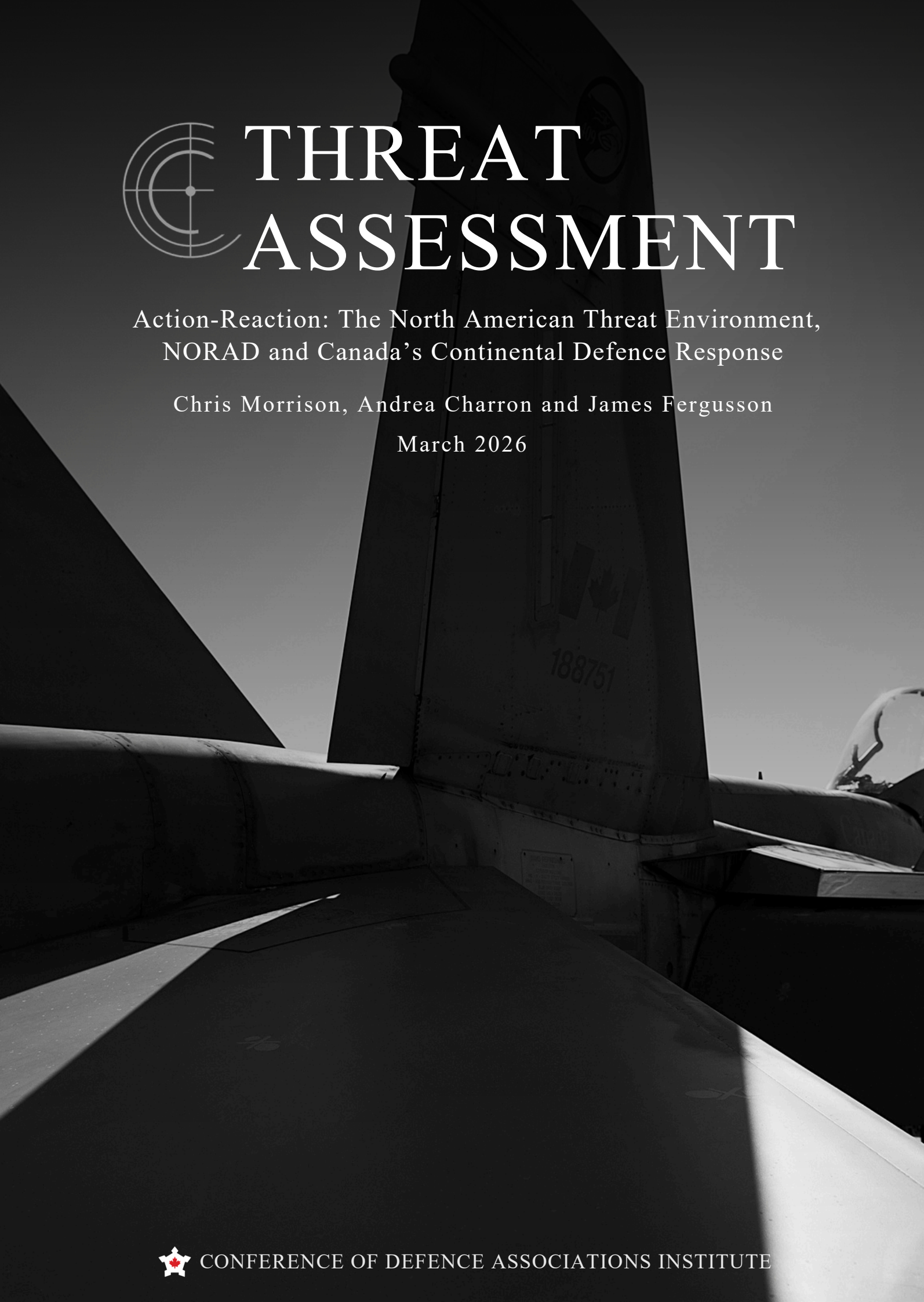

THREAT ASSESSMENT

Action-Reaction: The North American Threat Environment, NORAD and Canada's Continental Defence Response

Chris Morrison, Andrea Charron and James Fergusson

March 2026

CONFERENCE OF DEFENCE ASSOCIATIONS INSTITUTE

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On the Cover

Combat Camera / Flickr A CF-18 Hornet fighter jet sits on the tarmac, ready for the next mission at Camp Patrice Vincent during Operation Impact on January 14, 2015.
Photo: OP Impact, DND
https://www.flickr.com/photos/cafcombatcameradecombatfac/

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Executive Summary

The North American Aerospace Defense Command (NORAD) is at a critical juncture as the global security environment continues to deteriorate and adversaries develop advanced capabilities that challenge traditional defence postures that were optimized for the Cold War. With NORAD no longer having the technological dominance that it once did, there is an urgent need for Canada to modernize its NORAD commitments in the face of emerging threats, which includes advanced missile technologies, cyber operations, space-based vulnerabilities, and low-cost aerial systems such as small-to-medium sized one-way attack drones and surveillance balloons. These threats, coupled with increasing great power competition and the rise of American unilateralism, underscore the necessity for Canada to become a more robust and reliable defence partner to minimize the risk of the United States' re-nationalizing its homeland defence.

As Canada cannot afford to independently defend the nation, its $38 billion investment in NORAD modernization is an essential first step not only for national security but also for preserving the integrity of the bi-national defence relationship with the United States. Using the Royal Canadian Air Force's five operational functions of sense, command, act, shield, and sustain, this paper evaluates current capability gaps and outlines how modernization projects aim to close them. It concludes with strategic recommendations to ensure Canada's continued relevance in continental defence, emphasizing the importance of timely project delivery, public engagement, and integration across all domains of warfare. It fundamentally remains in the best interests of both Canada and the United States to have a strong and modern NORAD at the forefront of North American defence to avoid creating seams for its adversaries to exploit.

Introduction

The current global security situation is as bleak as it has been since the Cuban missile crisis of 1962. Long gone are the hopeful days of the post-Cold War peace dividend, which has now been replaced by a new era of great power competition. The Arctic Ocean remains a key, if not the key, avenue of attack toward North America not only for Russia, but also for China, as well as for North Korea and Iran. Consequently, Canada's Arctic remains vital to the security interests of both Canada and the United States, as they logically seek to defend their countries as far forward as

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possible, thus reducing the risk to the major population centres located in the central and southern regions of the continent.

The North American Aerospace Defence Command (NORAD), the only bi-national military defence organization in the world, is tasked with the defence of the continent from air threats and to warn of maritime threats (Guillott 2025). However, it remains largely dependent upon technology developed to counter Cold War-era threat weapons systems and is no longer optimized to counter the new generations of long-range weapons or to ensure continuity of operations for its extant missions from attacks directed against NORAD from the new domains of warfare such as space and cyber. While the need to update the North Warning System (NWS) was recognized by successive Commanders of NORAD starting as early as 2011 (Charron, Fergusson, Morrison 2025), the necessary political support to prioritize NORAD modernization only emerged in the context of the 2017 Joint Summit Statement by President Trump and Prime Minister Trudeau (Trump Whitehouse 2017).

Following the release of the Joint Statement, NORAD modernization featured prominently in the 2017 Canadian Defence White Paper, *Strong, Secured, Engaged* (SSE), although the government provided no funding commitments. In 2021, National Defence Minister (MND) Anand and the U.S. Secretary of Defence (SoD) Austin issued a joint statement on the priority of NORAD modernization (Department of National Defence 2021).[2] Subsequently, Minister Anand announced in June 2022 that Canada would invest $38 billion over twenty years under the umbrella of NORAD modernization. Two years later, the government released a Defence Policy Update, *Our North, Strong and Free* (ONSAF) with the Arctic and NORAD modernization as its centrepiece, six months before Donald Trump was elected to a 2nd term (Department of National Defence 2024a).

Since 2017, the Canadian government has identified nineteen projects under the umbrella of NORAD modernization covering a wide spectrum of much-needed capabilities to ensure the continued operational effectiveness and interoperability of Canada's NORAD contributions into the future (Government of Canada 2022). Notwithstanding these positive initial investment commitments, the election of Trump has had a destabilizing effect on the current American and Canadian relationship, partially as function of his repeated online statements that Canada should become the 51st state of the Republic. In addition, he has posited that the United States has defended Canada in the absence of significant Canadian defence investments, referencing Canada's failure to meet its then NATO commitment to spend 2% of its Gross Domestic Product (GDP) on defence.[3]

While President Trump's statements have generated a significant degree of public anti-American sentiment in Canada, it would be

[2] This was a bilateral joint statement approved by Minster of National Defence Sajjan and U.S. Secretary of Defense Austin.

[3] At the NATO Summit on 24 June 2025, the allies committed to spend 5% of GDP on defence, although the increase included 1.5% on wider security investments.

premature to assume that the normal, friendly relationship between Canada and the United States has ended, despite current government rhetoric and the recent agreement of an expanded defence relationship with Europe in particular (Government of Canada 2025). Regardless, President Trump has unequivocally exposed the uncomfortable truth that Canada's national defence has been financially under-written and resourced by the United States for many years; a situation that the current U.S. administration appears to be openly calling into question with far more force than previous governments (Canada Broadcast Corporation 2024). Despite domestic angst, the current environment presents a significant opportunity for Canada to take a more serious view of its national defence obligations and become a stronger ally in the common defence of North America. As Lee Carlson and Patrick Duxbury have noted, "Canada must defend its own national security and sovereignty issues and should restore its standing as a valuable and respected contributor to our security alliances" (Carlson & Duxbury 2024).

Canada's NORAD modernization investment commitments are critical to counter the threats of modern weapons systems acquired by key existing and potential future adversaries, and to ensure the continued existence of NORAD in the face of current political tensions with the United States. In order to understand the criticality of NORAD modernization, which is in essence an action-reaction process, the historical evolution of NORAD is briefly examined, followed by an assessment of the current military threats to North America in order to highlight the technological gaps that NORAD modernization seeks to address jointly within both Canada and the United States, and as rapidly as possible to maintain a credible deterrence by denial posture. Subsequently, these gaps are evaluated in terms of the five Royal Canadian Air Force's (RCAF) doctrinal operational functions (sense, command, act, shield, and sustain) in order to highlight the critical requirement to deliver on the extant NORAD modernization projects, as well as highlight some areas for further consideration (Department of National Defence 2016). Overall, NORAD modernization efforts are vital to ensuring that this unique bi-national organization remains at the forefront of North American defence. For Canada in particular, it is vital that it fulfil its pledges, as it certainly cannot absorb the greater cost of trying to *go at it alone* when it comes to defence of the nation.

The Evolution of NORAD and Today's Threats and Capability Gaps

NORAD has been active in helping to deter and defend the homelands of both Canada and the United States since 1957 (Charron & Fergusson 2022).[4] NORAD's key goal is to maintain a credible deterrence posture aimed at changing the calculus of adversaries in considering whether to attack North America. It is accomplished along two lines: first, by clearly possessing layered conventional defensive capabilities that will detect and defeat an inbound air attack (*deterrence by*

[4] Note that the agreement was not actually signed until 1958. See: https://www.norad.mil/About-NORAD/NORAD-Agreement/#:~:text=On%20May%2012%2C%201958%2C%20the,that%20established%20NORAD%20was%20formalized.

denial), and second by threatening an effective retaliatory strike as a function of NORAD's link to the American strategic nuclear triad (*deterrence by punishment*). In both, the objective is to raise the costs to any potential attacker to exceed significantly the perceived benefits of an attack (Mazarr 2018; Department of Defense 2020).[5] Thus, the primary missions of NORAD are directly aligned to support both deterrence postures. Its aerospace warning mission serves to identify an attack against North America from both the aerospace and maritime domains. These, in turn, support its aerospace control (defence against air-breathing threats) mission, as well as providing adequate time for the American National Command Authority (NCA) to decide whether to undertake a retaliatory strategic nuclear response.[6]

Originally established to counter the threat of Soviet long-range bombers (*deterrence by denial),* NORAD has undergone three distinct evolutions to maintain its operational relevance in response to changing weapons' technology. The first transformation occurred in the 1960s with the emergence of nuclear-armed inter-continental ballistic missiles (ICBM), and subsequently submarine launched nuclear armed ballistic missiles (SLBMs). As a result, resources devoted to its denial mission were significantly reduced, and attention was directed to a deterrence by punishment posture in support of the U.S. second strike nuclear force - the era of mutual assured destruction (MAD) (Charron, Fergusson, Morrison 2025; Charron & Fergusson 2022).

In the 1980s, NORAD renewed its force denial posture to adapt to the threat posed by both air and sea-launched Cruise Missiles (ALCM/SLCM). This new weapons' technology, in turn, necessitated new radar systems leading to the replacement of the Distant Early Warning system[7] by the North Warning System (NWS), and the establishment of forward operating locations (FOLs) in Canada's Arctic designed to intercept Soviet bombers prior to their release of ALCMs (Charron, Fergusson, Morrison 2025).

The third historical evolution occurred after the tragic events of 9/11, which saw the integration of civilian radar feeds from Navigation Canada (NAVCAN) and the U.S. Federal Aviation Administration (FAA) into the NORAD HQ in Colorado Springs in order to be able to see what was occurring inside North America, as well as the development of procedures to counter the asymmetric threat posed by violent extremist organizations (Charron & Fergusson 2022). 9/11 also served as an impetus to sign the NORAD agreement in perpetuity, and the addition of a maritime warning mission to provide improved situational awareness against

[5] The nuclear triad is represented by the three capabilities of land-based inter-continental ballistic missiles, submarine-based ballistic missiles, and finally, air-launched cruise missiles from the United State's Air Forces bombers with Global Strike Command. The United States continues to invest in 'deterrence by punishment' capabilities; for example, see: https://www.msn.com/en-ca/autos/news/u-s-unveils-nuclear-cruise-missile-capable-of-destroying-cities/ar AA1Gw07V?ocid=msedgntp&pc=HCTS&cvid=0c8e9f157122438790a9b445b6a132be&ei=22

[6] The three missions of NORAD are aerospace warning, maritime warning, and aerospace control.

[7] This also included the closure of the Mid-Canada and Pinetree radar lines.

maritime threats to North America (Charron & Fergusson 2022).

New, advanced weapons systems fielded by Russia and China in particular, coupled with a prolonged period of inattention on updating western capabilities for peer-on-peer conflict during the era of the Global War on Terror (GWOT), eroded NORAD's ability to deter and defend the homelands. As the current commander of NORAD, United States Air Force (USAF) General Gregory Guillot recently noted in his report to the United States Senate Armed Services Committee: "following years of steady investment, our strategic competitors have the means to overcome U.S. advantages provided by our favorable geography and advanced technology" (Guillot 2025). The recently released RCAF strategy further notes that, "in this new world, where the old safe haven of distance is now threatened by the advent of long-range hyper-sonic weapons, as well as the exploitation of the information environment and the cyber and space domains, Canada is no longer a sanctuary" (Department of National Defence 2023).

Key military threats to North America reside in four areas: new missile technologies; information and cyber operations; the space domain; and low-cost remotely piloted vehicles such as surveillance balloons and small-to-medium sized one-way attack drones. Although these areas are dominated by states, they also can be exploited by non-state actors.

On the ballistic missile front, Russia continues to modernize its capabilities while remaining within the limits of the NewSTART Treaty that expired on 5 February 2026.[8] China has both modernized and expanded its long-range arsenal, while North Korea continues their pursuit of missiles with the necessary range to strike targets throughout North America.[9] For now, Iran does not possess an ICBM capability but has a space launch capability which is a forerunner for ICBMs.

Ballistic missiles, as demonstrated by Russia, are now equipped to launch hypersonic glide vehicles (HGV); aerodynamic manoeuvrable vehicles travelling at speeds of Mach 5 and above in sub-orbital space and can carry either nuclear or conventional warheads. Conventional IC/SLBM warheads are also being pursued to offer alternative attack options for adversaries below the nuclear threshold, thus increasing the possibility of their employment in a conflict (Guillot 2025; Congressional Research Service 2009). Iran's attacks against Israel in 2024 and 2025, Russia's war of aggression against Ukraine, and the Houthi's attacks against shipping in the Red Sea have all employed

[8] NewSTART was signed in 2011 and extended by five additional years to 2026. In 2023, however, Russia suspended its implementation, the implications of which are unclear, and there is no indication yet of possible further extension or negotiations. See Arms Control Association. *New START at a Glance.* Fact Sheet. December 2024. https://www.armscontrol.org/factsheets/new-start-glance.

[9] Iran also has a robust ballistic missile capability but currently self-imposes a range limit of 2000km. It is possible that the recent events in the Middle East may cause Iran to abolish this policy and look to threaten North America directly.

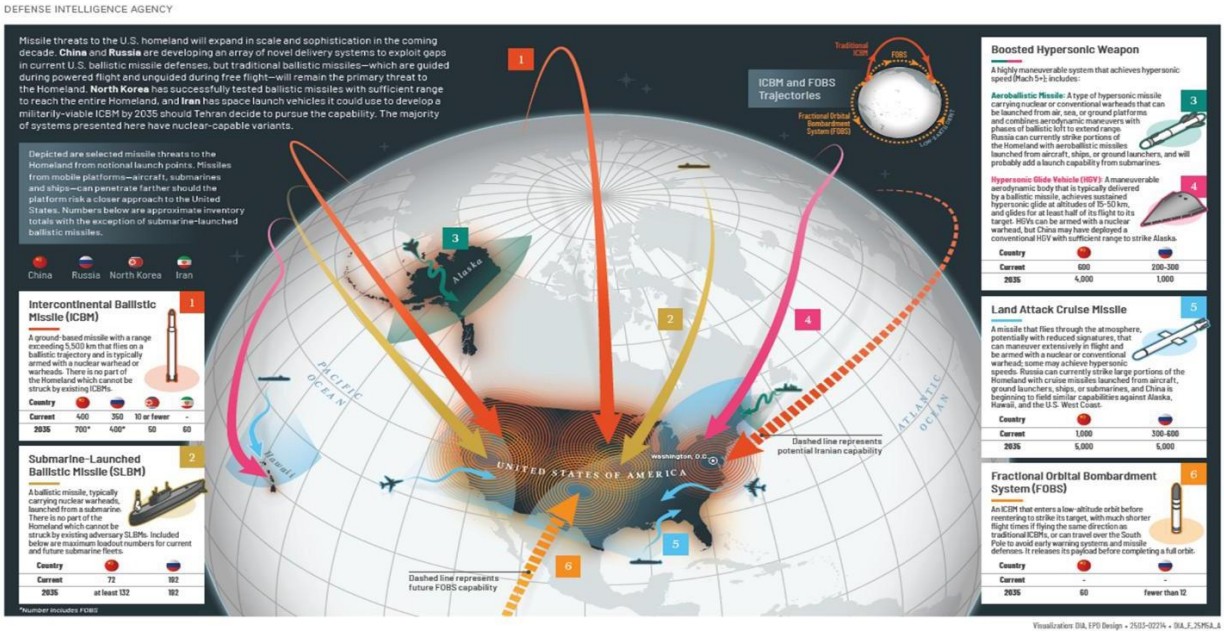

Figure 1

Global Commons: Missile Threats to North America (Defence Intelligence Agency 2025)

conventionally-tipped ballistic missiles.[10] Finally, IC/SLBMs that fly non-traditional profiles increase the difficulty of both tracking and developing intercept geometry. For example, a fractional orbital bombardment system (FOBS), under development by Russia, flies on a partial orbit along a southern-pole trajectory to avoid the preponderance of current sensors which are oriented towards the traditional northern axis of approach. All these missile technologies represent gaps to the currently fielded detect, track, and defeat capabilities available in North America (Guillot 2025).

Cruise missiles are a particular problem for NORAD because their maximum ranges (for both conventional and nuclear variants) have increased dramatically. ALCMs such as Russia's Kh-101/102 can now easily reach North America's front line of defences located in the Arctic even when launched deep in Russian territory, and the missiles themselves are equipped with stealth and terrain-following technologies, making them harder to detect (Charron & Fergusson 2022; Missile Defence Project 2017). The NWS for example, is optimized to detect the bombers and these new ALCMs have effectively rendered it obsolete (Charron & Fergusson 2022). The former commander of NORAD, USAF General Glen VanHerck (2019-2024), noted: "The North Warning System, when it was designed, it was certainly state of the art; today, it's a picket fence that low radar-cross-section (hard-to-detect) missiles can navigate their way through" (Blackwell 2025). Russia continues to pursue even longer-range cruise missiles using nuclear-powered sources,

[10] See https://www.twz.com/land/conventionally-armed-icbm-concept-highlighted-by-unprecedented-russian-missile-attack-on-ukraine as well as https://apnews.com/article/russia-oreshnik-hypersonic-missile-putin-ukraine-war-345588a399158b9eb0b56990b8149bd9

which will only increase the number of targets held at risk throughout North America (Trevelyan 2023). Additionally, hypersonic cruise missiles, which can reach speeds in excess of Mach 5 using scram-jet engines, further minimize the time available for NORAD to defeat inbound missiles (Congressional Research Service 2025).

The SLCM threat is equally pervasive, owing to new classes of Russian submarines that have an improved ability to avoid detection. This allows them to operate at closer distances to North America, maximizing the number of targets within range of their weapons. At the same, longer range SLCMs are also now in service drawing upon Russian ALCM technology. One other submarine-based threat is the development of the Poseidon trans-oceanic torpedo: effectively a submerged cruise missile, which can be leveraged to attack coastal infrastructure, in which there currently exist no defences.

Alongside these traditional military threats to North America, Russia and China have both demonstrated their ability to conduct a range of cyber operations against North America with relative impunity.[11] Their activities are wide-spread and pervasive, ranging from the promotion of disinformation, attempts to interfere with due democratic process during elections, to conducting military and industrial espionage. They are also targeting the digital networks upon which vital services rely, from military command networks, banking, to civilian critical infrastructure such as the provision of utilities (NSI 2019). In fact, the spread of disinformation resulting in the inability to discern the truth and cyber attacks are rated in the top ten greatest disruptive threats facing Canada, both in terms of likelihood and overall negative impact to the country (Policy Horizons Canada 2024). It must be assumed that any military attack against North America will encompass a full-spectrum cyber attack against all military, civilian and government institutions. While countering this increasing vulnerability requires a whole-of-government approach, there is also significant implications for NORAD in its ability to provide *continuity of operations* in the face of cyber attacks directed against the command.[12]

To maintain military superiority, both Canada and the United States' armed forces have had to undergo extensive digital transformations over the past two decades to promote faster decision-making processes by exploiting the increase in data from the vast array of battlefield sensors. All command-and-control systems are now digitized, and most modern military platforms are network-enabled, with artificial intelligence being incorporated as human capacity to process data has been exceeded. While this technology is essential to the conduct of modern warfare, it also generates new avenues of vulnerability, which can be exploited by adversaries; this point was highlighted using the Stuxnet virus against Iran's nuclear program infrastructure.

[11] For example, China has conducted a wide-spread cyber attack on the United States telecommunications companies starting as early as 2023, known by its Microsoft code name of "Salt Typhoon."

[12] The responsibility for NORAD is simply to survive a cyber attack such that it can continue to function. There is no suggestion that the mission set of NORAD should be expanded to include the conduct of cyber operations at this time – this mission rests with other military and government agencies.

Western militaries are also highly dependent upon space-based platforms to provide a host of functions, ranging from intelligence gathering, long-range voice and data communications, and the use of Global Positioning Satellites (GPS) to enable navigation, as well as guidance for precision-guided munitions. For example, frequency-hopping radios, which seek to hinder the enemy's ability to jam radio transmissions, rely on GPS to keep all radios synchronized. The use of high-tech, remotely piloted airborne systems (RPAS), such as the MQ-9B Reaper, are controlled via satellite communications from a limited number of sites which tend to be far removed from the area in which the RPAS are operating. Interrupting or jamming the signal can cause the RPAS to default to its fail-safe logic, which causes it to abort its mission and return. GPS spoofing is also a growing concern and may have been used in the latest Iranian attacks against Israel. It is suspected that several Iranian ballistic missiles may have been tricked into crashing into the Mediterranean Sea because of being fed incorrect positional data (Amalaraj 2025). Finally, earlier generations of precision-guided munitions (PGM), which utilized lasers to designate the target, have now given way to more reliable GPS guidance systems.

Furthermore, the use of GPS and satellite communications is not constrained to the military. Commercial aviation is now fully dependent on their use. Traditional long-range land-based navigation aids, such as Very-high Frequency Omni-directional Range (VOR) and Non-Directional Beacons (NDB) are vital, although they are largely in the final stages of being phased out of service.[13] Communications systems such as the Aircraft Communications Addressing and Reporting System (ACARS) are used to maintain communications when aircraft are beyond the reach of land-based radio broadcast stations. Additionally, air traffic control (ATC) now relies on Automatic Dependent Surveillance – Broadcast (ADSB), which requires GPS to aid in aircraft deconfliction. The loss of GPS would potentially halt most commercial aviation, at least in Canada. In addition, outside of aviation, automatic banking machines rely upon GPS nuclear clocks for timing purposes.

Satellites are inherently vulnerable, given their fixed, and therefore predicable orbits in space. Adversaries possess, or are in the process of developing, a range of capabilities that can deny the use of satellites via non-kinetic electronic warfare jamming and disrupting the signal by placing a satellite or blind in its line of sight. Kevin Pollpeter, the head of research at the China Aerospace Studies Institute, warns that "disruptions will grow more common, as Russia and China invest in technologies capable of jamming GPS on a massive scale" (The Economist 2025).

Russia and China have also demonstrated the kinetic ability to destroy satellites by employing ballistic missile defence interceptors, or possibly co-orbital collisions employing hunter/killer satellites. Other

[13] The NAVCAN NAVAID modernization program was primarily undertaken based on finances, and one that will prove unwise in the event of a conflict in which GPS is disabled. Canada is more vulnerable than the United States, given that they possess superior primary radar coverage, whereas in Canada there are significant gaps.

systems, such as directed-energy weapons, are under research and development that can effectively over-load satellite components, rendering them useless. In light of this, former U.S. Representative Jim Cooper, writing for the Center for Strategic and International Studies, posits that the Space Age is about to be replaced by the Anti-Satellite Age (Cooper 2024). In short, the increasing reliance on space-based technologies presents vulnerabilities for which strategies must be developed to preserve NORAD's freedom of action**.**

Finally, drones, in general, and drone swarms, in particular, have become one of the newest developments on the modern battlefield, used by both conventional militaries as well as terrorist organizations to great effect. From larger Iranian Shahed drone variants down to simple, commercially available quadcopters, their minimal cost and ease of operation make them an ideal choice to overwhelm air defence systems and dilute the resources available to intercept more lethal weapons such as cruise missiles. This tactic was employed by Iran during its attack against Israel in April 2024. It is possible that drone swarms could be launched by foreign infiltrators from within the territory of North America, or from ships that are operating off the coasts. The prolonged incursion on Langley Air Force Base over several days in December 2023 by drones certainly highlight the growing threat, whether for direct attack or simply conducting intelligence collection (Butterfield 2024). Like ALCMs, their small size and low-altitude flight paths make them a more difficult target to acquire and defeat, and at a very disproportionate cost. Stopping drone swarms can consume a vast number of expensive air-to-air missiles, rapidly depleting weapons stocks needed to repel follow-on attacks.

China has also shown a willingness to employ surveillance balloons to gather intelligence directly over North America, as evidenced by the events of February 2023. Despite the assurances of China that it was merely a weather balloon which had gone off course, the nature of the equipment installed suggests a more nefarious purpose. Journalist Tom Blackwell notes "though satellites are the major powers' chief aerial spying tool, the theory is that surveillance balloons, operating at lower altitudes and able to stay aloft longer over targets, can capture higher-resolution images and intercept more communications" (Blackwell 2025). This incident highlighted the domain awareness gaps facing NORAD today. Owing to the limitations of legacy radars in both Canada and Alaska, NORAD struggled to *see* the balloon initially as slow-moving objects were deliberately filtered out. As then NORAD Commander General VanHerck noted, "the balloon opened up eyes; we're not going to see long-range cruise missiles, we're not going to see balloons over the horizon" (Blackwell 2025). While the official public reporting states that no intelligence was gathered or passed back to China, its flight path in the vicinity of U.S. Malmstrom Air Force Base in Montana (341st Missile Wing) was certainly cause for concern. These lower and slower aerial systems represent another threat for which NORAD must be prepared to counter to protect the national security interests of both Canada and the United States.

Finally, foreign terrorist groups continue to threaten both Canada and the United States

directly through physical or cyber attacks, as well as giving rise to ideologically/religiously motivated home-grown terrorism through on-line recruitment. While Canada's National Terrorism Threat Level has remained at medium since 2014, the United States' Northern Command (U.S. NORTHCOM) has assessed the threat as increasing, with the risk the highest it has been in five years, attributed, at least in part, to the current war in Gaza between Israel and Hamas (Government of Canada 2024; Guillot 2025). From NORAD's perspective, the primary asymmetric threats remain the use of civil aviation aircraft to launch an attack, whether through the hijacking of commercial airliners, or equipping smaller aircraft with explosives to conduct 9/11-style attacks. The most important tool in combating this risk remains a high level of vigilance on the part of airport security organizations, whether in North America or abroad, as it is inevitable that terrorists will continue to seek new methods to counter the increases in security measures that have been implemented globally in the wake of 9/11.

Today's Geopolitical Environment

Given the current and evolving North American military threat environment, NORAD will require significant investments to ensure a credible deterrent and defence posture. However, NORAD operates in more than just a military threat environment. It also functions in a geopolitical environment. The recent return to great power competition coincides with the United States turning from a policy of multilateralism to one of unilateralism. It no longer appears content with the status quo of the post World War II rules-based international order and military alliances it forged. Disagreements with allies have arisen, and their significance is magnified as potential weaknesses for adversaries to exploit. It is an exaggeration, notwithstanding some Canadian rhetoric, to suggest that current U.S. policy direction itself is a latent threat. But significant concerns exist regarding Canada's relationship, which may affect the future of NORAD and thus continental defence and security.

Canadians, overall, feel an inherent sense of protection, albeit problematic, if not false, surrounded by three oceans and sharing a border with the United States. This partially explains the historically weak support for substantial defence spending and maintaining a large standing military force in Canada (Lagassé 2025). Whether consciously or not, successive Canadian governments have long leveraged the unilateral American security guarantee unexpectedly announced by President Roosevelt in his address at Queen's University in 1938; a guarantee that has never been rescinded to date (Fortman & Haglund 2002). Consequently, NORAD has always operated in the context of an unequal relationship between Canada and the United States. The United States has always provided a higher proportion of the funding and forces needed to ensure the success of NORAD, alongside other elements of North American defence cooperation. Canadian defence spending, during peacetime, has always been the bare minimum needed to appear as a *good partner* (Charron, Fergusson, Morrison 2025). While NORAD, in contrast to NATO, has remained *beneath the radar* politically for the moment, Canada's historical dearth of defence

spending has been laid bare, with the current administration highlighting that the United States has been effectively financing the defence of Canada for years.

President Trump has brought to the fore what has been a source of discontent for previous American governments, albeit muted. The current situation has been exacerbated by successive Canadian governments' hollow rhetoric and failure to respect their declared timelines for increasing defence spending. While President Trump's discourse has been met with rancour in Canada, he is also the first U.S. President who has managed to ensure all NATO countries agree to much higher defence spending objectives: five percent of GDP by 2036. Hence, it is important for the Canadian government to recognize that this problem will not simply disappear in four years when President Trump's second administration is complete. Continued demands for higher levels of spending on defence and security are likely to persist even after the next U.S. election.

To help ensure that the United States does not walk away from NORAD, Canada can no longer afford to be an *easy-rider* when it comes to matters of defence in general, and continental defence in particular (Leuprecht & Sokolsky 2014). Despite the NORAD agreement being renewed in perpetuity in 2006, Canada can ill-afford to take for granted the continued existence and/or relevance of NORAD as being assured, even if the United States has traditionally been reliant on certain Canadian capabilities, such as the NWS radar feeds, to facilitate their own domain awareness. Either country can decide to withdraw with only twelve months' notice (Government of Canada 2006).

The timing of the tensions in the relationship between Canada and the United States is unfortunate, given that Canada is actively embarking on an ambitious modernization of its armed forces, on a scale not seen since the early days of the Cold War. There is also a meaningful commitment to take responsibility for what is now known as the 10 to 2 o'clock positions for the defence of North America (Department of National Defence 2022).[14] Canada has initiated or signaled its intent to initiate various capital procurement projects to reduce its reliance on United States capabilities such as strategic air-to-air refuellers (AAR) and airborne warning and control system (AWACS) aircraft, as well as finally entering into a contract to purchase 88 new F-35 fighters. Although the government is formally re-evaluating the fighter purchase for domestic political reasons, to cancel the purchase would have disastrous consequences for the relationship in political and economic terms.[15]

[14] This terminology was used by then Chief of Defence Staff General Wayne Eyre during the NORAD modernization announcement on June 22, 2022. The 10 o'clock position refers to the Yukon/Alaska Border, 12 o'clock is due north over Canadian Forces Station Alert and the geographic North Pole, and the 2 o'clock would equate to a direct line from Toronto projected out to Iceland.

[15] Canada has been a member of the F-35 consortium since its onset in 1998, and to reverse course would lead Canadian companies currently involved in production to be frozen out. In addition, Canada is contractually committed to an initial purchase of 16 F-35s, and to decide to go another route for the remaining 72 would make no military sense whatsoever. See https://nationalpost.com/opinion/dumping-the-f-35-would-hurt-canada-far-more-than-the-u-s

Considering today's geopolitical climate, NORAD modernization has become even more important than when first conceived. It will provide Canada not only the necessary means to be a strong and inter-operable partner capable of defeating the modern military threats facing North America, but it will also provide a meaningful signal that Canada does not want to take the United States for granted. NORAD modernization can provide a foundation to help reinforce a bi-national relationship that is of great mutual benefit to both Canada and the United States. Fundamentally, it remains in the best interests of both Canada and the United States to ensure that this unique bi-national organization remains at the forefront of North American defence. The reality is that without NORAD, the United States and Canada would have to be defended in parallel, which would create more seams which can be exploited by North America's adversaries.

Modernizing NORAD for the Future

The genesis of NORAD modernization can be traced back as far as 2011 with the advent of the new generation of Russian long-range cruise missiles. It produced an urgent requirement for improved situational awareness and early warning of the full range of threats facing North America; what is known today as *joint all-domain awareness*. Simply, one cannot defend against that which one cannot see from the seabed up into outer space. Unsurprisingly, one of the first focuses of modernization was to address the growing vulnerabilities associated with the obsolete NWS. Nevertheless, in Canada, NORAD modernization did not gain significant traction until the release of the 2017 defence white paper *Strong, Secure, Engaged*.[16] Despite this, the term NORAD Modernization did not become standard nomenclature until the formal announcement of the NORAD Modernization Plan in 2022 by then-Minister of National Defence Anita Anand.

While NORAD modernization has been feted for its goal of "delivering modern, state-of-the-art equipment for [the] Canadian Armed Forces" (Department of National Defence 2022), in many areas, Canada's plan is simply allowing it to catch up to the United States, which has an ingrained culture of continual improvements in military capabilities. Nonetheless, Canada's NORAD modernization plan is critical for both countries, as it will improve NORAD's situational awareness, agility, operational reach, as well as ensure that the Canadian Armed Forces (CAF) remains inter-operable with all the elements of the United States' military. However, at least for the time being, NORAD modernization is effectively constrained to NORAD's three missions. As such, there is a limit to what NORAD can do in fields where it is not tasked to operate, such as cyber operations, notwithstanding the requirement to protect its own systems from attack. In other words, NORAD is only one piece of the requirement to modernize North American defence and security.

To provide context to the various aspects of NORAD modernization in Canada, the RCAF provides five core interdependent

[16] Of note, NORAD had only been briefly mentioned in the previous 2008 White Paper, the *Canada First Defence Strategy.*

doctrinal operational functions – **sense, command, act, shield,** and **sustain**.[17] First, for NORAD's deterrence posture, its **sense** capabilities must be robust. Adversaries must have a high degree of confidence that any attacks will be detected with sufficient advance warning to enable a suitable response. This is one of the fundamental reasons that Russia and China have been investing heavily in new cruise missile technologies as well as ICBMs that will approach from non-traditional directions or exploit lower altitudes to remain outside current sensor detection windows. In Canada, the problem is exacerbated by the fact that the NWS cannot cover the entirety of the Canadian Air Defence Identification Zone (CADIZ), as well as numerous gaps between civilian radars throughout the country, which gets progressively worse the farther north one goes. Retired RCAF General Scott Clancy, a former NORAD director of operations, has highlighted the scarcity of radar coverage in Canada (Blackwell 2025). NORAD modernization looks to reduce these risks in several important areas, notably procurement projects seek to contribute to domain awareness.

While traditional radars such as the NWS operate online-of-sight and are therefore limited by the curvature of the earth, Over-the-Horizon (OTHR) systems bounce high-frequency waves off the ionosphere to increase significantly their range and see over the curvature of the earth. Both Canada and the United States are pursuing a number of these systems. The first system of note for Canada is the Arctic OTHR, which will fill in many of the extant gaps in coverage in the High North. Canada announced the purchase of the Australian Jindalee system, which will be located in southern Ontario and aims to be fully operational by 2031.[18] A second system, North Watch (formerly called the Polar OTHR), will cover latitudes north of 70º, complementing the AOTHR system and could provide radar detection capabilities of Russia's Long-Range Aviation (LRA) forward staging bases, providing maximum warning of bombers launching towards North America. While the technology for this system remains in the research and development phase for now, it aims to be operational by 2033, but will need to overcome a number of hurdles, including securing sufficient energy supplies and successful negotiations with Indigenous rights holders (Department of National Defence 2024b).

While OTHR systems will be crucial to providing warning of the launch of both missiles and bombers, they may not be

[17] The core functions are Command, Sense, Act, Shield, and Sustain. RCAF doctrine breaks Act into two sections: Act-Move and Act-Shape, but this level of delineation is beyond the scope of this paper. As well, RCAF doctrine also includes the operational function Generate. While Force Generation is clearly important, only one NORAD modernization project touches on Generate, which is the re-development of the Cold Lake Air Weapons Range. This project is not discussed further in this paper. It must be noted that most equipment map overlap between multiple functions; as such, the equipment is listed in the area in which it will make the most direct contribution to NORAD operations.

[18] While the Jindalee system has been operational since the 1980s, it has only been used in Australia. it does not have to contend with the electromagnetic activity in the upper atmosphere in Canada (Aurora Borealis). Extensive Defence Research and Development Canada (DRDC) was conducted to model the performance in Canada prior to committing to the purchase.

capable of providing high fidelity tracking data in all instances, particularly with new-generation ALCMs that employ terrain-masking flight profiles. Tracking these missiles requires a look-down capability, and this is why fifth-generation fighters such as the F-35 and the next generation of AWACS aircraft are vital components of the overall **sense** network for NORAD. These aircraft employ Active Electronically Scanned Array (AESA) radars, which offer superior radar detection capabilities against both cruise missiles, as well as small objects such as drones by leveraging capabilities such as airborne moving target indication (AMTI) (Corcoran 1999). Experience has shown that the demand for AWACS aircraft always exceeds the number of resources available. Accordingly, the ONSAF announcement to earmark funds to pursue an organic AWACS capability is a vital step in Canada becoming capable of leading the defence of North America between the 10 and 2 o'clock positions and especially the vulnerable 12 o'clock position.

While AWACS aircraft can provide high-fidelity tracking information, they remain limited in both their on-station time (airtime), as well as their total radar coverage, which is but a fraction of Canada's total landmass. The use of newer space-based platforms, equipped with AMTI and ideally deployed in an orbital constellation, including polar assets, can help provide a persistent presence to cover areas where AWACS otherwise may not be available. The United States is actively moving in this direction (Guillot 2025). Canada's NORAD modernization plan to deliver defence enhanced surveillance from space (DESSP) will replace a number of legacy space-based satellites such as RADARSAT and the Polar Epsilon systems, although the full extent of the new project's capabilities are not known at this time and this project will not be completed before 2035 (Department of National Defence 2024b). However, if this system is not capable of providing continuous high-fidelity target-tracking, then there will remain a **sense** gap that will need to be addressed in a future wave of modernization projects.

While it is important to have the sensors to increase detection capability, they do little good if the architecture to feed their data back to command centres does not exist. It is therefore vital that the necessary communications and information systems' infrastructure exists, which must, by necessity, include adequate numbers of personnel, to both transmit the data and interpret it such that it can be transformed into what is called *actionable intelligence*.

As such, **command** is the second element and involves the purposeful integration of a system of systems, procedures, organizational structures, personnel, materiel, information, and communications, which are designed to enable any commander to exercise authority and direction across the spectrum of conflict. It is the key function that allows capabilities and/or forces to be grouped at the right time and location to allow for decisive military actions to be executed (Department of National Defence 2016). **Command** is typically considered through the lens of command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR).

To discern the actions of the enemy, it is crucial that the acquired information from the full complement of sensors is relayed back to a location where it can be processed and digested. This requires a robust and redundant communication and information systems' architecture. With the quantity of data being gathered by today's modern platforms far exceeding those of Cold War era systems, legacy networks can be easily overwhelmed in this new age of digital information dominance. At present, NORAD is drawing data from over one thousand different sensors to build a fulsome recognized air picture (RAP). This is the operational requirement that underpins the modernized command and control information systems (MC2IS) component of NORAD modernization.

To respond to the actions of the adversary, it is necessary to transform the data gathered by sensors and transform it into meaningful intelligence. In the past, this would be successfully carried out by personnel who were well versed in the tactics that the enemy employed. In the modern battlespace, this is no longer possible as there is far too much data for even a team of well-trained personnel to be capable of independently processing in a sufficiently timely matter. Instead, the Future Combined Aerospace Operations Centre (FCC) will provide the fusion of sensor data, and ensure sufficient personnel are available who can exploit artificial intelligence (AI) to allow for faster and more accurate intelligence predictions, arming commanders with the information that they need at the speed of relevance. The Canadian FCC will allow the Canadian NORAD Region (CANR) to remain relevant in helping deter North America's adversaries for the foreseeable future.

It is also imperative that decisions are taken in a timely manner. A perfect decision taken too late is of no use. As Canada's adversaries are aware of the locations of the headquarters in which commanders lead operations, they are prime targets for cyber attack operations and follow-on kinetic attacks. Consequently, as part of NORAD modernization, Cloud Based Command and Control (CBC2) offers several important benefits to legacy systems. First, it eliminates the reliance on vulnerable traditional (e.g. stationary) computer networks, and second, its embedded AI allows commanders valuable time to select an appropriate course of action and maintain an operational advantage. It also facilitates dispersed operations, allowing commanders to continue to function while physically transiting between various locations, and improves the continuity of operations if one of the headquarters locations is successfully attacked.[19]

To enable **command** at the tactical level, where the battle is fought, NORAD modernization has also implemented multiple projects to increase communications coverage across Canada. These networks are vital for redirecting forces to emerging threats, as well as passing orders needed to

[19] During the Cold War, much effort was made to have 'hardened' facilities that could withstand a nuclear strike; naturally, the counter-response to this defensive measure was for North America's adversaries to simply build bigger and more powerful weapons. Today, it is far more economical and practical to simply conduct dispersed operations, rather than be anchored to a predictable operating location. This is known as Agile Combat Employment (ACE) and has been a key operating tenet for nations such as Sweden and Finland.

prosecute hostile targets. By modernizing ground stations as well as leveraging satellite communications to increase the territory covered, both the quality and redundancy of communications is improved, which minimizes the risk that adversary activities in the electro-magnetic spectrum, such as jamming, will have a significant detrimental effect on NORAD operations. The previously mentioned AWACS aircraft will also be an invaluable asset for Canada and its NORAD operations in this regard, as it is able to extend networks as well as directly facilitating comprehensive air-battle management.

Despite these developments, a **command** capability gap exists within NORAD modernization, in particular related to NORAD's maritime warning mission. This is not an equipment problem *per se,* as much as a cultural integration one. Within the CAF, NORAD remains perceived in near-strict aerospace terms. However, North America is increasingly vulnerable to an attack from the maritime domain, which increasingly includes areas of the Arctic Ocean.[20] Joint All-Domain Awareness dictates that NORAD must be supported by all military branches. While strides are being made to better integrate the maritime domain, it is still inconsistent. For example, there is no Liaison Officer resident in the CANR CAOC to speak to RCN activities vis-à-vis maritime warning. Additionally, while ONSAF references procuring new maritime domain sensors, there was no link to the command. On the other hand, new capabilities such as the River Class Destroyers and the P-8 Canadian Multi-Mission Aircraft (CMMA) include references to supporting NORAD operations (Department of National Defence 2024a). By excluding the various maritime domain projects from NORAD modernization efforts as announced in 2022, an opportunity was lost to break down some of the cultural stovepipes that exist. These stovepipes serve to undermine NORAD's unity of purpose, and potentially allow North America's adversaries to exploit the maritime domain as a viable avenue of attack (Roza 2023).[21]

Command, of course, sets the foundation to **act** through the employment of military force. NORAD's aerospace control or defence mission requires a suitable combination of reach, inter-operability, and lethality to over-match an adversary. In addition, NORAD's operational footprint needs also to expand well beyond the territorial boundaries of North America to be capable of directly engaging Russian bombers and any potential fighter escorts. Moving forward, it may also require increased access, basing, and over-flight (ABO) permissions for NORAD operations in both Kalaallit Nunaat (Greenland) and Iceland to help bolster the defence of North America in the 12 and 2 o'clock positions.[22] This would require significant political

[20] Interestingly, due to the Beaufort Gyre current in the Arctic, the Northwest Passage is becoming more difficult to transit because it gets backfilled with the ice that is being freed because of climate change.
[21] USAF Gen VanHerck, then Commander of NORAD, testified to Congress that better integration of all sensors, including underwater surveillance systems, was needed to develop a comprehensive defence picture.
[22] Recent NORAD exercises such as VIGILANT SHIELD have seen the operation of fighters and tankers from Pituffik Space Base (formerly known as Thule Air Base).

negotiations, and potentially even amending the NORAD agreement.[23]

One of the first NORAD modernization projects to be approved was the acquisition of a fleet of new strategic tanker transport aircraft, based on the Airbus Industries A330 Multi-Role Tanker Transport (MRTT) platform.[24] This project was expanded beyond its original intended scope of simply replacing the fleet of five CC150 Polaris aircraft, allowing Canada to procure the additional aircraft necessary for holding the NORAD alert readiness posture. This capability eliminates Canada's historical reliance on the USAF KC-135 fleet in support of the deployment of Canadian fighters to the FOL sites in the Arctic. With the MRTT fleet, Canada will be capable of projecting combat air patrols into the Arctic and Atlantic Oceans in order to confront Russian LRA aircraft before they reach their optimal launch locations, particularly for second and third wave attacks.[25] Simply, it is much easier to target the bombers (the *archers)* rather than the ALCMs (the *arrows)* (Charron & Fergusson 2022).

Like the CMMA aircraft, the F-35 program is not officially part of NORAD modernization, but nevertheless it is viewed as a vital capability to "enable Canada to meet its NORAD obligations" (Government of Canada 2023). As a stealth aircraft employed by CANR, it can close in on Russian LRA aircraft undetected, increasing the probability of successfully engaging these aircraft before they launch their missiles. More importantly, as a fifth-generation fighter, the F-35 employs sensors and networking capabilities vital to seeing and engaging any ALCMs that are launched towards North America. It is also fully inter-operable with the full complement of combat aircraft that the USAF is in the process of fielding. Concurrently, Canada is also investing in a full suite of air-to-air missiles for the F-35 which will give it the necessary lethality to engage LRA from stand-off distances, as well as having missiles better optimized to intercept of ALCMs (Department of National Defence 2024b). Whether this also will provide a capability to intercept hypersonic vehicles is unknown.

One final related **act** area that NORAD modernization addresses is the concept of freedom of manoeuvre. As previously mentioned, western militaries have become highly, if not overly, reliant on the use of GPS. NORAD modernization recognizes that this is a risk to how forces navigate throughout the modern battlespace and proposes to add redundancy through the fielding of a new air navigation aid systems (AirNAS) replacement project. This will also have the advantage of improving position, navigation, and timing (PNT) capabilities in

[23] On 17 June 2025, the United States adjusted the combatant command boundaries to move Greenland from European Command (EUCOM) to NORTHCOM. While this currently does not affect NORAD, it does signal the importance of Greenland to North American continental defence and may be the precursor to additional discussions in the future.

[24] There is an obvious overlap of the CC-330 MRTT with the **sustain** operational function, particular for its transport role. However, given its critical role in enabling the expansion of NORAD's operational footprint in the CANR region, it is included under **act**.

[25] As a worst-case scenario, it should be assumed that the first wave of ALCMs will be launched from proximity to Russian territory to exploit maximum stand-off and would be well beyond the reach of NORAD assets.

areas that otherwise have been historically dependent upon GPS.

To maximize deterrence in Canada's North, there will be additional avenues available that a future NORAD modernization spiral should leverage. To fully exploit the capabilities of the F-35, ideally it would control a series of collaborative combat aircraft (CCA), also known as loyal wingman, which would vastly increase the number of weapons available within a given combat air patrol.[26] Furthermore, it would allow the F-35 to *push forward* the CCAs as assets directly engaging bombers, thus reducing the possibility of an F-35 being engaged by any fighter aircraft that may be escorting Russian LRA assets; a vital force protection measure for the more valuable F-35 and its pilot.

While many infrastructure upgrades are being made in Canada's Arctic, the available operating locations are still based on the existing Forward Operating Locations (FOL), which stem from the 1985 CANUS air defence modernization plan (Government of Canada 1985). To optimize the reach of NORAD forces, consideration should be given to establishing a new FOL in the farthest northern reaches of the Canadian archipelago, or perhaps developing Canadian Forces Station Alert with an appropriate runway and quick alert facilities.[27] This would allow the existing FOLs to be used to provide defensive depth to deal with any missiles that eluded the first line of defences. While this would inevitably give rise to an additional target for Russian military planners, the reality is that with the unpredictable weather in the far north, having some additional redundancy from which to project forces is a more important consideration in the defence of North America.

As an operational function, **shield** is concerned with force protection, which is the defence of critical infrastructure (DCI) by incorporating both passive (e.g. hardening, concealment, electronic monitoring, operational security) and active measures (e.g. security forces, adaptive dispersed operations/agile combat employment, electronic attack, kinetic interception) to ensure the ability to continue conducting operations when subjected to an attack.[28] Ukraine's recent Operation Spider's Web, a massive drone swarm attack against Olenegorsk, a key Russian LRA base, provides a vivid warning of the danger posed

[26] CCA are effectively a type of uninhabited combat air vehicles. Of note, the USAF has only recently commenced efforts to develop a CCA; Australia has been developing a CCA with Boeing known as the MQ-28A Ghost Bat. See also https://www.twz.com/air/f-35-ai-enabled-drone-controller-capability-successfully-demonstrated

[27] While most infrastructure projects are addressed under the **sustain** operational function, given that this is an entirely new base, it is felt to be better addressed under the **act** function, as it directly enables military freedom of action.

[28] Security forces are a crucial component of active defensive measures, and the F-35 purchase is forcing Canada to consider what security forces are needed to help protect the aircraft and its associated technology; one option could go so far as to see the development of an RCAF Regiment, modelled along the lines of that of the Royal Air Force (RAF). As the F-35 is not a formal project of NORAD modernization, the associated security forces will not be examined in any further detail.

by a lack of defensive capabilities.[29] Force protection stands as a vital component to deterrence by denial, and must be of preeminent importance in homeland defence plans.[30] Central to force and critical infrastructure protection today is Integrated Air and Missile Defence (IAMD) as elaborated upon in ONSAF (Department of National Defence 2024a).[31]

The path forward for Canada and IAMD is far from clear.[32] Positively, Canada has committed to making further contributions in IAMD for both itself and North America, including exploring options for purchasing ground and maritime based defence systems.[33] In addition, MND David McGuinty recently announced the removal of all restrictions on IAMD of Canada (Department of National Defence 2025). However, what this announcement explicitly means for future Canadian investments in ballistic missile defence (BMD) and possible Canadian participation in the American Golden Dome initiative remains to be seen. Participation and Canada's contribution will have to be negotiated with the United States, and central to Canadian strategic interests would be to place the Golden Dome under NORAD command.[34] Of note, however, in previous negotiations on Canadian participation in 2003-04, the United States refused to assign command to NORAD (Fergusson 2011). Much will depend on the willingness of Canada to acquire and deploy on Canadian soil key elements of new BMD capabilities against long range ballistic missile threats and at a minimum interoperable and linked to U.S. capabilities. This will also impact on the role NORAD will play in defence against hypersonic threats.

Finally, **sustain** directly relates to the logistical and infrastructure side of the equation**,** crucial for enabling front-line operations. The CAF, and by extension NORAD, must be prepared to increase its presence in the Arctic in response to the growing threat and level of activity from its adversaries, both in terms of the frequency and duration of deployments. NORAD modernization must address Canada's extant logistical challenges through fundamental

[29] This attack saw the destruction of several Russian LRA bombers. For further information, see: https://www.thebarentsobserver.com/security/satellite-images-from-olenya-show-4-strategic-bombers-destroyed/431046

[30] It must be noted that successful force protection begins with the culture of an organization; a willingness to promote operational security through the disciplined guarding of information, sound computer network practices, and avoid becoming complacent and establishing predictable patterns of operation; however, an in-depth discussion of these details falls outside the scope of this paper.

[31] Canada divested all of its ground-based air defence systems in the early 2000s. However, all of these systems were short-range, optimized for point-air defence. They would have only been of limited benefit to IAMD. To date, confirmed funding has been constrained to research and development (R&D) activities.

[32] For a detailed analysis of IAMD and Canadian policy, see James Fergusson's article at https://www.cgai.ca/th_pp_canadian_ballistic_missile_dilemma

[33] On the maritime side, this primarily concerns the new River Class Destroyers and whether the government will acquire the full range of Standard Missile (SM) interceptors, including the SM-3, which is capable of intercepting long range ballistic missiles.

[34] Currently, the U.S.-only ground-based mid-course phase system deployed at Fort Greely, Alaska is under U.S. Northern Command.

activities such as accommodations, feeding, ammunition stockpiling and ensuring that the necessary infrastructure exists to support operations in the Arctic, many of which are being addressed under the Northern Basing Infrastructure projects.[35] Together, these efforts will ensure that Canada is better postured to support prolonged operations.

One key item that has not been addressed is the issue of energy security in the North. Most Arctic hamlets must sail or fly in their fuel supplies. As the permafrost continues to melt, runways are becoming more unstable and may not be as capable of supporting the aerial delivery of the needed fuel to run equipment in the North on which the CAF relies. Furthermore, with the North-West Passage (NWP) becoming more difficult to transit as it gets clogged with melting sea ice because of the Beaufort Gyre, the replenishment of communities by cargo ships and/or barges is becoming more challenging (Doermann 2024). The bottom line is that the CAF cannot deplete local sources.

Given the operational need to operate the new fleet of MRTT aircraft from the North, there is also a vast increase in fuel storage capacity required. The proposed fuel depot at Nanisivik is still not operational, nor is it optimally located. Taken collectively, it is vital that alternative energy sources be considered for the CAF, as well as the communities with which they are co-located. One potential for reducing the reliance on legacy generators that rely on aviation fuels to operate is the development of small-modular nuclear reactors, which also has the associated benefit of being a greener form of energy than traditional fossil fuels.[36] A change of this magnitude will require significant engagement with the local community leaders, as natural fears still surround the use of nuclear energy. Nonetheless, it would be beneficial to securing energy independence in the North.

Another key consideration in redeveloping the FOL sites to **sustain** the increased presence of the CAF in the North is the expectations of the local communities. Currently, horizontal and vertical infrastructure[37] in the Canadian Arctic is already failing, or woefully inadequate. Communities lack access to clean drinking water and reliable sanitation. Health care access is limited at best, and food prices are exorbitant. Any demand on the local infrastructure by the CAF only risks further degrading the quality of life of northerners. While the CAF is certainly capable of organically bringing the necessary resources for independent operations, it would demonstrate a lack of appreciation to the plight of Canada's northern communities with significant political implications and would strain Canada's limited air-lift resources during periods of prolonged operations.

[35] For example, the NORAD Northern Basing Initiative will see runways lengthened to support flight operations by both the F-35 and CC330 MRTT aircraft. Hangars are also being built or revitalized to support these new aircraft fleets. There are more than 50 subprojects for the FOLs.
[36] For further information on this subject, see: https://smractionplan.ca/
[37] Horizontal infrastructure are those items that provide services throughout a town, such as water distribution and sewer systems. Vertical infrastructure are the buildings themselves.

It would be ideal if the infrastructure needed for the CAF could be used by the local communities. However, this is problematic with significant security regulations surrounding the basing of fifth-generation aircraft. At a minimum, regular and transparent engagements with the local communities is vital to manage expectations regarding multipurpose infrastructure as well as to identify areas where DND and the CAF can be positioned to help support the needs of the local community. NORAD modernization, as well as the Northern Operational Support Hub (NOSH) projects offer a unique opportunity to help foster a positive relationship between the CAF and the local communities.

Conclusion

Canada is no longer a sanctuary by virtue of its fortuitous geography and benevolent neighbour. In June 2024, former Canadian Chief of the Defence Staff (CDS) General Wayne Eyre stated that Canada must "confront the reality that the threats posed by a challenging and complex global environment have arrived on its doorstep" (Boynton 2024). This is the by-product of the current era of great power competition between the United States, Russia, and China, as well as emerging military aspirations of lesser powers such as Iran and North Korea. As such, Canada cannot afford to continue being an *easy rider* in matters of defence. Fortunately, recent surveys have indicated that most Canadians feel that their country is falling behind militarily, which presents a unique window of opportunity that has seldom existed in Canada (Stevenson 2025). The government has chosen to capitalize on this fertile ground by agreeing to significantly increase Canadian defence spending (Brewster 2025; Brewster & Zemonjic 2025).[38]

While Canada does not need to be the military equal of the United States, it cannot be the weak link in the chain of continental defence. The range of threats facing North America are continuing to grow in their diversity and complexity. Canadian NORAD modernization efforts will be vital to support NORAD's goal to defend the homelands generating a credible deterrence by denial posture. NORAD modernization must enable the CAF to take the lead for the operations within the CANR region.

The Canadian government must also remain cognizant of the growing unilateralism in the United States. Consequently, it is vital that Canada remains on its current path of military rejuvenation, lest it risk the United States re-nationalizing homeland defence. Furthermore, Canada will also need to adopt a process of continual renewal to help ensure that NORAD does not lose its technological advantages over its adversaries again. Much more will be needed in the future than just the current Canadian NORAD modernization plan as noted above.

NORAD is in a race against time to maintain its credibility and relevance. Today's situation brings to light the words of United States General Douglas MacArthur: "the history of failure in war can be summed up in two words: too late. Too late in

[38] The Canadian government announced on 9 June 2025 that it will reach the NATO minimum of 2% GDP spending no later than 31 Mar 2026. This was subsequently increased to meet the new 5% NATO GDP target by 2035.

comprehending the deadly purpose of a potential enemy. Too late in realizing the mortal danger. Too late in preparedness. Too late in uniting all forces for resistance." The shared histories of Canada and the United States have been founded in trust and mutual respect. Canada successfully delivering on its NORAD modernization plan will be vital to maintaining that trust. North America needs a strong, bi-national organization helping to defend the air and space above the continent now more than ever.

Recommendations for Canada:

1. Commit to fully delivering on all NORAD modernization projects within the current advertised timelines; advance them where feasible.

2. Continue and expand the education of the Canadian public on the threats facing North America in the goal of reducing risks in the personal, private, and public sectors.

3. For future procurement projects, ensure that linkages to NORAD are clearly articulated.

4. Establish a process to facilitate continual improvements for NORAD beyond just those projects captured under the current NORAD modernization project.

5. Acquire a sensor capability with coverage over all of Canada that will provide high-fidelity target-tracking information to facilitate intercept and engagement of all inbound threat systems.

6. Better integrate the NORAD maritime warning mission into all branches of the CAF.

7. Examine, with detail, the existing maritime domain control structures and processes with the objective of greater integration of NORAD into this mission suite given its warning mission.

8. Examine what ABO requirements are needed in Kalaallit Nunaat (Greenland) to facilitate increased deterrence of the 12 o'clock position.

9. Study the feasibility of adding additional FOLs in Canada's high arctic especially toward the twelve o'clock position.

10. Continue with the purchase of the full complement of 88 F-35 aircraft.

11. Acquire a CCA compatible with the F-35 to increase NORAD defensive capabilities.

12. Explore the viability of joining the Golden Dome initiative.

13. Work with Indigenous rights holders to explore the feasibility of using small-module nuclear reactors in the Arctic to increase energy independence.

14. Work with the Indigenous rights holders in the North to lay out the framework for access to multi-purpose infrastructure.

List of Abbreviations

AAR	Air-to-Air Refuelling
ABO	Access, Basing, and Overflight
AESA	Active Electronically Scanned Array
AI	Artificial Intelligence
AirNAS	Air Navigation Aid Systems
ALCM	Air Launched Cruise Missile
AMTI	Airborne Moving Target Indication
AWACS	Airborne Warning and Control System
BMD	Ballistic Missile Defence
C2	Command and Control
C4ISR	Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance
CADIZ	Canadian Air Identification Zone
CAF	Canadian Armed Forces
CANUS	Canada-United States
CANR	Canadian NORAD Region
CBC2	Cloud-Based Command and Control
CCA	Collaborative Combat Aircraft
CDS	Chief of the Defence Staff
CMMA	Canadian Multi-Mission Aircraft
DCI	Defence of Critical Infrastructure
DESSP	Defence Enhanced Surveillance from Space
DEW	Distant Early Warning
DND	Department of National Defence
DRDC	Defence Research and Development Canada
FAA	Federal Aviation Administration
FCC	Future Combined Air Operations Centre

FOL	Forward Operating Location
GDP	Gross Domestic Product
GPS	Global Positioning System
HQ	Headquarters
IAMD	Integrated Air and Missile Defence
ICBM	Inter-Continental Ballistic Missile
LRA	Long-Range Aviation
MAD	Mutually Assured Destruction
MC2IS	Modernized Command and Control Information Systems
MND	Minister of National Defence
MRTT	Multi-Role Tanker Transport
NWS	North Warning System
NATO	North Atlantic Treaty Organization
NAVCAN	Navigation Canada
NCA	National Command Authority
NNBI	NORAD Northern Basing Initiative
NORAD	North American Aerospace Defence Command
NOSH	Northern Operational Support Hub
NWP	Northwest Passage
ONSAF	Our North, Strong and Free
OTHR	Over-the-Horizon Radar
PNT	Position, Navigation, and Timing
R&D	Research and Development
RADARSAT	Radar Satellite
RAP	Recognized Air Picture
RCAF	Royal Canadian Air Force
SLBM	Submarine Launched Ballistic Missile
SLCM	Submarine Launched Cruise Missile

SoD	Secretary of Defense
SSE	Strong, Secured, Engaged
START	Strategic Arms Reduction Treaty
USAF	United States Air Force

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