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FROM NORAD TO NOR[A]D: THE FUTURE EVOLUTION OF NORTH AMERICAN DEFENCE CO-OPERATION

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Executive Summary

The North American defence environment is in the process of a major transformation, occasioned by dramatic changes in the geostrategic/political landscape and the development of new generations of weapon systems. As a result, the requirements to deter, detect and defend North America from a variety of new threats are transforming. In this context, Canada and the United States, through the Permanent Joint Board of Defense (PJBD) established the Evolution of North American Defense (EvoNAD) study, and tasked its execution to the North American Aerospace Defense (NORAD) command. EvoNAD considers a long time horizon and has been broken into subcomponents reflecting six domain priorities: air, maritime, cyber, aerospace, space and land.

The overarching factor which binds the six components together is the recognition that the single-domain threat environment is evolving into a multi-domain one. In the past, the threat to North America resided largely on a single axis (north-south), within a dominant domain (air, combined with ballistic missiles), met by a bi-national structure. While this threat seemed to collapse with the end of the Cold War, NORAD continued and evolved to adapt to new threats as well as to continue to monitor the Cold War-styled air and aerospace threats. Subsequently, 9/11 created a new threat environment and forced NORAD to consider threats emanating from within North America as well as outside of it. In addition to a number of changes, including direct feeds from the Federal Aviation Administration (FAA) and NAVCANADA, NORAD expanded into the maritime domain via a maritime warning mission. Roughly at the same time, NORAD's attention also turned to the cyber-domain and its common threat to North America.

The air threat has now returned with the resumption of long-range Russian flights across the Arctic, and down the Atlantic and Pacific coasts. This threat, however, is of a different character because of the development of a new generation of Russian long-range air-launched cruise missiles, as well as sea-launched cruise missiles, which have direct implications for NORAD's capacity to deter, detect and defend, as well as for its current area of operations and mission suites (air/aerospace warning and control and maritime warning). Not only will these new long-range capabilities diffuse to other potential adversaries, generating a global threat environment, but also the first generation of hypersonic weapons has set the conditions for the merger of air and missile defence, and the air and outer space domains. Finally, the consequences of an attack against North America, alongside potential catastrophic natural disasters relative to the role of military forces in support of civil authorities, raises issues for both Canada and the U.S., and thus NORAD, regarding the most efficient and effective means to respond.

The multi-domain/multi-dimensional North American threat environment should drive both Canada and the U.S. towards deeper defence co-operation, and the functional demands of this new threat environment could lead to NORAD's ultimate transformation into an integrated, multi-domain and dimensional North American Defense Command solution. Of course, this

outcome is not inevitable, and numerous barriers exist. Nonetheless, the same logic which led to NORAD's creation in 1957 (with the agreement signed in 1958), remains valid. Driven by the common recognition that the defence of North America is indivisible, a North American Defense Command would be a natural evolution in Canada – American defence relations.

The bi-national North American Aerospace Defense (NORAD) command emerged following more than a decade of bilateral air defence co-operation, within the context of the Permanent Joint Board of Defense (PJBD) and Military Cooperation Committee (MCC), established at the onset of the Second World War. It was the logical functional outcome, or next step, in the defence relationship between Canada and the United States, driven primarily by their air forces. NORAD was presented as a fait accompli to the governments of the day. Both the U.S. and Canada were focused on the Cold War and implications for Europe in particular. NORAD was the desperately needed solution for North America's defence.

The NORAD solution was the product of several key factors: geography, which made the defence of North America indivisible; the Second World War experience of the common threats posed by Japan and Nazi Germany, followed by the Soviet threat of the Cold War; shared democratic values; a common language; growing economic integration; and the high costs associated with developing an air defence infrastructure, especially in Northern Canada. NORAD also benefited from a defence environment and structure of a single air domain that was the sole responsibility of the Royal Canadian Air Force (RCAF) and United States Air Force (USAF) to defend. This, in turn, meant they shared a set of common values related to the (then) brotherhood of the air force.

These factors, even following the end of the Cold War and collapse of the Soviet threat, ensured that NORAD would continue and evolve in response to 9/11. Today, (as will be the case in the future), new threats have emerged, with one distinct difference: the single-domain threat of the Cold War is being replaced by multi-domain threats. As Canada and the U.S. respond to this new threat environment, the same functional logic that led to NORAD is likely to create the conditions for NORAD to expand its mission suite into other domains, likely resulting in a multi-domain/multi-mission, bi-national (and perhaps tri-national with the addition of Mexico), North American Defense Command. The window into this future is evident in the ongoing Evolution of North America Defence (EvoNAD) study, which the PJBD tasked to NORAD.

EvoNAD

The origins of the ongoing classified EvoNAD can be traced back to the initial years following 9/11. In its immediate wake, then-U.S. Secretary of Defense Donald Rumsfeld apparently tasked NORAD to examine issues concerning the expansion of its missions, which could transform it into a multi-dimensional North American Defense Command (NOR[A]D). In response, former minister of National Defence Art Eggleton informed Rumsfeld that such a transformation was premature.[1] Subsequently, in 2002, the U.S. established U.S. Northern Command

[1] Philippe Lagassé, "A Common 'Bilateral' Vision of North American Defence Cooperation 2001-2012," *Game Changer: The Impact of 9/11 on North American Security*, Jonathon Paquin and Patrick James (eds.), (Vancouver: UBC Press, 2014): 193-212.

(USNORTHCOM),[2] with an area of responsibility that extended beyond NORAD's as a function of USNORTHCOM's maritime control mission. This decision, in turn, led to high-level meetings between senior Canadian and American officials to discuss the future of North American defence co-operation across multiple domains and all mission suites (except for ballistic missile defence), given that NORAD's commander was now also USNORTHCOM's commander.

In order to examine the future of continental defence co-operation, Canada and the U.S. agreed to establish initially a bi-national planning cell in NORAD, succeeded by the Binational Planning Group (BPG). The BPG issued an interim report in 2004, a final report in 2006 and then it was disbanded.[3] The reports focused on the future of North American defence co-operation and were driven (although not exclusively) by the terrorist threat. Two key concepts emerged from the documents: seams and gaps. The former was geographically based, looking at the possibility that terrorists could exploit the seams of the Canadian-U.S. border, as well as the seam between North America and the area of responsibilities of other Canadian defence commands (or ".coms"). These included USNORTHCOM relative to the maritime approaches, U.S. European Command (USEUCOM) and U.S. Pacific Command (USPACOM). Gaps largely focused on North American defence co-operation capability issues. Perhaps, most importantly, the BPG was not strictly an Air Force study;it brought land, maritime and civil security actors into the study process, and eventually into NORAD via increased information sharing.

Although the majority of the BPG's findings were shelved, the final report did set the stage for NORAD's acquisition of a new mission, in a new domain – maritime warning (MW) – formally codified in the 2006 NORAD renewal.[4] While NORAD's new MW mission faced its growing pains, NORAD became more than simply an aerospace defence command.[5] Not only did NORAD's command structure change with the assignment of Canadian and American naval (and U.S. Coast Guard) personnel to the command, but it also became directly engaged with Canadian and American civil security agencies involved in maritime domain awareness (MDA), MW, and responses to maritime events including the national coast guards, transportation departments, police and other agencies.[6] Indicative of this change from being mainly an air force organization, Adm. Timothy Keating, a naval officer, took command of NORAD between 2004-2007 followed by USAF Gen. Victor Renuart (2007-2010), Adm. James Winnefeld (2010-2011) , U.S. Army Gen. Charles Jacoby (2011-2014) and Adm. William Gortney (2014-2016).

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[2] In 2002, USNORTHCOM was added to the existing geographic command structure within the Unified Command Plan. NORAD and USNORTHCOM were matched primarily on geographic grounds. Whether or not Canada's reticence to expand NORAD's mission suites was the major impetus for the creation of USNORTHCOM is an interesting question, but likely not the only driver.

[3] Binational Planning Group. "Executive Summary," *Interim Report on Canada and the United States (CANUS) Enhanced Military Cooperation,* Oct. 13, 2004; and Binational Planning Group, "Final Report on Canada-United States (CANUS) Enhanced Military Cooperation," March 13, 2006.

[4] Agreement between the government of the United States of America and the government of Canada on the North American Aerospace Defense Command, April 28, 2006. (Otherwise referred to as the "2006 NORAD Agreement"): para 2c. See http://www.state.gov/documents/organization/69727.pdf In Canada, the House of Commons passed the change to the original agreement (257 in favour and 30 opposed) on May 3, 2006.

[5] For details, see Andrea Charron and James Fergusson, *Left of Bang: North American Maritime Domain Awareness and NORAD's Maritime Warning Mission.* Report. (Winnipeg: Centre for Defence and Security Studies, 2015). Found at https://umanitoba.ca/centres/cdss/media/0_NORAD_Maritime_Warning_Mission_Final_Report_8_Oct_2015.pdf

[6] National Maritime Intelligence-Integration Office. See http://nmio.ise.gov/ in the U.S. and Canada's three Marine Security Operations Centres. See http://www.ccg-gcc.gc.ca/eng/CCG/Maritime-Security/MSOC

In 2011, five years following the acquisition of its new MW mission, Jacoby, who was commander of USNORTHCOM and NORAD, established an omnibus NORAD Next study process[7] which essentially built upon the BPG's findings. This time, however, the primary impetus for the study was the changing geopolitical environment and the emergence of new, threatening, military technologies which could exploit the seams and gaps that persisted. The immediate, but not exclusive, foci were Russian military modernization, and the emergence of new Russian military capabilities, which would be reinforced by the subsequent deterioration of political relations between Russia and the West. NORAD Next looked far beyond just Russia to include a wide range of future issues and technologies that could threaten North America, as well as organizational internal structures and processes. However, the study's expanse, coupled with serious resource and personnel constraints (especially on the Canadian side), meant that the study needed to be reimagined.

Jacoby's successors, Gortney and now Gen. Lori Robinson, have redirected and altered the scope of the study to consider multiple threat domains (including yet-to-be identified ones) and to consider not just NORAD's bi-national role to defeat those threats but the national and bilateral roles Canada and the U.S. will play. Indeed, given that the time horizon of projected threats extends into the future, this new project goes beyond a study of just NORAD and became EvoNAD, whose full parameters and scope were briefed to the Permanent Joint Board of Defense (PJBD) in 2016. In agreeing to the study and tasking NORAD with its execution, the PJBD found the initial scope of the study too large, and requested NORAD to break it apart and temporally prioritize its components. In 2017, NORAD reported back to the PJBD and broke apart the study into six domain components, to be studied and submitted in the following order: air, maritime, cyber, aerospace, outer space and land.[8]

At EvoNAD's core is the examination of immediate and future threats to North America and the utility of current defence structures and capabilities to meet them. Until now, threats and capabilities have largely been packaged into single domains, with North America defence command structures and processes (bi-national, bilateral and national ones) uniquely reflected in each domain. EvoNAD's central long-term assumption, however, is that future threats, with advanced technology, will be multi-domain, and that the current command structures and processes are not equipped to deter, detect and defend against a multi-domain environment.

This does not necessarily mean that the inevitable outcome is a multi-dimensional NOR[A]D, not least of all given political sensitivities, especially in Canada, that usually emerge whenever further bi-national defence integration is raised. Reticence (on both sides of the border) to expand the number of NORAD missions beyond MW following 9/11 is the exemplar. Changes to NORAD's missions/scope/focus face numerous other barriers, including organizational

[7] Donna Miles, "U.S., Canada Think Ahead to NORAD Next," U.S. Department of Defense, Jan. 7, 2013. Found at http://archive.defense.gov/news/newsarticle.aspx?id=118926

[8] We suspect the separation of air, aerospace and space is to expand the study in order to consider all possible threats, especially yet-to-be-identified threats given the pace of technology and artificial intelligence. NASA's dictionary of terms is quick to point out that "aerospace" is a USAF term. See https://er.jsc.nasa.gov/seh/a.html. Usually, one would refer to within the Earth's atmosphere and outside of the Earth's atmosphere as distinct categories. Air and aerospace are within the Earth's atmosphere and space is outside. Air and aerospace are separated as there are "air-breathing" threats that require the intake of air for combustion of fuel (e.g., a jet) within the atmosphere. Other threats, such as missiles, can go higher and don't need to use air for propulsion, but are still found within the Earth's atmosphere.

resistance, which is a natural reaction whenever big changes are proposed. Moreover, the structure and timeline of the EvoNAD study into separate, traditional domains is not necessarily conducive to a multi-dimensional analysis or a functional bi-national outcome. The order of the study's components and their delivery (i.e., air, maritime, cyber, aerospace, space and land last) are as much a function of immediate requirements relative to NORAD's existing missions as they are to future requirements and missions. Note, for example, EvoNAD assumes the existing U.S. geographic combatant command system will remain and for now, there is no appetite to discuss Mexico's inclusion (although there are Mexican liaisons in USNORTHCOM).

Nonetheless, the rapidly evolving geopolitical and strategic threat environment strongly indicates that future functional demands will likely drive both Canada and the United States toward a multi-dimensional, but still bi-national solution. This probable, but not inevitable, outcome reflects similar thinking and processes which led to the creation of NORAD as the most cost-effective and efficient solution to North American air defence in 1957. Therefore, and reflective of past logic, each study component must be understood as consequences of both immediate and long-term requirements.

Naturally, the specific content of each component is classified and so this analysis is somewhat limited. Nonetheless, sufficient information is available to provide an overview of each component's likely content. This information, in turn, suggests that NORAD will continue, as it has in the past, to evolve into new domains with corresponding missions on the path to the establishment of NOR[A]D.

Air

The prioritization of air as the first EvoNAD component logically follows from three considerations: 1) air early warning and control are, and will remain, NORAD's primary missions; 2) the North Warning System (NWS) will reach the end of its operational life in 2025, representing a capability gap; and 3) the new generation of long-range Russian air-launched cruise missiles (ALCMs) requires new air early warning and control/defence solution(s) (Figure 1).[9] Specifically, the NWS, and forward operating locations (FOLs) for fighter interceptors cannot meet the threat that Russian capabilities pose today, as well as other potential future adversaries which acquire such capabilities. There is a significant and immediate capability gap for NORAD's air missions.

[9] Current Russian long-range aviation (bombers) including the Bear, Blackjack and Backfire.

Figure 1: Russian ALCM Range to Ottawa (est.) and Payloads

Current North Warning System

KH-101, range 5,500 km, conventional

KH-102, range 9,600 km, nuclear

KH-55, range 3,000 km, nuclear

Kalibr (submarine-launched, land attack cruise), 1,500-2,000, conventional[10]

[10] *Game changer: Russian Sub-Launched Cruise Missiles Bring Strategic Effect*, Jane's, 2017. See http://www.janes.com/images/assets/147/70147/Game_changer_Russian_sub-launched_cruise_missiles_bring_strategic_effect_edit.pdf

The current NWS configuration of short- and long-range radars cannot reach out to identify and track Russian long-range bombers prior to them arriving at their ALCM launch points over the Arctic Ocean, or at farther distances which will be possible as technology evolves. Nor can the current NWS identify and track ALCMs in flight due to their low radar profile signature and ground-hugging flight paths. Fighter interceptors, launched from current Canadian FOLs, also lack the range to intercept long-range aviation prior to reaching their ALCM launch points, and cannot be vectored by the current system to ALCM targets, unless tracked by a limited number of U.S. airborne warning and control (AWACS) aircraft.[11] As a result, the status quo, in which the NWS is simply modernized as is and current FOLs remain in place, does not provide a solution to the air threat to North America.

There is no single solution to this current capability gap. Instead, there are multiple solutions andoptions potentially available which are also being identified and evaluated through a separate bi-national committee on the NWS. Among the possible options are: more powerful long-range radars, as well as surface wave radars; moving the line farther north to the tip of Canada's Arctic archipelago; acquiring and dedicating more AWACS aircraft to patrol the Arctic; expanding and employing space-based radar satellites, possibly in an enlarged and more capable RADARSAT constellation;[12] and/or employing a second radar line, either by modernizing the current NWS in place, or establishing a new line farther north across the continent and down both coasts.

Regardless of the solution(s), it appears that the new NWS will entail integrated land, air, sea and space systems into a single system-of-systems construct. Concerning the defence component of NORAD's mission, a separate bi-national committee, which notably includes representatives from USEUCOM, is examining options for establishing FOLs farther north. Among the options may be to use a FOL in Thule, Greenland – the location of a U.S. ballistic missile early warning (BMEWs) radar – and possibly Canadian Forces Station (CFS) Alert, on the eastern edge of Ellesmere Island. Both would increase interceptor coverage, possibly bringing into range Russian long-range aviation prior to reaching their ALCM launch points. Supported by AWACS, it will also be essential for the CF-18 replacement to possess a look-down-shoot-down ALCM capability. Furthermore, the possibility of ALCMs leaking through the first line of defence may necessitate a second line of air- or ground-based point defence to protect key infrastructure.[13]

[11] Although AWACs are U.S. assets, Canadian personnel are employed on them. One needs to ask, however, if Canada's decision to get out of the NATO AWACs program was a mistake from a training and equipment point of view.
[12] The current planned three-satellite constellation, capable of wide-area surveillance primarily for the identification and tracking of relatively large maritime objects in the Arctic, is insufficient in revisit times to provide 24-hour/seven-day-a-week coverage. It is also unlikely that it can identify and track aircraft and ALCMs in flight. In order to contribute to the NWS solution, the constellation will likely have to be expanded, with additional radar capabilities. (Recent news suggests, for example, that the University of Waterloo is working on quantum radar solutions). The costs may fall within the parameters of the 60 (US)/40(CDN) NWS NORAD funding formula, but there is no guarantee that this funding formula will persist and Canada may have to pay more.
[13] During NORAD's Vigilant Shield 17 in 2016, as part of the exercise, a U.S. National Guard air defence unit was deployed from South Carolina to North Bay. Currently, Canada does not possess any air defence capability, but the government identified this requirement in the recent defence

Overall, the likely system-of-systems essential to meet NORAD's mission to deter, detect and defeat threats to North America has significant cost implications for both Canada and the U.S., not least of all due to the high expense associated with building new infrastructure in the Arctic. In addition, if the NWS is retired, there will be significant environmental cleanup costs, which likely Canada would need to finance almost exclusively. Politically, however, there should be few roadblocks by either government to a replacement plan for the NWS, notwithstanding Canadian Arctic sensitivities. The long-established procedures that have governed NORAD's air early warning and control mission in the North are unlikely to change, even if both states agree to the creation of a new NORAD combined forces air component command (NORAD CFACC) structure, co-located with NORAD U.S. Continental Region (CONR) command in Florida.[14]

Maritime

The maritime defence and security community on both sides of the border met NORAD's acquisition of MW in 2006 with concern. Besides the obvious question of whether or not an aerospace-dominant command could adapt to the unique nature of the maritime domain, some, especially within the two respective navies, feared that it was the first step towards NORAD acquiring the maritime control/defence mission for North America.[15] While there is some independent logic to such an acquisition, the immediate issue is not maritime control per se, but the maritime domain threat environment.

As in the case of the air domain, NORAD confronts a long-range ALCM threat from the North Atlantic and North Pacific, as well as submarine-launched cruise missiles (SLCMs) (Figure 1). With the current NWS extending down the Labrador coast, the NWS solution(s) is likely to be applied here as well.[16] In addition, the NWS solution may also include an extension down the Canadian West Coast.[17] Farther south, the U.S. has been exploring the possibility of employing untethered high-altitude air ships for the early warning mission.[18] While moving current FOLs farther north may enable fighters to intercept bombers prior to reaching their launch points,

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white paper, albeit for the protection of land-based forces, suggesting a focus upon overseas employment. Government of Canada, *Strong, Secure, Engaged: Canada's Defence Policy*: 37. http://dgpaapp.forces.gc.ca/en/canada-defence-policy/docs/canada-defence-policy-report.pdf

[14] In moving operational command and control from NORAD headquarters in Colorado Springs to Florida, actual battle management may stay with the NORAD regional commands (Alaska, Canada and CONR) and/or these regional commands may serve as "rotating" CFACCs. This proposal, exercised in the two most recent Vigilant Shields, is now being briefed to senior decision-makers. For details, see Andrea Charron and James Fergusson, *The Elephant in the Room: Canada and NORAD Modernization*, *The Strategic Outlook for Canada* (Ottawa: Canadian Defence Associations Institutes, 2018): 31-38 See https://cdainstitute.ca/wp-content/uploads/2018/02/strategic-outlook-2018.pdf and Andrea Charron and James Fergusson, *NORAD Modernization and Evolution*, (Winnipeg: Centre for Defence and Security Studies. Forthcoming, 2018).

[15] For details, see Andrea Charron, James Fergusson, and Nicolas Allarie, *Left of Bang: NORAD Maritime Warning and North American Maritime Domain Awareness.* (Winnipeg: Centre for Defence and Security Studies, 2015). http://umanitoba.ca/centres/cdss/media/0_NORAD_Maritime_Warning_Mission_Final_Report_8_Oct_2015.pdf

[16] The U.S. also has radar stations in Iceland, which could be linked into NORAD. In addition, long-range radars in Norway and the United Kingdom could have functional value for NORAD's mission.

[17] Due to the current political/strategic threat environment, it appears that extending the NWS down the West Coast is a lower priority, and one can envision a phased approach in which the Arctic and Labrador are undertaken first.

[18] This capability could potentially be part of the system-of-systems for the Arctic approaches. According to one source, 11 such airships would provide full coastal coverage, including the U.S. southern border, with a range of 750 diametric miles. Global Security, *High Altitude Airships (HAA)*, 2017. https://www.globalsecurity.org/intell/systems/haa.htm
See also Lockheed Martin, *High Altitude Airships*, 2017. https://lockheedmartin.com/content/lockheed/us/products/lighter-than-air-vehicles/haa.html/

such is not the case for the maritime approaches, unless, in the case of the North Atlantic, NORAD assets were to deploy to Greenland or Iceland.[19] Of course, Greenland and Iceland lie within the purview of NATO, USEUCOM, and in the case of naval forces, USNORTHCOM. This raises the two complicated issues facing the defence of North America: command seams and a coordinated multi-domain response.

During the Cold War the maritime air threat to North America was marginal at best, emerging only with the first generation of cruise missiles of very short range. The threat was a naval one, and directly related to the requirement to defend the sea lines of communication (SLOCs) to NATO Europe against surface and sub-surface threats. The command solution was Supreme Allied Command Atlantic (SACLANT), which was replaced in the 1990s by Allied Transformation Command. At the recent NATO defence ministerial, a new North Atlantic command was announced. However, it was rationalized in Cold War terms to protect the SLOCs. This is not, however, the primary maritime threat to North America, not least of all because the idea of a replay of the Second World War is at odds with the reality of modern military capabilities, and future war as "come as you are".

As noted with the Arctic, the preferred solution is to eliminate the platforms (archers), rather than deal with the more difficult task of defeating the cruise missiles (arrows). In the North Atlantic maritime domain, the task of eliminating the platforms primarily resides with navies, either in an anti-air or anti-ship role. Also, naval anti-air assets can play a role in identifying, tracking and defeating cruise missiles as a nominal second line of air defence. Both of these missions, under the current structures, fall to USEUCOM and/or NATO. Yet, at the same time, it is vital for NORAD's missions to ensure that the air defence battle for North America is coordinated, and it is this requirement that leads to a potential NORAD solution. In other words, the North American maritime threat environment is actually an air domain issue, even in the context of naval launch platforms.

A NORAD solution will not likely entail the maritime anti-platform/archer mission, not least of all because it would occur farther north of the Greenland-Iceland-United Kingdom (GIUK) gap. This mission would remain USEUCOM/NATO. Instead, the NORAD solution concerns the second line of defence primarily against A/SLCMs, which could leak through the primary line. In this function, NORAD will depend on two existing relationships: NORAD-USNORTHCOM, and the Royal Canadian Navy (RCN) and U.S. Navy (USN).

The NORAD-USNORTHCOM relationship entails a dual-hatted commander and integrated command centre in Colorado Springs.[20] USNORTHCOM does not possess an air warning and control mission, which is NORAD's responsibility.[21] USNORTHCOM's maritime element is Fleet

[19] This option may explain the presence of USEUCOM on the bi-national FOL committee.
[20] Within the command centre, only the J-3 operations' position is separated into a NORAD J3 and USNORTHCOM J3 position mainly because of USNORTHCOM's different mission sets (especially the ballistic missile defence mission).
[21] There are circumstances when national U.S. air assets are employed by USNORTHCOM for unilateral U.S. missions, often because of USNORTHCOM's larger area of responsibility (AOR). USNORTHCOM's AOR includes air, land and sea approaches and encompasses the continental United States, Alaska, Canada, Mexico and the surrounding water out to approximately 500 nautical miles. It also includes the Gulf of Mexico, the Straits of Florida, and portions of the Caribbean region to include the Bahamas, Puerto Rico and the U.S. Virgin Islands. The

Forces Command/NAVNORTH, located in Norfolk, Virginia. This maritime mission is strictly national, as is the Canadian maritime mission. At the same time, there are long-standing links between the national commands, and the RCN and USN. These bilateral links provide the foundation for establishing a bi-national command structure that could integrate air and maritime assets in response to the new maritime threat environment within NORAD, which would acquire USNORTHCOM's maritime mission.

The process and this outcome, of course, would likely take place gradually. Currently, RCN-USN maritime co-operation largely occurs at the tactical level, witnessed by the ability of RCN vessels to integrate into USN task forces. However, co-operation and formal arrangements between them at the operational or theatre level are minimal to date. This new threat environment will likely drive operational co-operation forward on a bilateral basis. This is likely to entail the development of some kind of formal command structure or arrangements detailing the conditions under which RCN vessels could be assigned to USNORTHCOM's maritime command and vice versa. In turn, these would be developed through joint exercises; already maritime elements are engaged in NORAD's Vigilant Shield exercises.

In addition, the current NORAD battle management command structure, even if the NORAD CFACC is adopted (whether on a permanent or need-be basis), is readily transferable to the maritime domain. One can envision a combined-forces maritime command centre (CFMCC), likely located in Norfolk, with a U.S. commander and Canadian deputy, with Canadian and U.S. regional commands. The respective national command authorities (NCAs) would allocate national naval assets to NOR[A]D as required during a crisis.[22]

Of course, the devil is in the details, and numerous obstacles exist, including national sovereignty concerns and organizational barriers evident in the implementation of NORAD's MW mission. Nonetheless, as the two navies develop and implement bilateral arrangements in response to the new maritime threat environment and its link to the air threat environment, functional demands are likely to lead to a bi-national solution. In effect, the process which led to the creation of NORAD long ago is likely to be replicated for the defence of the maritime approaches to North America. Whether this will be the finding of the maritime component of EvoNAD is difficult to predict. Yet, the new threat environment, along with constrained resources, leads one to expect such a conclusion sometime in the future.

Cyber

NORAD has long considered the problem of cyber-defence for North America as it has always been responsible for the defence of its infrastructure. The integrated nature of the Canadian and

commander of USNORTHCOM is responsible for theatre security co-operation with Canada, Mexico and the Bahamas. See http://www.northcom.mil/About-USNORTHCOM/

[22] In the air domain, NCAs allocate fighter interceptors on a 24-hour/seven-day-a-week basis, not least because of the requirement to challenge Russian long-range aviation training flights approaching North American air space. In contrast, dedicated maritime assets would not be exclusively assigned to NOR[A]D, but would be available for other missions. In effect, the maritime component command would have virtual assets, which NOR[A]D could take over during a crisis.

American economies and critical infrastructure, in many ways it begs for a bi-national solution. At the same time, however, beyond the requirement to secure both countries' military systems from cyber-attack, including NORAD's, a bi-national solution confronts the reality that most of the economies and critical infrastructure lie in the private, rather than public, domains. In addition, on the military front, Canada lags somewhat behind the U.S. in the cyber-defence domain in resources, especially with the existence of U.S. Cyber Command. Moreover, there are certain areas in the cyber-domain that relate to national secrets which are not shared, despite the close level of intelligence co-operation between Canada and the U.S., as well as within the Five Eyes world.[23]

As a function of the unique nature of the cyber-domain and threat environment, both Public Safety Canada and the U.S. Department of Homeland Security should assume a bilateral solution evolving to a bi-national one. NORAD has a potential role to play, similar to its MW mission. In obtaining the MW mission for North America, NORAD brought a North American perspective to the maritime domain, in contrast to the national perspectives held by the security agencies tasked with this mission on both sides of the border. In addition, NORAD, in part because of the fears of its MW mission being just a steppingstone to the acquisition of North American maritime control, served as a catalyst for improved and enhanced bilateral co-operation. Finally, NORAD also provided a value-added contribution to MW and MDA as a function of its access to a maritime common operating picture (COP), forwarded from U.S. Fleet Forces Command (the naval arm of USNORTHCOM), but also because of its link to both USNORTHCOM intelligence and Canadian national intelligence capabilities. NORAD effectively evolved from an aerospace to a multi-domain organization, with access to maritime and other non-military security agencies with the addition of "only" maritime warning.

As such, NORAD's MW experience provides a model for its role in cyber-domain awareness (CDM) and cyber-warning (CW). It provides a foundation for integrating the private-public-military domains, a catalyst for enhanced Canada-U.S. co-operation, and a valuable North American perspective, rather than a national, bilateral one. Similar to the other environmental domains, the cyber-threat to North America cannot be managed effectively and efficiently nationally, and the need for enhanced bilateral co-operation itself begs an ultimate bi-national solution. NORAD is not necessarily the ultimate bi-national solution in the defence of and response to attacks on critical infrastructure. It is, however, a potential major contributor in terms of CDM and CW for North America.

Aerospace

Perhaps most surprising in the EvoNAD study is the presence of a separate aerospace component. Some time ago, the concept of aerospace was dropped from the air force lexicon.[24] Air and space became conceptualized as separate domains, reflecting their environmental

[23] Five Eyes intelligence co-operation includes Australia, Canada, New Zealand, the United Kingdom and the United States.
[24] Steve James, "Aerospace," in *Aerospace Power: Beyond 100 Years of Theory and Practice* (volume 1) James G. Fergusson (ed.), (Winnipeg: Silver Dart Series, Centre for Defence and Security Studies, 2011): 10-17.

uniqueness. Today, the concept of aerospace implicitly refers to a non-domain, or no man's land. It is the area where there is insufficient air for traditional jet engines to operate, but below orbital space.[25] This area also exists in an international legal vacuum between national airspace and international outer space because there is no agreed-upon definition of the dividing line between the two domains. Organizationally, it also represents a command seam between NORAD and its air control function and U.S. Strategic Command's (USSTRATCOM) space function. This area and seam are on the precipice of being populated by a new generation of delivery systems – hypersonic.

Hypersonic systems employ advanced scramjet engines, capable of using the limited amount of air at these high altitudes. They can exploit the absence of significant air friction to reach extremely high speeds between 6,125 (Mach 5) and 12,250 km/h (Mach 10).[26] Systems can be deployed from a ballistic missile or aircraft, employ a nuclear or conventional warhead, and are long range and maneuverable in flight. They are (reportedly) capable of defeating a ballistic missile defence interceptor, and are too fast for a traditional anti-air missile system. China, Russia and the U.S. have tested them, with an estimated operational deployment date between 2020 and 2025.[27]

In terms of early warning, these systems clearly fall under NORAD's mission, which includes both air systems and ballistic missiles. They represent, however, a challenge for the North American early warning networks, which include the NWS and the U.S. Ballistic Missile Early Warning System (BMEWS).[28] Certainly, in the case of NWS modernization, the solution for the air-breathing threat will have to take into account this new threat to North America. As for current BMEWS capabilities, they are likely able to track a system released from a ballistic missile, having been cued by the U.S. Defense Support Program (DSP).[29] In case of an air-launched hypersonic weapon, whether DSP can cue BMEWS is an open question. In addition, as BMEWS points outward from the continental radar coverage, gaps may exist, especially once the hypersonic weapon flies past the existing sites.[30]

In effect, the systems-of-systems solution for NWS should include the capability to prosecute the hypersonic early warning mission. This, in turn, suggests that NORAD is a logical choice to acquire the hypersonic defence mission. However, this same logic underpinned the case for NORAD's acquisition of the ballistic missile defence for North America, which never materialized, primarily because of the Canadian government's decision not to commit during the

[25] This area is also known as sub-orbital or near space. Orbital space is nominally set at 150 km. The traditional dividing line between space and air is nominally set at 100 km, known as the Karman line.
[26] Zach Berger, *Hypersonic Missiles,* Missile Defense Advocacy Alliance, March 2016. http://missiledefenseadvocacy.org/missile-threat-and-proliferation/future-ballistic-missile-technology/hypersonic-missiles/
[27] Richard H. Speier, George Nacouzi, Carrie Lee, and Richard M. Moore, *Hypersonic Missile Nonproliferation: Hindering the Spread of a New Class of Weapons,* (Washington, D.C: Rand National Defense Research Institute, 2017). See https://www.rand.org/pubs/research_reports/RR2137.html
[28] BMEWS' radars are located at Fylingdales (U.K.), Thule (Greenland), Clear (Alaska), Beale (California), Cavalier (North Dakota) and Cape Cod (Massachusetts).
[29] DSP consists of infrared satellites in geosynchronous and polar orbit, which identify ballistic missile launches, and inform or cue the ground-based BMEWS x-band radars where to look in the sky.
[30] The exception is Cavalier, which looks northward across the Canadian border. Originally, the radar was constructed as part of the U.S. ABM site, but was closed in 1976. During the subsequent Cold War era, its primary warning function was to track potential Soviet submarine-launched ballistic missiles from the Arctic. Its other function has been to contribute to the U.S./NORAD Space Track.

development phase. Today, hypersonic capabilities, and thus hypersonic defence are also in the development phase, which opens the door to a NORAD solution. It avoids the current unacceptable situation the U.S. and Canada face with regard to ballistic missile defence. USNORTHCOM is not legally bound to defend Canada and Canadian cities, but it faces a moral and political dilemma if it does not. Canada, in turn, relies upon this moral imperative to assume that the U.S. will protect Canadian cities because it is an ally, regardless of whether or not Canada has contributed to any of the missile defence architecture.

This does not necessarily mean that Canada will have to invest significantly in the hypersonic defence world. Rather, given the high costs associated with the modernization of North American defence, a division of investment/labour across the emerging multi-domain defence realm is a more likely and cost-effective solution. At the same time, as the early warning solution is likely to be a system-of-systems, the air defence, hypersonic and ballistic missile defence solution is also likely to be the same. Canada would have to reverse its position on ballistic missile defence participation because of the merger of the three domains into a single outcome. In other words, the hypersonic challenge is erasing the separation of air defence from ballistic missile defence, opening the door for a NORAD solution.

Of course, this is not the only solution, except when one considers that it was the driving logic behind the original, functional bi-national North American air defence outcome; there is no reason to conclude that it is not still the prevailing logic for other domains. Moreover, a bilateral, as opposed to bi-national, solution is problematic – case in point: ballistic missile defence. Bilateral co-operation in missile defence would require Canada to acquire significant missile defence capabilities, which would leave the U.S. with little choice but to co-operate out of its own self-defence interests. This, however, simply replicates the air defence environment of the past which concluded in a bi-national agreement. Certainly, a national solution is also possible, but then it leads to the same situation both parties face regarding ballistic missile defence.

Nothing is inevitable, despite logic. There are no shortages of obstacles that will have to be addressed, and key among them is the much more politically charged domain of outer space.

Space

Beyond the land domain, albeit for different reasons, space is arguably the most contentious of all the domains for a bi-national solution. Its contentious nature is connected to the issue of weaponization, even though there is no agreed-upon international or national consensus on what weaponization means or entails.[31] Nonetheless, an all-party non-weaponization consensus has long existed in Canada. Moreover, dating back to former president Ronald Reagan's

[31] Generally, weaponization refers to the deployment of kinetic kill capabilities in orbit, rather than terrestrial-based missiles with kinetic kill capabilities. In 2008, for example, a U.S. ballistic missile interceptor launched from an Aegis destroyer hit and eradicated an intelligence satellite that had failed to reach orbit and was returning to Earth. "Navy Missile Hits Dying Spy Satellite, Says Pentagon," CNN, Feb. 21, 2008. http://www.cnn.com/2008/TECH/space/02/20/satellite.shootdown/

Strategic Defense Initiative (SDI) in the 1980s, the debate on Canadian participation in U.S. ballistic missile defence programs has long been coloured by, or conflated with, the weaponization of space.[32] Reflecting this political reality, national defence officials have emphasized that Canadian military space activities are purely defensive in nature.[33]

Even so, both the American and Canadian military establishments recognize the economic and military significance of space. Militarily, space assets have emerged as a major force multiplier and space is now fully integrated into the CAF's and U.S. forces' domestic and expeditionary operations. These assets, in turn, are very vulnerable as a function of their predictable orbital paths and electronic emissions, and are threatened by developments in anti-satellite weapons, as evidenced by the successful 2007 Chinese anti-satellite test. Alongside these potential direct threats, natural and man-made orbital debris has also emerged as a threat to the use of space. [34]

With the integrated North American economy and both the American and Canadian militaries significantly dependent on access to space, the conditions on the surface are similar to those which led to a functional bi-national air defence solution in the 1950s. These, in turn, are reinforced by the blurring of the air and space domains with the aforementioned development of hypersonic weapons. However, there are several unique factors which pose significant obstacles to NORAD acquiring a space defence mission.

First, the threat is not conceptualized in direct terms to North America per se, as is the case in the air, maritime and aerospace domains. Rather, the threat is directed against satellites in orbit. In this sense, the space domain has more similarities with the cyber-domain, including the presence of significant commercial actors.[35] Second, as objects in orbit are constantly in motion, circling the Earth, and with the dramatic expansion of the number of states with space assets, the space domain may be more suited to a multilateral solution. Kinetic kill actions, regardless of the target, threaten other space assets as a function of debris left in orbit. Thus, all states engaged in space share a common interest in developing a multilateral regime to govern activities, similar to the shared interests that led to the creation of an international regime to govern the civil air domain.

Third, beyond the space component of its aerospace warning mission, NORAD has been somewhat marginalized in the space domain, especially in contrast to the 1980s when it was

[32] Ronald Reagan's 1980s Strategic Defense Initiative (SDI) contained architecture for space-based missile defence interceptors, known as Brilliant Pebbles, but it was only a paper architecture, for political reasons. SDI was a basic research program, which is commonly misunderstood. See James Fergusson, *Canada and Ballistic Missile Defence, 1954-2009: Déjà Vu All Over Again*, (Vancouver: University of British Columbia Press, 2010). The problematic link of the current U.S. ballistic missile defence program and weaponization is most clearly found in Mel Hurtig, *Rushing to Armageddon: The Shocking Truth about Canada, Missile Defence, and Star Wars*, (Toronto: McClelland & Stewart, 2004).

[33] This is clearly reflected in the outdated 1998 National Defence Space Policy. *Department of National Defence Space Policy*, (Ottawa: DND, 1998). Despite efforts to update the policy, and implement a formal space strategy for national defence over the past 20-odd years, internal drafts of both have not been formally adopted or made public. This is also reflected in the absence of a national space policy/strategy, notwithstanding volume 2 of the 2012 Aerospace Report, under David Emerson's direction. See "Reaching Higher: Canada's Interests and Future in Space," *Aerospace Review*, volume 2, (Ottawa: Public Works and Government Services Canada, 2012).
http://aerospacereview.ca/eic/site/060.nsf/vwapj/Space-e-online.pdf/$file/Space-e-online.pdf

[34] Leonard David, "China's Anti-Satellite Test: Worrisome Debris Cloud Circles Earth," *Space.com*, Feb. 2, 2007.
https://www.space.com/3415-china-anti-satellite-test-worrisome-debris-cloud-circles-earth.html

[35] As part of the ballistic missile component of its aerospace warning mission, NORAD also tracks objects on orbit, including debris, and provides warning of possible threats of collision and de-orbiting objects.

married to U.S. Space Command with a dual-hatted commander. Instead, Canada-U.S. military space co-operation is bilateral between USSTRATCOM and the DND Director-General Space/Canada Space Operations Centre (CANSpOC). Canadian personnel are assigned to USSTRATCOM's Joint Space Operations Center (JSpOC) at Vandenberg, and Canada directly contributes to the U.S. Space Surveillance Network (SSN) via its Sapphire low Earth orbit optical satellite tracking objects in the geostationary belt. In addition, while Sapphire is a military satellite which also has civilian functions, it is flown by civilian contractors, rather than military personnel, whereas key U.S. military satellites are flown by the U.S. military.[36]

Fourth, Canada-U.S. military space co-operation has also become multilateral in nature, centered upon the Five Eyes community of nations. In 2014, for example, the U.S., Canada, the U.K., Australia and now New Zealand signed onto combined space operations (CSpO) to find areas where there can achieve multilateral efforts in space operations. Today, this has grown into a Combined Space Operations Center (CSpOC) to replace the name of JSpOC, and the CSpO partners regularly participate in space wargames. More initiatives are also likely on the horizon, moving the multilateral ball forward in combined space operations.[37]

Fifth, USSTRATCOM represents another obstacle to a bi-national solution. It has traditionally been the most restrictive national command within the U.S. armed forces, not least of all due to its nuclear weapons deterrent mission. USSTRATCOM also possesses the overarching U.S. ballistic missile defence and global strike missions. Its mission suite is both defensive and offensive in nature. Neither USSTRATCOM, nor Canada for that matter, are likely to support movement towards a bi-national solution for the defence of North American interests in space, unless a major restructuring of USSTRATCOM's mission suite occurs in a future UCP.

Finally, with future Canadian military space investments unclear, there seems little need to go beyond existing bilateral arrangements. In *Strong, Secure, Engaged*, space receives only a very general treatment, identifying the need to "modernize its space capabilities and [will] (sic) take steps to protect these critical assets against sophisticated threats, while continuing to promote the peaceful use of outer space."[38] More specifically, the new defence policy emphasizes situational awareness and targeting focusing upon the replacement of RADARSAT, the surveillance of space and communications.[39] A more detailed Canada/DND space policy still awaits a formal update, alongside the need for a clear space strategy.

Despite these obstacles, a long-term future bi-national solution cannot be rejected out of hand. It is difficult to predict how the space domain will fully unfold, especially once new technology emerges that enables the easy transition from air to space, and maneuverability within space. In

[36] This is also the case for RADARSAT-2, and likely for the future RADARSAT constellation.
[37] The Five Eyes community consists of Australia, Canada, New Zealand, the United Kingdom and the United States, and emerged in the realm of intelligence. In 2014, a MOU on co-operation was signed. https://www.defense.gov/News/Article/Article/603303/stratcom-dod-sign-space-operations-agreement-with-allies/
[38] Government of Canada, *Strong, Secure, Engaged: Canada's Defence Policy*, 2017: 9. http://dgpaapp.forces.gc.ca/en/canada-defence-policy/docs/summary.pdf
DND space policy has not been updated since 1999 and there is no formal public DND space strategy.
[39] This is the second of the new initiatives for the RCAF, following the replacement of the CF-18s. The communication component is primarily directed towards the high Arctic. Ibid., 16.

addition, much will depend upon the future of Canadian space capability investments. Here, a future expanded RADARSAT constellation providing global coverage, and surveillance of space capabilities, is the foundation for a bi-national, rather than bilateral solution to the space domain for the defence of North America and its space assets. While current RADARSAT constellation plans are focused on providing wide-area surveillance of the Arctic, it may also be part of the NWS solution. Moreover, global coverage would provide a significant contribution to Canadian and U.S. expeditionary operations. Similarly, additional Sapphire satellites in different orbital inclinations could provide a cost-effective solution to the surveillance of all orbits, including the capacity to track long-range ballistic missile warheads in flight, and possibly hypersonic weapons in sub-orbital space.[40]

In effect, key Canadian space investments of significant value to U.S. and North American defence interests replicate the value of Canadian capabilities, including its territory, which led to air defence co-operation and NORAD in the 1950s. Directly related, the U.S. rejection of a bi-national solution for North American ballistic missile defence in the 2003-2004 negotiations can be significantly attributed to the absence of any Canadian investments in missile defence. Finally, the USSTRATCOM problem has been managed in the past. NORAD has long provided warning of a ballistic missile attack to provide time for a U.S.-only nuclear retaliation decision as part of its deterrence mission. In keeping the U.S. nuclear deterrent at arms-length distance, so it may be possible to keep future U.S. offensive space systems at a similar distance, and focus on non-kinetic space defence capabilities. Of course, the outcome may simply reinforce NORAD's long-standing aerospace warning mission. But, the future merger of air and space portended by hypersonic weapons may also serve the foundation for a true space defence mission.

Land

It is not surprising that the land domain is the final component of the EvoNAD study process. Any suggestions of an integrated bi-national approach to Canada-U.S. defence co-operation are always met with emotional fears of a threat to national sovereignty, especially from Canada. In addition, there is no realistic land threat to North America. The land domain is exclusively concerned with support to civil authorities, largely in response to natural disasters. In the Canadian case, this falls under aid to the civil power and domestic operations, and in the case of the U.S., defense support to civil authorities (DSCA). The military forces of both countries in these cases act in the capacity of second responders. Finally, there are well-established bilateral protocols and arrangements which enable each party to provide support to the other as necessary, and this, in turn, also extends into the civil domain.

The central question here is not that the current processes are dysfunctional. Rather, it is whether the current arrangements are sufficient to meet a catastrophic natural disaster. A potential example is the possibility of a major earthquake off, or on, North America's West

[40] By its orbital orientation, Sapphire can only track objects in the higher orbits. However, its optical technology in tracking objects moving at high speeds holds the potential for applying this technology to missile tracking. The barrier, for now, is Canada's decision in 2005 not to participate in the U.S. ballistic missile defence program.

Coast, which scientists predict is long overdue. Such an earthquake could ravage, for example, Victoria, Vancouver and Seattle. The requirement to move large national resources rapidly, especially military forces, into the disaster zone is likely to overtask both nations. Beyond a natural disaster of this magnitude, concern should also be given to the low probability, but high consequences, of the impact of a nuclear detonation in one or both countries.

The case for a bi-national solution in the realm of support to civil authorities in response to natural or human-made disasters is a function of several considerations. First, in one sense, the foundation is already in place. An integrated NORAD-USNORTHCOM command centre (N2/C2) exists.[41] Canadian and American personnel are already engaged to some degree in support of these missions. Indeed, the overwhelming activities of USNORTHCOM, especially over the past year, have been in response to the series of hurricanes across the southern U.S., and Caribbean which engaged in some measure Canadian NORAD personnel, and saw Canadian military assets deployed in support. In addition, NORAD and U.S. resources played a significant security role in the background for the Vancouver Olympics and international summits like the upcoming G7 summit.

Second, NORAD's C^2 structure provides a ready solution to national sovereignty concerns. The specific execution of a domestic operation, as in the case of NORAD's air control/defence mission for Canada assigned to CANR, would fall to a nationally based regional command. Third, the overarching command's functions, as in the current NORAD case, would be based upon assets dedicated to NORAD by the respective national command authorities. This would enable the efficient employment of dedicated national military resources by a centralized command.

Finally, both states possess a finite number of military resources, which are taxed by significant overseas commitments and deployments, and with national forces distributed across the continent's wide expanse. A NORAD command structure could ensure a more effective, efficient and rapid response to major disasters. For example, being able to call upon U.S. or Canadian forces deployed in the west to meet an earthquake would be much more efficient than having to transport significant numbers of Canadian forces from east to west.

Regardless, the national sovereignty barrier will remain, especially in Canada's case. In this regard, it is interesting to note that while Canadians' support to U.S. natural disaster relief is well publicized, the U.S. contribution to Canadian disaster relief is not. Few Canadians know, for example, that the U.S. provided key airlift for the movement of generators from east to west during the 1997 ice storm. Few Canadians know that in the same year, the U.S. offered to provide Minnesota National Guard personnel to support the Manitoba flood fighting effort. Few know that Canada turned down the offer, and instead moved Canadian forces from far away, at significant cost. For the people directly affected by the flood, or any major disaster, getting help and relief quickly is much more important than who provides it.

[41] The only exception is the J-3 operations position, which is separate primarily due to USNORTHCOM's ballistic missile defence mission, in which Canada does not participate. As discussed above, this is likely to change for a variety of reasons, thereby resulting in a fully functionally integrated structure.

Moving beyond national sovereignty barriers, any proposal to establish a bi-national land domain command structure will also meet significant organizational barriers similar to those NORAD confronted when implementing its maritime warning mission. Indeed, one might predict that, rather than the military (which is in a support role to federal and other agencies during natural and other disasters) it will be civilian agencies, such as FEMA in the U.S. and Public Safety in Canada, that could create a bi-national arrangement for conducting disaster relief, given the growing scale of these disasters

Overall, a NORAD solution represents a simple functional step forward grounded upon current bilateral arrangements. For some, this may appear unnecessary, because existing arrangements already work well. The lessons of hurricane Katrina in New Orleans, and Maria in Puerto Rico, should give pause to simply accepting the status quo as sufficient for future contingencies. Too often, governments and national agencies believe that existing plans and arrangements are adequate only to discover they are under-prepared and resourced to respond effectively.

Conclusion

As the EvoNAD study and its various components reside in the classified world, this analysis can only speculate on its full contents. Nonetheless, its structure, and the immediate priority to modernize the NWS, along with emerging new weapons technologies and their likely diffusion, clearly indicate that the requirements to deter, detect and defend North America are much more complicated than the single domain of the Cold War. In response to this new defence environment, Canada and the U.S. are likely to be driven down the same functional, cost-effective and efficient path that led to NORAD's creation. As such, the likely outcome will entail a significant expansion of NORAD's mission suite, resulting in NORAD's transformation into a multi-domain, multi-dimensional bi-national North American defence command.

Of course, this will not be a simple linear path. Numerous obstacles exist, which are likely to produce a process of stops and starts, perhaps even sideways movements, in the relationship. While no one can predict the future, and especially "the unknown unknowns" that can derail the best-laid plans, certain obstacles can be readily identified. National caveats and concerns will be raised, even though the NORAD bi-national solution has ensured respect for the specific national interests on both sides of the border. Canada is likely to prefer that the essence of North American defence co-operation remains defensive in scope. Conversely, the U.S., as a global great power, can only be so sensitive to Canadian caveats when faced with new threats and potential great power rivals, which may demand changes to U.S. command structures and the overall unified command plan.

Organizational barriers will not go away, despite military jointness, as clearly witnessed in the development of NORAD's maritime warning mission after 2006. This includes not only military service barriers, but also civilian security agency barriers as well. This will especially be the case in the cyber and land domains. Finally, the future will also be influenced by individual personalities involved at both the political and military level. NORAD's success has been driven

in large part by individuals, and the close personal links between Canadians and Americans at all rank levels; there is no guarantee, however, that these links are always beneficial or that they cannot be derailed.

In the end, however, functional defence logic will drive Canada-U.S. North American defence co-operation down the bi-national path. The indivisibility of Canadian and U.S. defence in North America, the efficiency of an overarching bi-national command structure and the cost-effectiveness of shared defence investments, will drive both states to the ultimate bi-national solution.

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