

CDA INSTITUTE

NORAD MODERNIZATION FORUM

AUGUST 26TH, 2020



SECOND REPORT DEFEAT CAPABILITIES

Introduction

NDIA/CDAI hosted the second of three webinars on 26 August 2020, intended to examine key capability requirements for the modernization of continental defence under auspice of North American Aerospace Defense Command (NORAD). The goal was to allow experts from industry, academia, and government to break down silos and engage in direct conversations about North American continental defence challenges and what form NORAD modernization might take to address them. The forum was created to imagine the art of the possible. More specifically, the goal of these three events were to identify security gaps and brainstorm actionable solutions to the issues identified during the discussions.

- **12 August 2020: Domain Awareness/Sensors**
- **26 August 2020: Defeat Capabilities**
- **9 September 2020: JADC2/JADO**

This second webinar focused on defeat mechanisms and brought together experts from government, academia and industry to discuss the rationale and requirements for kinetic and non-kinetic defence capabilities.

Military representatives presented a white paper template to industry representatives to structure the submission of short-, medium-, and long-term defeat mechanisms directly to NORAD J8 planners for further consideration, potential future confidential technical discussions, and possible operational endorsement. Given the urgency for enhanced sensing, short-term solutions were a major theme throughout the discussion.

NORAD Deputy **Commander L. Gen Pelletier** and **Brig. Gen Pete Fesler** provided introductory remarks. A white paper overview was provided by **Dr. Thomas Walker** of Lockheed Martin. Co-director of the Network for Strategic Analysis and Professor of Political Science at Université du Québec à Montréal, **Dr. Justin Massie** served as a guest speaker. Maj Gen (USAF Ret) and VP Defence Support & Cyber Strategies for Stellar Solutions Inc., **Harold “Punch” Moulton** moderated a panel discussion that included:

- **Richard Foster**, MGen (RCAF Ret), Vice President, L3Harris technologies
- **David Scott**, Maj Gen (USAF Ret), Business Development Executive, Raytheon
- **Carol Zanmiller**, CEO, Cosmic AES
- **Jerome Dunn**, Chief Architect, NG Counter Hypersonics Campaign Launch & Missile Defense Systems, Northrop Grunmman

This report was produced by the CDA Institute in collaboration with rapporteurs affiliated to the [North American and Arctic Defence and Security Network \(NAADSN\)](#), a Department of National Defence MINDS Collaborative Network.

Executive Summary

North American defence is evolving to meet the challenges posed by hypersonic glide vehicles, new generation cruise missiles, and unmanned aerial systems. These threats require defeat capabilities that go beyond intercepting incoming missiles (“arrows”) to striking the launch platforms themselves (“archers”). Defeat mechanisms are part of the tripartite system concept integrating all domain awareness and joint all domain awareness and command and control (JADC2) in a layered multi-domain architecture that can track threats from “cradle to grave” in a continuous “kill chain.”

The evolution of NORAD within this defence architecture involves expanding its deterrence by denial capability, possibly into an offensive role. Canadian domestic politics traditionally opposed participation in defeat capabilities deployed by the United States, such as ballistic missile defence (BMD). Canada must decide where to prioritize its NORAD modernization efforts, whether to focus on all domain awareness and JADC2, or find niche capabilities in defeat mechanisms.

Defence industry experts offered their advice for achieving effective defeat mechanisms. Defeat mechanisms require a layered defence, specifically sensor redundancy to direct interceptors and a ‘shoot-assess-shoot’ shot doctrine to ensure NORAD has the requisite number of interceptors to deal with incoming fire. NORAD effectiveness could be improved by developing the capability to destroy adversaries’ weapons platforms before they launch. Industry solutions for catching up with adversaries in hypersonic technology include rapid prototyping to bring capabilities to the field quicker, tweaking technology designed for one mission to another, finding cost-saving ways to integrate technologies by upgrading systems and make them more stable, branching new technology off of previous models, and changing model processes through disruptive technology.

Many of the technologies that will fully enable NORAD’s fusion of all domain awareness and defeat mechanisms through JADC2 are still in development. Experts argued that Canadian industry had opportunities to contribute to NORAD modernization in data sciences, specifically artificial intelligence (AI) and machine learning (ML). Canadian industry also perceives opportunities in developing non-kinetic defeat mechanisms that could first supplement and then supplant kinetic missiles.

Points of Consensus

- The Canadian public is wary of NORAD developing offensive capabilities or technologies that could disrupt the strategic stability of Mutually Assured Destruction (MAD).
- NORAD needs to develop its 'left of launch' capability to destroy weapons platforms before they can fire on North America.
- Canadian industry should be pursuing non-kinetic defeat mechanisms such as electronic warfare and signals technology.
- AI and ML technologies will allow for the fusion of all domain awareness, defeat mechanisms, and JADC2 needed to enable the full potential of NORAD's deterrence by denial capability.

Points of Contention

- There was debate over current technology allowing for a 'best sensor, best shooter' scenario or if NORAD must be satisfied with 'any sensor, best shooter' for now.
- NORAD's layered 'shoot-assess-shoot' doctrine is too heavily influenced by United States Air Force thinking and should be expanded to better include the space domain and non-kinetic defeat mechanisms.

Defeat Mechanism Requirements

Dr. Thomas Walker of Lockheed Martin stated that the key requirement for renewing NORAD's defeat mechanisms – as with all domain awareness – is readiness levels of the enabling technologies. There is no time for dreaming up something new, given that “the need is now.” Walker presented a white paper template created by NORAD's J8 (science and technology) staff. The purpose of the white paper is to give industry the opportunity to propose their defeat solutions directly to the J8.



Applicants must match effective defeat solutions to the “threats and potential gaps” requirements that had been circulated to industry for near-term (now to 24 months), mid-term (24-60 months), and far-term (60 months +) time horizons. NORAD's emphasis is on near-term solutions, with successful applications leading to further discussions with J8 staff. The key is for industry applications to look for opportunities to give demonstrations and tests at events like the [Advanced Battle Management System \(ABMS\) exercises](#). White paper applications for defeat mechanisms are due on 16 October 2020.

Brig Gen Fesler, Deputy Director of Operations at NORAD HQ, elaborated on his

command's defeat requirements. Fesler made the critical distinction that defeat mechanisms are different from all domain awareness and joint all domain command and control (JADC2) solutions. While sensors and JADC2 can span the full spectrum of threats, different threats call for different defeat mechanisms. A missile designed to kill a hypersonic glide vehicle at range is not appropriate for shooting down a small unmanned aerial vehicle (UAV). Fesler stated that the most pressing threat for NORAD are the large number of cruise-missiles that could be fired into North America. From this challenge, different defeat solutions will be generated to address the full spectrum of threats.

Fesler went on to make four stipulations for defeat mechanisms. First, solutions must be purpose-built for Homeland defence. Defeat mechanisms should not be adapted from the ‘away game’ for use in continental defence. Second, there is a need for a persistent capability. NORAD's adversaries are



working hard to reduce their launch times and the command may not be able to rely on ‘on demand’ systems in response, particularly if the goal is to deter these threats. Third, NORAD requires a limited area defence

approach that it can deploy over clusters of critical infrastructure, supplied by a purpose-built persistent system. Lastly, NORAD also needs defeat mechanisms to go after adversarial launch platforms at range. It is more efficient to kill one bomber before it can launch its payload than to individually kill its twelve cruise-missiles.

Obstacles to the Modernization of NORAD and the defence of North America

Canadian politics pose a significant obstacle to the modernization of NORAD's defeat mechanisms. Dr. Justin Massie, professor of political science at the Université du Québec à Montréal and co-director of the Network for Strategic Analysis, stated that public polling regarding NORAD is stale, with the last surveys conducted in 2017. Media attention devoted to NORAD has typically focused on Canada's non-participation in U.S. ballistic missile defence (BMD). Massie notes that current polling on defence spending indicates that most Canadians are pleased with the current levels of spending – a problematic situation because, while [*Strong, Secured, Engaged*](#) strongly referenced NORAD, the defence policy provided no funding for the command's modernization. The pandemic could affect continental defence spending,



but there is little current data to assess where this will lead.

Past data on Canadian political support for NORAD suggests that Canadians are



reluctant to embrace offensive weapons or capabilities like BMD that could disrupt the strategic stability of Mutually Assured Destruction (MAD). BMD remains a salient and divisive issue for Canadians, especially French-speaking Quebecers. Massie concluded that BMD “remains a political landmine” for any Canadian government. Ultimately, there is broad political support for Canada to remain a credible ally in continental defence through renewing NORAD's defensive capabilities, but a more offensive NORAD could adversely affect this support.

Industrial capability is another obstacle to Canada renewing NORAD's defeat mechanisms. MGen (ret'd) Richard Foster of L3 Harris concluded that Canadian industry does not have the capacity to produce kinetic defeat capabilities and is pessimistic that the government will invest in creating one. Foster situated a hypersonic defence capability solely within the realm of the great powers of the China, Russia, and the United States, and places this threat within the context of their global competition beyond NORAD. Nonetheless, NORAD Deputy Commander LGen Alain Pelletier stated that

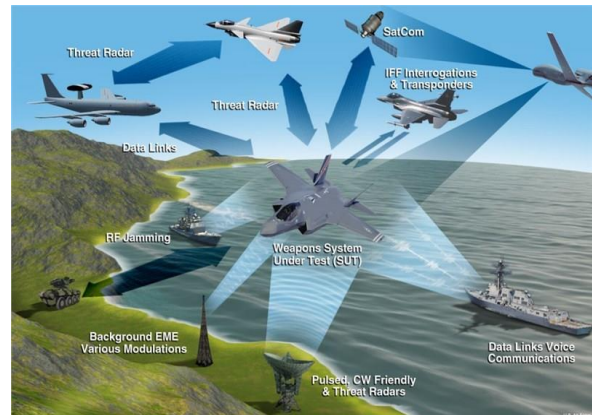
it is important for Canadian industry to remain abreast of defeat developments to keep it cohesive with their all domain awareness and JADC2 solutions.

Design Considerations for Canadian Industry

Foster argues that there are a lot more to defeat mechanisms than merely developing anti-missile kinetics. There are requirements for many sensors and communication links to enable defeat mechanisms. A major Canadian priority will be developing the space sensor layer. Canadian industry has a better fit on the sensor and JADC2 capabilities, especially with the dual-use concepts addressed in the first webinar. Canadian industry needs to keep engaged with their American counterparts, the military, and academia to stay informed of developments, understand the problems, and educate Canadians. Industry needs to participate more in Research and Development (R&D) forums, such as through NATO or the [DRDC IDEaS Programme](#). The government can help direct and prioritize R&D activities through these forums to address threats like hypersonics. Ultimately, Canada needs to get its procurement programme right for NORAD.

Raytheon Technologies' David Scott expressed confidence that industry will quickly catch up to and then surpass Chinese and Russian hypersonic technologies. He emphasized 'left of launch' – the destruction of adversarial weapons platforms before they can fire – acknowledging that while it might not appeal to Canadian audiences, it is an extremely important capability for NORAD to develop. Scott also urged Canadian industry to consider how it can offer defeat mechanisms that will thin the volume of incoming fire through a layered defence system. Scott suggested that the United States

Navy offers a great model as it has generated some excellent defence-in-depth solutions to protecting its fleets. While the current research priority is hypersonic and counter-hypersonic technologies, he advised that



attention should be paid to direct energy weapons, from high power microwave to lasers. Canadian industry should consider how such technologies could be integrated into NORAD's layered defences.

Carol Zanmiller, a founder of Cosmic AES, provided a small business perspective on NORAD's modernization. She argued that the major challenge will be integrating smaller components into the larger architecture supporting NORAD. Small businesses are apt for this as they are fast, flexible, and innovative. She supported NORAD adopting an open architecture system, which will better enable a wider range of businesses to continuously refresh NORAD's capabilities. Zanmiller suggested that smaller Canadian businesses should be looking at non-kinetic defeat mechanisms such as electronic warfare and signals technology, which can deal with threats such as UAVs.



She argued that rapid prototyping can assist small business in this area, bringing capabilities to the field far quicker than traditional procurement cycles. She recommended that industry and NORAD should create together new branches in the command's architecture with which to try new technologies. If some of this new technology fails, such a system can easily dissolve the branch it was employed in or expand that branch if things work.

Jerome Dunn, who works on countering hypersonic threats for Northrop Grumman, stated that layered defence is a critical aspect of NORAD's modernization needs. NORAD has two distinct layered defence needs. The first is redundancy, with additional layers offering enhanced resiliency. Instead of a few well-placed shots by an adversary resulting in complete sensor failure, layered redundancy can better absorb the damage, leading to the "graceful degradation" of NORAD's domain awareness capability. Second, Dunn stated that NORAD defeat mechanisms must be organized around a layered 'shoot-assess-

shoot' shot doctrine. The benefit of shoot-assess-shoot is that it mathematically allows for the least number of interceptors to achieve a 'kill' (not including 'left of launch' targeting). The disadvantage of this shot doctrine is that it requires longer range initial intercepts to provide enough battlespace for assessment, tracking, and follow on shot opportunities. Dunn was emphatic that NORAD needs both layered redundancy and layered shot doctrine to deal with great powers. Smaller states simply do not have the volume of fire to overwhelm NORAD, even if the command did not have both layered defence aspects.

Layer upon Layer

Fesler stated that deterrence is the goal of NORAD modernization. Enhancing NORAD's deterrence by denial – its ability to block an adversary from achieving its objective – was a necessary part of increasing the overall credibility of its deterrent. Layering sensors along the approaches to

North America is the first element of deterrence by denial.

Dunn explained that NORAD can now achieve at least three layers of sensors, granting the command it's all domain awareness capability. The first and farthest layer is composed of space-based sensors, providing NORAD a vantage point from "the highest of high grounds." Dunn stated that the second layer is made up of forward deployed sensors like aircraft. The third and final layer is terminal sensing by dedicated systems. The benefits of layered sensors are that they allow NORAD to be more conservative with its kinetic interceptors, but more sensors place greater coordination



demands on NORAD's JADC2. Dunn concluded that the better the JADC2, the more layers of sensors could be added to NORAD.

Zanmiller pointed out that industry needs to invest in data sciences to enable the JADC2 capability needed to handle the data provided by additional layers of sensors. Dunn stated that the aim of JADC2 with current technology was to enable 'engage on remote,' making the most of the defeat mechanisms that NORAD already has. Layered sensors can tell a fighter to shoot its missiles early at a target, beyond that aircraft's radar coverage, so that the missile's maximum range is the point of intercept. He

explained that this engage on remote capability not only extends the effective range of the weapon, it also introduces more layers and greater effectiveness.

Punch Moulton of Stellar Solutions Inc. suggested that the premise of a sensor different from that of the launch platform's guiding an intercept should allow for a 'best sensor, best shooter' kill-chain scenario. Dunn disagreed, stating that AI and ML technologies required to achieve 'best sensor, best shooter' was not there yet. In the meantime, he insisted that it is much cheaper to deploy more sensors and pull data from as many of them as possible for an 'any sensor, best shooter' solution. Nevertheless, Scott and Zanmiller emphasized that Canadian industry should invest heavily in AI and ML to eventually achieve the fusion of all domain awareness, defeat mechanisms, and JADC2 needed to truly enable NORAD's deterrence by denial capability.

The second element of deterrence by denial is the layered 'shoot-assess-shoot' shot doctrine. Zanmiller worried that there is a too much United States Air Force thinking behind how this concept is presented, and that it must be expanded to include the space domain and non-kinetic defeat mechanisms. Both she and Foster flagged non-kinetic defeat mechanisms as an area in which Canadian industry should take greater interest. Dunn stated that non-kinetics are critical and must work in tandem with



kinetics in a layered fashion, presenting enough uncertainty to an adversary to deter their first attack. The technology to integrate kinetics and non-kinetics does not yet exist, but if detection, identification, and tracking improves, non-kinetics can be used to save interceptors. Used in a shoot-assess-shoot doctrine, “non-kinetics become magazine extenders.” Non-kinetics will allow for NORAD to flip the cost curve back in its favour across all defend missions from BMD, to cruise-missiles to UAVs. The technology might develop to allow NORAD to smartly choose whether to commit a kinetic at all, relying solely on non-kinetic solutions to achieve a ‘kill’.

More than Missiles

Of NORAD’s three key capability requirements, defeat mechanisms present the greatest difficulty for Canadian industry to participate in developing. Unlike all-domain awareness and JADC2, defeat mechanisms must be purpose-built for NORAD use and not adapted from pre-existing systems. Canadian politics do not support NORAD developing the full spectrum of defeat capabilities it requires, whilst Canadian industry does not have the capacity to

produce kinetic defeat mechanisms. Nevertheless, there is more to defeat mechanisms than developing counter-hypersonic interceptor missiles that can be perceived by the public as offensive weapons.

Experts throughout the webinar argued that Canadian industry had three major opportunities for participating in defeat mechanisms. First, industry should be developing the sensor and communication links that are essential to enabling defeat mechanisms over the near-term time horizon. Second, industry should invest in non-kinetic defeat mechanisms. Focusing on electronic warfare and signals, this technology has the capacity to grow with time from being “magazine extenders” to likely the primary method of defeating incoming fire outright. Lastly, Canadian industry pursue the development of direct energy weapons. While not a near-term solution for NORAD, such mechanisms can be integrated into NORAD’s evolving layered defences in the long-term. In pursuing all of these defeat options, industry must remain cognizant of how their solutions will thin the volume of incoming fire through NORAD’s renewed layered defence.

Special thanks to our NAADSN rapporteurs:

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