need to build new ground stations throughout the Arctic to replicate the same effect. Additionally, the E-7 could continue the provision of C2 over the high Arctic regardless of ionospheric conditions since, unlike ground and space based C2 solutions, it is not reliant upon satellite communications. It could operate independently as a C2 node during periods of reduced connectivity with southern headquarters to ensure a continuity of surveillance and C2.

As an integrated sensor, the fusion between the wide area space-based coverage and AIS data from the RCM and the high-fidelity radar and ELINT data collected by the E-7 would assist Canadian authorities in directing its limited maritime patrol aircraft to maximise their effect over non-cooperative contacts. With the integration of current intelligence cueing capabilities, the E-7 could be positioned to provide the surveillance, identification, and C2 needed to direct the prosecution of traditional threats to Canadian sovereignty, as is currently done by NORAD with the USAF E-3 AWACS.[19] Limited only by fuel, the capabilities that the E-7 would bring to the

[18] Royal Australian Air Force, "E-7A Wedgetail,".
[19] Global News, "Canadian jets intercept 2 Russian bombers near North American coastline: NORAD," Last modified 2 February 2019, https://globalnews.ca/news/4894339/norad-russian-bombers-canada/.

Canadian Arctic connects the delta between what is needed to meet Canadian goals, and what is within current and planned Canadian capabilities.

Beyond its use in the Arctic, the acquisition of the E-7 would also bolster Canadian capabilities within the other core CAF missions as stated in SSE.[20] Domestically, beyond its employment within the NORAD mission, its ability to provide C2 over a region independent of ground based communications could aid with disaster assistance where local infrastructure has failed, or is non-existent. The combination of its maritime surveillance and ELINT capabilities would be an invaluable addition to the RCN and RCAF assets involved in Op Carribe. In support of Canadian expeditionary missions as part of a coalition, the E-7 would perform more traditional air battle management AEW roles for coalition air assets. The overall additional contributions that the E-7 would make for Canada domestically and internationally would be immense. Its surveillance, C2, and ELINT capabilities have the potential to vastly increase the impact and value of Canadian participation to international coalition operations.

Outside of increasing CAF capabilities domestically and abroad, the E-7's Boeing 737-700 airframe also presents an avenue for a common platform to lifecycle both the CP-140 Aurora and CC-150 Polaris with the Boeing P-8 Poseidon and C-40 respectively.[21] SSE has identified that the operational lifespans of both the CP-140 and CC-150 are coming to an end. To continue to receive and improve upon the capabilities that both platforms provide, the CAF has planned to invest in their replacements as part of Canada's Defence Policy.[22] The advantage of replacing these two aircraft with a platform in common with the E-7 is that it creates an interchangeable

[20] Canada, "Strong Secure Engaged…" 82.
[21] Boeing, "P-8A Poseidon," Last accessed 25 May 2019, https://www.boeing.com/defense/maritime-surveillance/p-8-poseidon/index.page: Boeing, "C-40A," Last accessed 25 May 2019, https://www.boeing.com/defense/c-40a/.
[22] Canada, "Strong Secure Engaged…" 65.

pool of expertise, experience, and aircraft parts for the flight systems and aircraft structures that are common across the fleet. Arguably, this reduces the logistical load on the CAF, the training time needed for maintenance personnel, and a broad network of parts suppliers resulting from the ubiquity of the Boeing 737. Notwithstanding the numerous procurement and political roadblocks that this procurement strategy could face, the E-7 would fit well within a future RCAF ISR, C2, and transport future based around the Boeing 737-700 airframe.

Canada requires the addition of an AEW platform to increase its ability to enforce its Arctic sovereignty. The Boeing E-7 Wedgetail provides this capability and is quickly establishing itself amongst Canada's allies and is starting to replace the E-3 Sentry globally.[23] Despite its advanced capabilities, the E-7 will not solve all of Canada's Arctic sovereignty challenges. The E-7 will close capability gaps in Canada's ability to detect threats to Canadian sovereignty, provide C2 over the assets dispatched to counter those threats, and add its AEW capabilities to Canadian domestic and expeditionary missions. It will aid the Government of Canada in the deterrence and prosecution of threats to Canadian sovereignty, but it cannot stop them altogether. A strong and enforceable Canadian Arctic policy supported by both existing and new capabilities is the only way that Canada can maintain its Arctic sovereignty against international competition. The current Canadian Arctic policy framework is now almost ten years old and a new policy has been being developed since April 2017. Significant public consultation across the Arctic has been conducted to orient this new policy around the needs of Northern Canadians. Despite this internal refocusing and the avoidance of directly referencing sovereignty in the public consultations, the new policy framework is expected to maintain the

[23] Jane's 360. "UK signs for E-7 AEW&C aircraft." Last modified 22 March 2019. https://www.janes.com/article/87390/uk-signs-for-e-7-aew-c-aircraft.

previous intentions to defend Canadian sovereignty over the Arctic.[24] With Canada heading into another election and a potential change of government in the fall of 2019, how will the governments motivation to invest in Arctic capabilities be affected by the fiscal whims of election politics? Will Canada continue to press with the necessary investments in capability to ensure it retains control of the Canadian Arctic and its waterways or will Canada be relegated to observer status as the Arctic is developed and exploited around us?

[24] The Polar Connection. "Canada's Arctic Policy Framework: A new approach to Northern Governance." Last modified 18 May 2018. http://polarconnection.org/canada-arctic-policy-framework/.

BIBLIOGRAPHY

Air Force Technology. “Canada awards two contracts to boost Arctic surveillance.” Last modified 5 February 2019. https://www.airforce-technology.com/news/canada-arctic-surveillance/.

Alaska Public Media. “Navy plans to be more active in the Arctic.” Last accessed 5 May 2019. https://www.alaskapublic.org/2019/05/02/navy-plans-to-be-more-active-in-the-arctic/.

Boeing. “737 Airborne Early Warning and Control.” Last accessed 21 May 2019. https://www.boeing.com/defense/airborne-early-warning-and-control/#/capabilities.

Boeing. “C-40A.” Last accessed 25 May 2019. https://www.boeing.com/defense/c-40a/.

Boeing. “P-8A Poseidon.” Last accessed 25 May 2019. https://www.boeing.com/defense/maritime-surveillance/p-8-poseidon/index.page

Canada. Department of National Defence. *Harry DeWolf-Class Arctic/Offshore Patrol Ship – Fact Sheet*, Ottawa: DND Canada, 2015.

Canada. Department of National Defence. *Strong Secure Engaged: Canada’s Defence Policy*, Ottawa: Royal Canadian Navy Public Affairs, 2017.

Canadian Coast Guard, “Marine Communications and Traffic Services MCTS.” Last modified 29 April 2019. http://www.ccg-gcc.gc.ca/Marine-Communications/Home.

Canadian Space Agency. “What is RCM?” Last modified 14 May 2019. http://www.asc-csa.gc.ca/eng/satellites/radarsat/what-is-rcm.asp.

Defence Aerospace. “Elta Wins US$ 60m Contract for the Royal Australian Air Force "Wedgetail" AEW Aircraft.” Last modified 29 August 2001. http://www.defense-aerospace.com/article-view/release/6397/elta-wins-australian-ew-contract-%28aug.-29%29.html.

Globe and Mail. “China used research mission to test trade route through Canada’s Northwest Passage.” Last modified 10 September 2017. https://www.theglobeandmail.com/news/politics/china-used-research-mission-to-test-trade-route-through-canadas-northwest-passage/article36223673/.

Global Affairs Canada. “Canada and the circumpolar Arctic.” Last modified 14 September 2018. https://international.gc.ca/world-monde/international_relations-relations_internationales/arctic-arctique/index.aspx?lang=eng.

Global News. “Canadian jets intercept 2 Russian bombers near North American coastline: NORAD.” Last modified 2 February 2019. https://globalnews.ca/news/4894339/norad-russian-bombers-canada/

Government of Canada. “Statement on Canada’s Arctic Foreign Policy.” Last modified 12 May 2017. https://international.gc.ca/world-monde/international_relations-relations_internationales/arctic-arctique/arctic_policy-canada-politique_arctique.aspx?lang=eng.

Jane’s 360. “UK signs for E-7 AEW&C aircraft.” Last modified 22 March 2019. https://www.janes.com/article/87390/uk-signs-for-e-7-aew-c-aircraft.

Lockheed Martin, “AN/FPS-117: Long Range Air Surveillance Radars.” Last accessed 14 May 2019, https://www.lockheedmartin.com/content/dam/lockheed-martin/rms/documents/ground-based-air-surveillance-radars/FPS-117-fact-sheet.pdf.

National Defence and the Canadian Armed Forces, “North Warning System: Backgrounder.” Last modified 6 July 2017. http://www.forces.gc.ca/en/news/article.page?doc=north-warning-system/hgq87x9w.

The Polar Connection. “Canada’s Arctic Policy Framework: A new approach to Northern Governance.” Last modified 18 May 2018. http://polarconnection.org/canada-arctic-policy-framework/.

Transport Canada. “National Aerial Surveillance Program.” Last modified 4 June 2018. http://www.tc.gc.ca/en/programs-policies/programs/national-aerial-surveillance-program.html.

Royal Australian Air Force. “E-7A Wedgetail.” Last accessed 22 May 2019. https://www.airforce.gov.au/technology/aircraft/intelligence-surveillance-and-reconnaissance/e-7a-wedgetail.

Royal Canadian Navy. “Arctic and Offshore Patrol Ship Project.” Last modified 9 April 2019. http://www.navy-marine.forces.gc.ca/en/fleet-units/aops-home.page.