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CANADA'S EXPANDED ADIZ

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JCSP 43 DL

Exercise Solo Flight

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CANADA'S EXPANDED ADIZ

In support of the Canadian Defence Policy, Strong Secure Engaged (SSE), the Government of Canada (GoC) decided to “expand the Canadian Air Defence Identification Zone (CADIZ) to cover the entire Canadian Arctic archipelago.”¹ This expansion took “effect 24 May 2018 at 09:01 Coordinated Universal Time (UTC).”² As a precursor to expansion, the Department of National Defence (DND) Departmental Plan set results to achieve over the 2018-2019 period. The departmental result 1.4 of the plan states that “North America is defended against threats and attacks.”³ In the aerospace domain, this is to be achieved by “continuously monitor[ing] current aerospace and maritime conditions, including warning, assessment and characterization of attack...”⁴ To further this objective, the DND/CAF will “expand Canada’s capacity to meet [North American Aerospace Defense] NORAD commitments by improving aerospace domain awareness and response through the implementation of the [CADIZ] expansion.”⁵

This paper will argue that only aerospace domain awareness of compliant participants will be achieved in most of the expanded CADIZ area, and that full awareness and response to non-compliant actors and threats within the expansion will be dependent on modernization and augmentation of the infrastructure and capabilities supporting the new CADIZ.

¹ Canada. Department of National Defence. *Strong, Secure, Engaged: Canada's Defence Policy* (Ottawa: Department of National Defence, 2017), 80.

² NAV CANADA, “Notice of Change, Adjustment to the Canada Air Defence Identification Zone” Last Accessed 21 May 2018. <https://www.navcanada.ca/EN/products-and-services/Service%20Project%20Announcements/SPA-2018-ADIZ-EN.pdf>

³ Canada, National Defence and the Canadian Armed Forces, *2018-19 Departmental Plan*, Planned Result 1.4. Last accessed 26 May 2018. <http://www.forces.gc.ca/en/about-reports-pubs-report-plan-priorities/2018-planned-results-1-core-responsibilities.page>

⁴ *Ibid.*

⁵ *Ibid.*

By examining the North American Aerospace Defense Command's (NORAD) evolution of infrastructure and capabilities supporting domain awareness and the evolution of the threats against aerospace defence, this paper will demonstrate that domain awareness and response against non-compliant actors in the expanded CADIZ will be a challenging endeavour. This will be accomplished by an overview of the purpose of the CADIZ, NORAD's evolution of infrastructure to support it, how compliant actors participate in the CADIZ, the current aerospace threat against the CADIZ, and how the current capabilities supporting the new CADIZ will be challenged against that threat. Prior to examining these elements, a geography discussion of the expanded CADIZ followed by the concept of domain awareness is necessary to fully appreciate the challenges to achieving domain awareness and response.

Figures 1 and 2 show the geographic outline of the expanded CADIZ on 24 May 2018, and the expanded CADIZ superimposed on the previous CADIZ respectively. Figure 2 highlights the net expansion by the area in red shading. The non-shaded outline in Figure 2 labeled CANADA ADIZ (Air Defence Identification Zone) was the previous CADIZ boundary. In summary the southern line of the CADIZ over the Arctic has been pushed farther north to align with the Alaska ADIZ and the northern boundaries have been expanded to align again with the Alaska ADIZ while also covering the rest of the Arctic Archipelago.



Figure 1 - Expanded CADIZ 24 May 2018
Source: NAV CANADA, *Notice of Change*

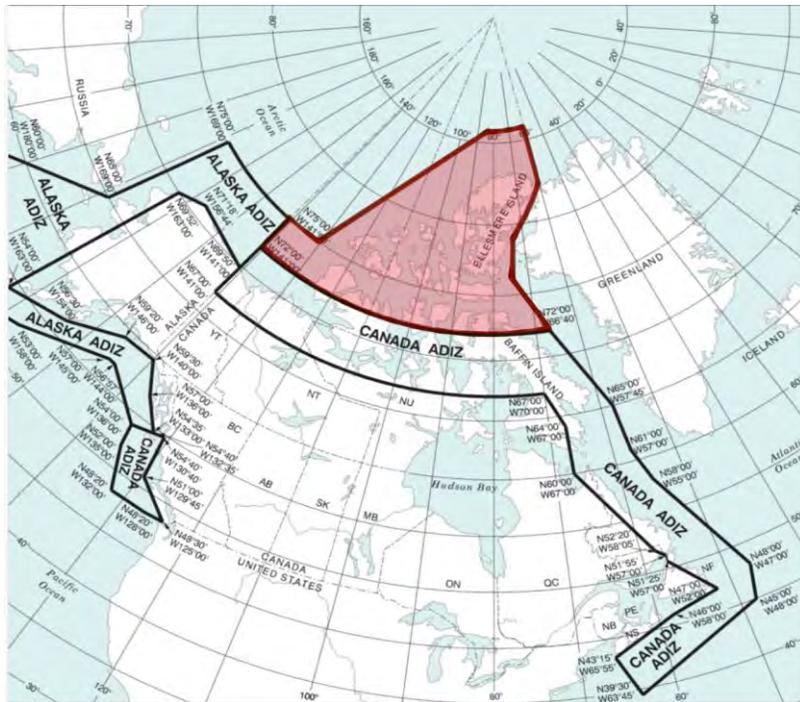


Figure 2 –Expanded CADIZ Superimposed on Previous
Source: Zavidil, *Expanded Canadian ADIZ*

In terms of area, the expansion is substantial in comparison to the previous CADIZ. Figure 3 demonstrates this vast area of expansion over the Arctic Archipelago on the left as compared to a similar land area outlined on the right. The expansion is roughly equivalent to the area from Vancouver, British Columbia, to San Diego, California, to Sioux Falls, South Dakota, to Madison, Wisconsin, and back to Vancouver.

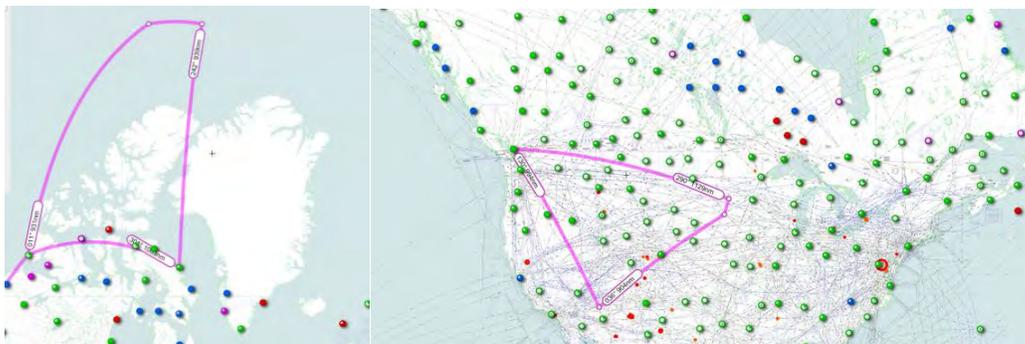


Figure 3 – CADIZ Expansion Comparison over Continental North America

Source: *SkyVector Aeronautical Charts*

Given the increase in size of the new CADIZ, the daunting task for NORAD is to now have an acceptable level of awareness of aerospace activity within this area combined with the ability to mount a response if required to meet its mandate. Indeed, as determined in the 2006 NORAD agreement between Canada and the United States, “The primary missions of NORAD in the future shall be to provide:

- a. Aerospace warning for North America;
- b. Aerospace control for North America; and
- c. Maritime warning for North America.”⁶

⁶ United States and Canada. North American Aerospace Defense Command. *Agreement between the Government of the United States of America and the Government of Canada on the North American Aerospace Defense Command*. (Washington, DC: U.S. Department of State, April 28, 2006), Article 1. <https://www.state.gov/documents/organization/69727.pdf>. Hereafter referred to as the “2006 NORAD Agreement.”

To limit the scope of discussion this paper will focus on the first two missions.

In terms of aerospace warning this “mission includes detecting aircraft, missiles or space vehicles that might threaten North America. This is done with a global network of sensors. These include satellites and radars on the ground and in the air.”⁷ The warning mission is all about collating multiple sources of information about aerospace activity from many agencies, assessing it, and then fusing it together into a recognizable ‘picture’ that enables decision making to accomplish the control mission. The complimentary “control mission ensures the air sovereignty and air defence of the airspace of Canada and the United States. Fighter aircraft from the air forces of both countries are in position to act, if this became necessary.”⁸ The concept being that when the warning mission detects an aerospace element that cannot be identified and may be a threat, the control mission is then enacted to direct fighter aircraft to the appropriate area of responsibility (AOR). Aircraft would launch, intercept, identify and potentially engage the element if there is a threat that satisfies the rules of engagement (ROE). Hence the ability to achieve domain awareness and response are addressed by the capabilities associated with the aerospace warning and control missions.

The Canadian ADIZ now needs to be defined in practical terms to properly understand its role in the defence of North America. In simple terms “the role of ADIZs is to provide a means

⁷ National Defence and the Canadian Armed Forces, “North American Aerospace Defense Command (NORAD),” last accessed 26 May 2018, <http://www.forces.gc.ca/en/operations-allies-government-partners/partners-norad.page>

⁸ National Defence and the Canadian Armed Forces, “North American Aerospace Defense Command (NORAD),” last accessed 26 May 2018... Interestingly the 2006 NORAD agreement characterizes the two missions slightly differently than DND’s Website. The NORAD agreement specifics aerospace warning “consists of processing, assessing, and disseminating intelligence and information related to man-made objects in the aerospace domain and the detection, validation, and warning of attack against North America whether by aircraft, missiles or space vehicles utilizing mutual support arrangements.” While control is “providing surveillance and exercising operational control” of NORAD assets “to direct, coordinate, and control the operational activities of forces assigned, attached” to the mission. Despite the different interpretations, the same ends of having an awareness of activity and an ability to response are intended however. The warning mission for North America also includes for missile defense which Canada has not signed onto and has no organic capability for.

of anticipatory self-defense from incoming and immediate threats emanating above the high seas.”⁹ It is not a capability in and of itself however. The CADIZ defines the openly published geographical playing field to be used in conjunction with the capabilities of the warning and control missions. It is merely *where* the identification of aerospace entities is desired to enable the defence of North America. Aerospace entities operating within or traversing it are expected to comply with the published procedures or risk having defensive measures enacted. It is the collective of the awareness and response capabilities used in conjunction with the CADIZ boundaries, which form a credible deterrent to actors with nefarious intentions.

The United States Federal Aviation Administration (FAA) defines an ADIZ “as an area of airspace over land or water in which the ready identification, location, and control of civil aircraft is required in the interest of national security.”¹⁰ DND expands that the “ADIZ is a buffer zone of internationally-recognized airspace surrounding North America that facilitates the identification of aircraft well before they would enter sovereign ... airspace.”¹¹ This is achieved by ensuring those operating in or crossing into or out of the CADIZ follow strict procedures.

Simply put, ADIZ procedures amount to compliant players being on an appropriate flight plan, passing regular position reports, having a functioning two way radio, and a functioning air traffic control (ATC) transponder (when required) which reports to ATC and NORAD Air

⁹ Roncevert G. Almond, “South China Sea: The Case Against an ADIZ,” *The Diplomat*, (13 September 2016), <https://thediplomat.com/2016/09/south-china-sea-the-case-against-an-adiz/>

¹⁰ Federal Aviation Administration, DOT, *Code of Federal Regulations, Part 99 – Security Control of Air Traffic*, Article 99.3 (a), (Washington, DC: U.S. Government Printing Office, January 06, 2015), 305.

<https://www.gpo.gov/fdsys/pkg/CFR-2000-title14-vol2/pdf/CFR-2000-title14-vol2-part99.pdf>

¹¹ Department of National Defence, “Canadian NORAD Region aircraft practice intercept and escort procedures with United States Air Force bombers” *Government of Canada*, (18 June 2017). https://www.canada.ca/en/department-national-defence/news/2017/06/canadian_norad_regionaircraftpracticeinterceptandescortprocedure.html

Defence Sectors aircraft positioning on a defined basis.¹² The intent being, that most law abiding civilian aircraft will be intrinsically compliant and therefore easily identified. By having the compliant participants easily identifiable, this permits NORAD to focus the warning and control missions on the few non-compliant elements that pose a risk to national security. Awareness of non-compliant entities is subsequently achieved by the capabilities associated with NORAD's warning mission.

To be sure, NORAD's aerospace warning and control missions are not just constrained to the ADIZ surrounding the coastlines of North America. The lessons learned from the 11 September 2001 (9/11) terrorist attacks were terribly instructive of the consequences of having limited and poorly coordinated domain awareness and response efforts against asymmetric threats. Since 9/11, the ability for NORAD to achieve domain awareness and response on internal threats has become much more comprehensive. Prior to 9/11, NORAD's warning and control missions had transitioned away from the defunct Cold War Soviet bomber and cruise missile threat to helping law enforcement agencies counter drug trafficking. Awareness efforts on these threats had been focused outwards in order to detect and track them as they entered North American airspace vice looking for threats originating from within.

The hard lessons stemming from NORAD being "unable to protect New York and Washington from the air attacks that had arisen not from without... but from within the continent,"¹³ were incorporated at many levels and have resulted in a tremendous increase in cooperation between agencies in Canada and the U.S. The result is that the ability to cue a response to this threat was significantly increased as a result of an increased level of domain

¹² Justice Laws Website, Canadian Aviation Regulations, "ADIZ," Article 602-145(1), last accessed 26 May 2018. <http://laws-lois.justice.gc.ca/eng/regulations/SOR-96-433/FullText.html#s-601.21>

Detailed and technical Canadian ADIZ procedures are available at the Canadian Aviation Regulations link.

¹³ Joseph T. Jockel, *Canada in NORAD, 1957-2007: A history* (McGill-Queen's University Press, 2007), 2.

awareness. An excellent example of an increase in awareness achieved through this increased agency cooperation is shown in Figure 4.

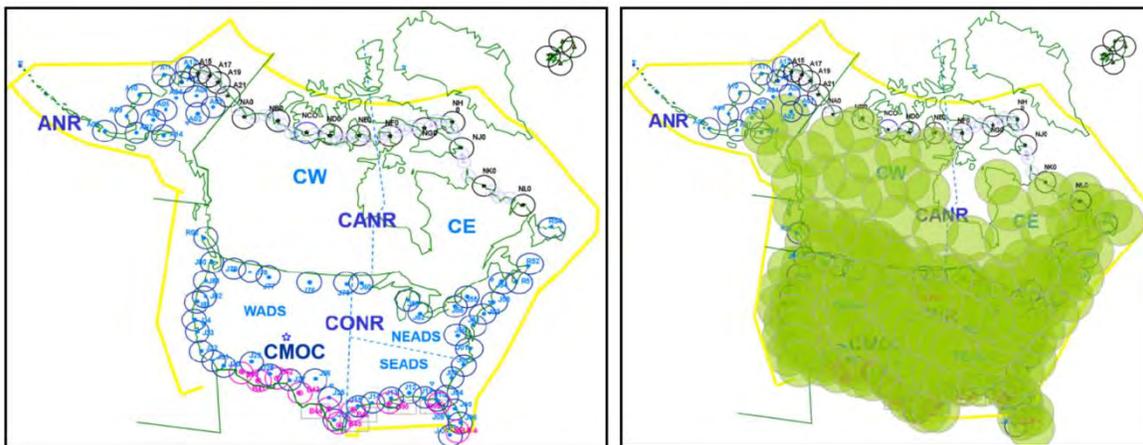


Figure 4 – NORAD Radar Coverage Pre and Post September 11, 2001

Source: *Parent and French, The Re-defining of NORAD*

Figure 4 depicts “the difference in fused radar coverage provided to NORAD from its own radars, NAV CANADA and FAA radar sites before and after 9/11.”¹⁴ The circles showing NORAD radar coverage on the pre 9/11 map in Figure 4 demonstrate how NORAD’s efforts at domain awareness were literally focused outwards against the old threat, which was likely to originate outside North America. Now that these agencies share their information, a fused common operating picture (COP) is achieved, significantly improving NORAD radar domain awareness as shown on the post 9/11 map in Figure 4. These measures have allowed NORAD and partner agencies to better cue responses towards asymmetric threats originating from within the continent since 9/11.

The evolution of NORAD’s efforts to achieve domain awareness has been driven by the evolving threat and technology. Having discussed the effects of the internal threat stemming

¹⁴ M.A. French, “NORAD - A New Command and Control Model to Improve Agility and Responsiveness (The NORAD CFACC Concept)” (Master of Defence Studies Course Paper, Canadian Forces College, 20170, 14.

from 9/11, the discussion turns to the technological evolution of the external threat and the capabilities NORAD uses to counter them. The traditional external threat to NORAD has recently realized a resurgence.

Over NORAD's sixty-year history, "NORAD's enduring mission – the one that precipitated the command's creation...- was air defence."¹⁵ The original air defence agreements of 1958 were cast to counter the manned Soviet bomber which had to physically penetrate North American sovereign airspace over the continental landmass to be in range to launch its weapons. NORAD detection and response in the beginning was aimed at identifying, intercepting and shooting down the bombers beyond the continental landmass or in the Far North in order to render their attacks ineffective over unpopulated areas.

This threat quickly became intercontinental as "the Soviets were equipping their bombers with air-launched cruise missiles [ALCM], and there were indications that they were developing a new generation of strategic bombers as well as longer range air launched cruise missiles."¹⁶ ALCM technology increased Soviet capability to launch ordnance farther away, which drove the corresponding requirement for NORAD to increase their ability to detect and shoot down their bombers and ALCM's or risk failing at the air defence mission. The CADIZ was to be the limit to still have a reasonable chance of early detection and provide enough time to achieve fighter launch, intercept and prosecution of the Soviet bomber prior launching ALCMs at maximum range

The increase in Soviet capability was becoming more and more difficult to counter though. "The early warning zone could, however, be more readily moved northward...."¹⁷ to

¹⁵ Jockel, *Canada in NORAD, 1957-2007...*, 5.

¹⁶ *Ibid*, 100.

¹⁷ *Ibid*, 11.

enable earlier detection and response as long as it was accompanied with increased detection capability. The Pinetree and the Mid-Canada Lines of long range radars supporting the detection of Soviet aircraft were gradually augmented by the “Distant Early Warning (DEW) Line built... across the high Canadian and Alaskan Arctic... When it came on line in 1957 it provided well over four hours’ warning, allowing more fighters to be readied, more to get into the air... and more to engage over [mid to] southern Canada...”¹⁸ before the bombers could engage their targets.

Figure 5 corresponds to the approximate locations of the early warning radar lines that were developed and pushed forward as the Soviet threat advanced. The CADIZ at the time was set to correspond to the warning line’s *detection* capability not the limit of sovereign airspace. The pre 24 May 2018 “CADIZ [was] based on the capabilities of the Distant Early Warning (DEW) Line radars which were replaced [upgraded] in the late 1980s by the North Warning System [NWS].”¹⁹ While an increase in detection performance was realised with the NWS, it was not significant enough to move the CADIZ to cover the Arctic Archipelago.

¹⁸ *Ibid.*

¹⁹ Canada. Department of National Defence. *Strong, Secure, Engaged*, 80.

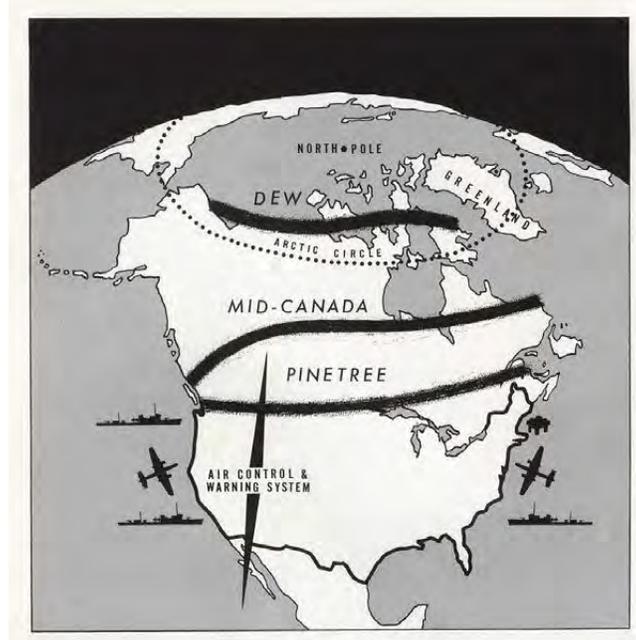


Figure 5 - NORAD Early Warning Radar Lines

Source: *Wikipedia, Distant Early Warning Line.*

The NWS “consists of 47 radar sites located along the Arctic Ocean: ... 11 are long-range radar sites, and 36 are short-range.... The unmanned sites are equipped to gather information about any airborne activity within their coverage area. The radar sites automatically send the information ... to the Canadian Air Defence Sector located at 22 Wing North Bay ... over a long-haul satellite communications network.”²⁰ Figure 6 shows the NWS line of radar stations and their approximate geographic radar coverage capability.

²⁰ National Defence and the Canadian Armed Forces, “North Warning System,” last modified December 17, 2012, <http://www.forces.gc.ca/en/news/article.page?doc=north-warning-system/hgq87x9w>.



Figure 6 – NORAD North Warning System

Source: *CBC, Raytheon wins 5-year North Warning System contract.*

The long range radars of the NWS are comprised of AN/FPS-117 radars. The system is considered long range with a manufacturer specified coverage from “10-470 km”²¹ which as evidenced by Figure 6 provides little to no coverage of the Northern two thirds of the Arctic Archipelago in the expanded CADIZ.

With Russia’s recent activity in Crimea, Eastern Ukraine, and Syria there has been a “shifting attention from intra-state conflict and ‘the war on terror’ back to state-on-state great power politics and deterrence,”²² akin to the Cold War. Indeed relations between Russia and the West are as poor as they have been since Vladimir Putin has been in power. Charron and Fergusson assess that the “most immediate and pressing concerns facing North American

²¹ Lockheed Martin, “AN/FPS 117 Long-Range Air Surveillance Radars” Fact Sheet, last accessed 26 May 2017, <https://www.lockheedmartin.com/content/dam/lockheed-martin/rms/documents/ground-based-air-surveillance-radars/FPS-117-fact-sheet.pdf>

²² Andrea Charron and James Fergusson, “Beyond NORAD and Modernization to North American Defence Evolution,” *Centre for Defence and Security Studies*, (University of Manitoba, May, 2017), 2. https://www.cgai.ca/beyond_norad_and_modernization_to_north_american_defence_evolution

defence are from Russia... [as] Russia has adopted the doctrine of ‘escalation to de-escalate’.”²³ The concept being that “if spillover from other conflicts results in Russia escalating, it could choose the Arctic as a target to force the US to deescalate elsewhere in the world. The Alliance, in turn, could invoke Article 5 ... [making] war is a possibility.”²⁴ This resurgent Russian posturing coupled with new threat technology has driven “the Permanent Joint Board on Defense’s call for a study of the evolution of North American Defense (EVONAD) in all domains...” The newest Russian ALCM threats alone are cause for significant concern to NORAD.

In 2015, Russian Aviation Tu-160 bombers demonstrated the real capability of their latest ALCM’s when they took off from Russia and successfully launched “for the first time ... Kh-101 [ALCM’s] with a range of up to 4,500 kilometers in real combat conditions”²⁵ at targets in Syria. The Kh-102 variant with a “nuclear warhead is thought be a 250KT device... [with] a low radar signature”²⁶ The Little Boy atomic bomb used on Hiroshima, “exploded with an energy of approximately 15 kilotons of TNT”²⁷ making the Kh-102 roughly 16 times more powerful by comparison. Figure 7 shows a Tu-160 Blackjack launching a Kh-101 at a target in Syria on 17

²³ *Ibid.*

²⁴ Andrea Charron, “Canada, the US, Russia and the Arctic – A Pragmatic look,” *Centre for Security, Intelligence and Defence Studies*, (24 March 2014). <https://carleton.ca/csids/2017/canada-the-us-russia-and-the-arctic-a-pragmatic-look/>

²⁵ Andrei Akulov, “Russian Kh-101 Air-to-Surface Cruise Missile: Unique and Formidable,” *Strategic Culture Foundation*, (19 October 2016). <https://www.strategic-culture.org/news/2016/10/19/russian-kh-101-air-to-surface-cruise-missile-unique-and-formidable.html>

²⁶ *Ibid.*

²⁷ Wikipedia, “Little Boy,” last accessed 26 May 2018, https://en.wikipedia.org/wiki/Little_Boy.

November 2015.



Figure 7 – Tu-160 Blackjack Launching Kh-101

Source: *Military balance Blog*.

In addition to an expanded CADIZ, the nuclear Kh-102 ALCM is an important factor that complicates the defence of North America. At an already publically demonstrated range capability of 4500 km, the Kh-101/102 could be launched to strike major Continental U.S. or Canadian centres without ever being close to the current detection capabilities of the NWS or the buffer of the CADIZ. Figure 8 provides a geographic comparison of the Kh-102's demonstrated long range capability showing a 4500 km track. This weapon could be launched from the East Coast of Greenland well outside the CADIZ for example, and reach New York City.



Figure 8 – Kh-102 Geographical Range Comparison

Source: *Sky Vector Aeronautical Charts*.

Charron and Fergusson inform us that the “NWS as currently configured is inadequate to meet this threat and has been for some time. It is not in a physical position to be able to identify cruise missile launch platforms (bombers) ... [nor] is the NWS capable of identifying and tracking [the latest] cruise missiles, because of their low radar and flight path profiles.”²⁸ Even with the previous ADIZ, the ability to achieve domain awareness with existing capabilities is significantly challenged. The expansion of the CADIZ with no improvement to detection infrastructure cannot physically improve detection capability in an area where there is none.

Nonetheless SSE states that an “expanded CADIZ will increase awareness of the air traffic approaching and operating in Canada’s sovereign airspace in the Arctic.”²⁹ Without additional capabilities to provide domain awareness to cue a response to nefarious activity, the expanded CADIZ will largely be a symbolic area of desired Canadian influence, and an administrative area of control for compliant participants. This is unlikely to change until “the development of new technologies to improve Arctic surveillance and control, including the renewal of the North Warning System...,”³⁰ as committed to in SSE are realised. Given Putin has shown contempt for sovereign borders in Crimea and elsewhere, all indications are that he will continue to do the same for the expanded CADIZ. The “pair of Russian bombers [that] were intercepted by two U.S. ... fighters,”³¹ in the Alaskan ADIZ on 12 May, 2018 nicely illustrate this point and the resurgence of Russian posturing to test NORAD.

While expansion of the CADIZ may have been well intentioned to increase domain awareness, Charron and Fergusson note further challenges in being able to mount a response to the threat:

²⁸ Charron and Fergusson, “Beyond NORAD...”, 3.

²⁹ Canada. Department of National Defence. *Strong, Secure, Engaged*, 80.

³⁰ Department of National Defence. *Strong, Secure, Engaged: ...*, 80.

³¹ Mahita Gajanan, “U.S. Fighter Jets Intercept Russian Bombers Off Alaska Coast,” *Time*, last modified 12 May 2018, <http://time.com/5275249/u-s-fighter-jets-intercept-russian-bombers-off-alaska-coast/>

... the current location of NORAD forward operating locations (FOL) for jet fighters are likely too distant to be able to intercept and destroy the platforms prior to launch. There are no radar systems currently available, except for a limited supply of American Airborne Warning and Control (AWACS) platforms, to be able to detect ALCMs or SLCMs from a long distance off the east, and west, and north coasts of North America. Finally, Canada, in particular, does not possess any ground-based air defence capacity to intercept the missiles.³²

While the GoC has expanded the CADIZ to cover Canadian sovereign airspace, and has pledged to modernize its ability to achieve increased awareness in this new domain, “how Canada intends to police this new ADIZ is left unstated. So, too, is how the country intends to renovate the North Warning System.”³³ The Alaskan ADIZ by comparison is relatively close to US bases, refueling assets and more advanced detection capabilities making the warning and control mission significantly more achievable than in the expanded CADIZ. Additionally the F-22 fighters performing NORAD duties in Alaska are significantly more modern, and have superior range and detection capabilities as compared to Canadian fighters performing the same role.

The lessons of 9/11 demonstrated to NORAD the consequences of poor domain awareness on the threat. With the resurgence of Russian bellicosity towards the West coupled with a clear and present threat, it behooves NORAD and its parent nations to move quickly to

³² Charron and Fergusson, “Beyond NORAD...”, 3.

³³ Adam Lajeunesse, “What Canada's New Defense Policy Means for the Arctic,” Canadian Global Affairs Institute, (16 June 2017), 3. <https://www.cgai.ca/opedjune162017>. Lajeunesse also notes that “questions remain about Canada’s ability to cover this entire area effectively with fighters based in the existing Forward Operating Locations. A CF-18 flying out of Inuvik, for instance, must make a 4,000km (2,485 miles) round trip to intercept a Russian bomber off the northwest coast of Ellesmere Island – roughly 700km (435 miles) farther than the aircraft’s maximum (unarmed) range.”

counter them or risk credibility in deterrence. In order to achieve domain awareness and response to this threat in the new CADIZ and beyond, M.A. French does well to highlight that:

...NORAD needs to acquire the best capabilities to detect and characterize threats (i.e. eliminate capability gaps) and develop ways to affect an adversary left-of-launch. These capabilities include space-based, land-based and airborne systems to detect adversary preparations and approaching threats with small radar-cross sections. Highly reliable communications systems to correctly describe what is detected are also required. NORAD also needs to maintain and acquire the properly placed infrastructure to be able to react to a detected, characterized, and communicated threat. The system of systems needs upgrades and it is an expensive materiel endeavour.³⁴

These recommendations have little to do with an expanded CADIZ and everything to do with acquiring capabilities, platforms and infrastructure that truly enable the NORAD warning and NORAD control mission to be effective against the current threat which will originate well outside the CADIZ.

Having examined the evolution of infrastructure and the current capabilities supporting domain awareness as compared to the evolution of the threats against aerospace defence, it has become clear that NORAD will only be able to achieve domain awareness of compliant participants in most of the expanded CADIZ. Until a modernization of the infrastructure and capabilities supporting NORAD's warning and control missions can be achieved, full awareness and subsequent response against non-compliant actors and threats will continue to be challenged within the expanded CADIZ. The GoC has been very active in pledging support to improve domain awareness to support sovereignty initiatives in the Canadian Arctic. Unfortunately the

³⁴ M.A. French, "NORAD - A New Command and Control Model...", 45-46.

expanded CADIZ can only serve as a symbolic and administrative measure for compliant actors to this end until concrete improvements start to take hold. Perhaps realisation of the lack of capability to achieve full domain awareness and response in the expanded CADIZ will serve to motivate more urgent efforts to remedy this deficiency.

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