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ALL DOMAIN AWARENESS: THE FUTURE OF THE NORAD DETER, DETECT, DEFEAT MISSION

Major John N. Verran

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By Major John N. Verran

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ALL DOMAIN AWARENESS:
THE FUTURE OF THE NORAD DETER, DETECT, DEFEAT MISSION

AIM

1. The pace of operations, the timelines to make decisions and the amount of information that needs processing by the North American Aerospace Defense Command (NORAD) has exponentially increased and all indications point to this trend continuing. These increased processing demands combined with a significantly reduced decision space, due to advancements in adversary capabilities, have begun to out-pace what humans are capable of achieving. The timeline from sensing a threat to acting on decisions is too short to continue to rely on humans for processing in the manner we do today. Threats facing NORAD are now more than capable of bridging what was once North America's greatest defense, its favourable geography bordered by oceans[1]. NORAD must adapt and optimize its sense capabilities given these emerging threats. By doing so NORAD will capitalize on opportunities to gain decision-making advantages. All Domain Awareness is an opportunity that NORAD must seize or risk adversaries exposing vulnerabilities in aging NORAD capabilities. All Domain Awareness offers NORAD an opportunity not just to improve its sense capability, but also by exploiting these new, innovative capabilities, it offers opportunity for quicker, higher fidelity decisions in achieving its mission of deter, detect, defeat. Especially important in today's time constrained environment of high-stakes decisions.

INTRODUCTION

2. NORAD, as a bi-national command has protected Canada and the United States (US) for over 60 years[2]. In 2006, NORAD assumed a maritime warning mission,[3] a crude first step toward All Domain Awareness. While NORAD operates primarily in the aerospace domain, the threats do not always originate there. Adopting the maritime warning role allowed NORAD a more comprehensive awareness of where many aerospace threats originate. It enabled valuable situational awareness (SA), tracking threats from launch platform. In adopting the role, NORAD granted itself the most valuable commodity in its mission, time, time to prepare, time to anticipate and time to act. Adopting the maritime warning mission may have been an early effort in All Domain Awareness; however, many technological advancements have emerged since. These technological advancements have continued to shorten decision-making timelines. Improved adversarial technologies have created an increased threat. This increased threat has

[1] Terrence O'Shaughnessy, Peter Fessler, *Hardening the Shield: A Credible Deterrent and Capable Defense for North America*, Sept 2020, 2.

[2] Fact sheet, https://www.norad.mil/Newsroom/Fact-Sheets/Article-View/Article/578770/north-american-aerospace-defense-command/.

[3] NORAD, *About NORAD*, Last accessed February 5, 2020. https://www.norad.mil/About-NORAD/.

intensified, as both China and Russia, have increased and renewed aggressive actions and rhetoric toward North America. Improved friendly sense technologies, as well as computing and processing, offer a valuable opportunity to combat the increased threat. All Domain Awareness, if exploited properly, is this opportunity.

3. All Domain Awareness, using sensors from all domains to gain SA in all domains, be it space, land, cyber or other, to gain the highest fidelity picture, offers NORAD an opening to improved decision-making. On the inverse, there is significant risk in maintaining the status quo and falling into obsolescence. Former Intel CEO Andy Grove said, "Success breeds complacency. Complacency breeds failure. Only the paranoid survive."[4] Complacency in NORADs historical success poses a risk that cannot be overlooked. NORADs last major upgrade took place over thirty years ago;[5] NORAD cannot ignore the necessity to evolve. There is a choice, stay the course and accept the risk or evolve and continue to detect, deter and defeat. Moreover, it is a necessary choice; NORAD must evolve to flourish into the future and continue to deliver on its aerospace defense mission.

DISCUSSION

4. In order to understand why All Domain Awareness is necessary identifying the risks and vulnerabilities to current capabilities is required. Technological advances in threats from traditional NORAD adversaries have made the need for All Domain Awareness more important than ever. Hypersonic arms, air and sea launch platforms and arms to accompany are examples of the technology. Combine these with new and renewed aggressive political rhetoric and the examples of current and developing threats that are driving the need for NORAD to embrace All Domain Awareness begin to emerge.

5. Hypersonic arms, defined as those that can travel faster than Mach 5, between 5,000-25,000 kilometers per hour,[6] pose a threat for obvious reason, speed. Hypersonics can travel thousands of miles from launch to impact in minutes. Russia and China, NORAD adversaries, are two of the worlds most advanced hypersonic nations.[7] Designed to overwhelm modern air and ground-based defenses with speed,[8] the need to be aware of the location and to have the ability to track from pre-launch can be the difference between success and failure. Further, if an adversary is aware of a superior sense and defend capability their incentive to engage becomes constrained, bolstering NORAD deterrence.

[4] Herminia Ibarra, "Intel's Andy Grove and the difference between good and bad fear," *Financial Times*, April 11, 2016. https://www.ft.com/content/4c84d2e8-fa5f-11e5-8f41-df5bda8beb40.

[5] Terrence O'Shaughnessy, Peter Fessler, *Hardening the Shield: A Credible Deterrent and Capable Defense for North America*, Sept 2020, 9.

[6] Speier, Richard H., et al. "Hypersonic Missile Nonproliferation : Hindering the Spread of a New Class of Weapons," *RAND Corporation*, 2017, xi. ProQuest Ebook Central,

[7] Ibid, xii.

[8] Ibid, 1.

6. Russian air and surface launch platforms have been a threat to NORAD since the start of the cold war; however, upgrades have improved launch platforms and the accompanying arms. The newest editions of Russian air and sea-launched cruise missiles, both nuclear and conventional, offer challenges for NORADs detection capabilities. These new missiles were designed to be low observable and to fly patterns to evade detection from NORADs aging warning radars. Further, upgrades Russia has made to the Tu-160 Blackjack bomber will see its continued use as the bomber of the future, a capable aircraft with capacity for twelve cruise missiles.[9] Russia also continues to operate and build a variety of nuclear powered submarines with both a submarine launched cruise missile (SLCM) and submarine launched ballistic missile (SLBM) capability.[10] When considering all Russian capabilities against the 'Arrow and Archer concept,' with the launch platform being the archer and its projectile the arrow, tracking the archer, regardless of the domain, has advantages. Initial detection of arrows is easier at the point of launch and offers the best opportunity to defeat the threat. In the best-case scenario, deterrence prior to launch is achieved through superior awareness by creating doubt in the adversary's mind.

7. China also possesses a significant subsurface fleet with an accompanying SLBM threat. China's intercontinental ballistic missile (ICBM) stockpile holds approximately 90 ICBMs capable of reaching North America.[11] Finally, China's development and imminent introduction of the new H-20 bomber aircraft, with initial indications the aircraft could be capable of delivering kinetic effect to North America demand NORAD look at methods to rebalance the scales of conflict. The H-20 bomber will be a capable aircraft and once operational will give China the prestige of having the nuclear triad.[12] Further, the animosity between NORAD partners and China cannot be understated. Tension created by the Canadian arrest of Meng Wanzhou on US accusations of Huawei wrong-doing, and the retaliatory arrest of two Canadian citizens highlight the more overt friction between North America and the Chinese.[13]

8. Sun Tzu wrote, "Victorious warriors win first then go to war, while defeated warriors go to war first and then seek to win,"[14] stressing the importance of planning and preparation. Speed, deception and tension between NORAD and its adversaries are highlighting the fact NORAD must be as prepared as possible. All Domain Awareness is that preparation. Constantly sensing to be aware, using capable tools to fuse together the data coming from multiple sources,

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[9] Gareth Jennings, "Maiden flight for upgraded Tu-160M bomber" *Janes,* February 7, 2020, https://www.janes.com/defence-news/news-detail/maiden-flight-for-upgraded-tu-160m-bomber.

[10] Hans Kristensen, Matt Korda, "The Pentagon's 2020 China Report," *Federation of American Scientists.* September 1, 2020. https://fas.org/blogs/security/2020/09/the-pentagons-2020-china-report/.

[11] Hans Kristensen, Matt Korda, "The Pentagon's 2020 China Report," *Federation of American Scientists.* September 1, 2020. https://fas.org/blogs/security/2020/09/the-pentagons-2020-china-report/.

[12] Ibid.

[13] Jason Proctor, "2 years after Meng Wanzhou's arrest, fate of '2 Michaels,' China relationship hang in balance," *CBC News,* December 1, 2020. https://www.cbc.ca/news/canada/british-columbia/meng-wanzhou-arrest-anniversary-michaels-1.5822546.

[14] Cool Fire Solutions, "The OODA Loop Explained," *Cool Fire Core,* March 6, 2019. https://www.coolfiresolutions.com/blog/ooda-loop-explained/#:~:text=The%20OODA%20loop%20is%20a,them%20before%20they%20become%20critical.

identifying patterns and behaviors to be as best prepared as possible should a given situation arise. The age of checklist decision-making, in essence filtering what could be valuable data, has passed. It is too slow and there are too many opportunities for adversaries to take advantage. NORAD can no longer operate at 'the speed of human,' technology dictates humans cannot keep pace. While efforts to obtain, fuse and use this information in the cyber domain evolve so must the need to shield and protect the systems and information. Adversaries will attempt to develop techniques and procedures to disrupt, damage and intrude. As NORAD moves forward emphasis must be placed on protecting valuable sensors and technological tools from cyber-attacks.[15]

9. John Boyd's OODA Loop model of decision-making offers a framework to evaluate how All Domain Awareness can affect the decision making cycle. The model demonstrates how NORAD, through All Domain Awareness, can optimize decision making and how All Domain Awareness can be exploited to disrupt the decision-making process of adversaries. The OODA loop, representing Observe, Orient, Decide, Act, works as a cycle starting with observe, the collection of data from multiple sources. The loop then moves to orient, where collected data is filtered, analyzed and enriched. Decide allows, "actionable insights to enable best available responses."[16] Finally act, where decisions are executed.[17]

10. All Domain Awareness, through the collection of data from multiple sensors and the fusing, processing and delivering of results far quicker than ever possible, demonstrates how decision and information superiority can be obtained. Essentially, working from observe through to act far quicker than adversaries, with far superior information, to gain the decision making edge. Superior information to come to faster, better decisions. This edge is amplified when friendly decisions and actions out-pace that of the adversary, breaking and altering their decision cycle, as they are continually out maneuvered by the speed of decisions enabled by All Domain Awareness. All Domain Awareness is the foundation in achieving decision-making superiority. As Col Matt Eberhard explained the ability to, "make faster and better decisions on a foundation of clearer data than…adversaries, thus achieving 'decision-making superiority.'"[18] All Domain Awareness will place NORAD at a competitive advantage, particularly in NORADs deter and detect roles. The ability to continually disrupt the adversary's decision-making cycle through superior information offers a means to a significant deterrence.

CONCLUSION

11. Adversary technological advancements in kinetic armament, delivery vehicles and in the cyber domain pose significant threats to NORAD. Recently developed conventional kinetic arms

[15] Sherrill Lingel et al., "Joint All-Domain Command and Control for Modern Warfare: An Analytic Framework for Identifying and Developing Artificial Intelligence Applications," *Rand Corporation* 2020, 43.

[16] Cool Fire Solutions, "The OODA Loop Explained," *Cool Fire Core,* March 6, 2019. https://www.coolfiresolutions.com/blog/ooda-loop-explained/#:~:text=The%20OODA%20loop%20is%20a,them%20before%20they%20become%20critical.

[17] Ibid.

[18] CDA Institute, *NORAD Modernization: Report Three: JADC2/JADO,* October 28, 2020. https://cdainstitute.ca/norad-modernization-report-three-jadc2-jado/.

pose a nuclear and sub-nuclear threat that challenges NORADs detect capabilities, while advances in delivery vehicles, be they air or sea launched, will test NORADs ability to sense. In the cyber and information domains the enemy will continue attempts to exploit weakness and the sheer amount of data that is contained or entering the domains poses challenges for human processing. These new adversarial capabilities are being designed to defeat NORADs current capabilities. Further, the strain placed on NORADs processing capacities is stressing and not enabling or maximizing the use of available information, there is too much data for today's practices to continue. NORAD must adopt an All Domain Awareness solution, first integrating current sensors into a single system, then using technology to fuse, assess, process, and deliver timely and pertinent data to decision makers. Sensors and technology must work together, connected, feeding the All Domain Awareness tool with all available information, building on the layers of defense and the fidelity of information to continue to develop better solutions with better data. The result will be decision-making superiority, a comprehensive ability to navigate the decision space and, in doing so, providing a higher level of deterrence with an enhanced ability to detect and defeat. The current and future adversary threats and friendly deficiencies are real, the need to be aware, regardless of the domain, is a requirement not a 'nice to have.' NORAD must evolve or risk fighting a 2030 adversary with 1990's technology.[19]

RECOMMENDATIONS

12. While the benefits of All Domain Awareness are detailed above, there must be a starting point, a system to be fed data and to provide the processing and interface between what is received and delivered to decision makers. The United States Air Force designed Joint All Domain Command and Control (JADC2) is that system. "JADC2 draws data from a myriad of sensors to quickly detect threats, alert decision-makers, and guide defeat mechanisms to meeting… dangers."[20] JADC2 is being designed with resiliency and redundancy for the immediate need.[21] However, beyond the immediate there is a view to the future. One of the key considerations in the design of JADC2 is capacity to integrate new technologies "from sub-surface to on orbit," as they become available. The goal is not simply building the next tool that begins its walk toward obsolete upon introduction, but to develop an agile tool capable of integrating new systems into a layered defence.[22] Cloud based computing and artificial intelligence will play heavily in JADC2, to the point that "machine-enabled insights"[23] will be necessary as the amount of information available "overwhelms the human brain."[24] The data sharing will eliminate the current stove piping of information, making all data available for all users, with safeguards in place. The advantage of such a model is that it allows multiple users to

[19] Terrence O'Shaughnessy, Peter Fessler, *Hardening the Shield: A Credible Deterrent and Capable Defense for North America*, Sept 2020, 9.

[20] CDA Institute, *NORAD Modernization: Report Three: JADC2/JADO,* October 28, 2020. https://cdainstitute.ca/norad-modernization-report-three-jadc2-jado/.

[21] Ibid.

[22] Ibid.

[23] Ibid.

[24] Ibid.

develop sub-solutions, pulling pertinent data while the machine identifies new, improved solutions based on user inputs. Finally, the true benefit of such a system is its ability to deter.

> JADC2 comes into play before a shot is fired, increasing the decision space to act earlier on deployments and overall posture. Ultimately, JADC2 aims to provide authoritative information in real time to decision-makers so they can take actions 'that deter competition and deescalate in crisis.'[25]

JADC2 is the All Domain Awareness tool NORAD requires to achieve its mission of detect, deter, defeat.

13. Pathfinder, a Northern Command and NORAD All Domain Awareness test initiative is already showing promising results of what JADC2 could be. In controlled tests, the system has shown the ability to track data that previously had not been possible. "Pathfinder is identifying information buried in the data, giving new life to old sensors."[26] The results are largely due to the increased processing power in Pathfinder. The possibilities Pathfinder is presenting in terms of next step All Domain Awareness are encouraging, especially considering onboarding new sensors and increasing processing power.[27]

14. While integrating current technologies is the existing need, the need to continue to develop and layer capabilities must not be neglected. To that end research and development into new capabilities must continue. Redundancy is a cornerstone to the sense function, and the layering of systems a cornerstone to All Domain Awareness. A single point of failure bringing down a multi-billion dollar weapons system is unacceptable. Defence Research and Development Canada's All Domain Situational Awareness Science and Technology Program (ADSA) is one example of where future sensors may emerge.[28] The ADSA project is currently working on underwater sensing capabilities that may eventually help NORAD with subsurface tracking and detection.[29] ADSA is also working on a long range over the horizon radar. This technology could extend NORADs sensing range and would add another layer to the sense capability.[30] Research and development programs, such as ADSA, cannot be forgotten as an important factor in NORADs future.

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[25] Ibid.

[26] Terrence O'Shaughnessy, Peter Fessler, *Hardening the Shield: A Credible Deterrent and Capable Defense for North America*, Sept 2020, 13.

[27] Terrence O'Shaughnessy, Peter Fessler, *Hardening the Shield: A Credible Deterrent and Capable Defense for North America*, Sept 2020, 14.

[28] Defence Research and Development Canada, "All Domain Situational Awareness Science and Technology Program," *Government of Canada*, December 7, 2020. https://www.canada.ca/en/defence-research-development/programs/all-domain-situational-awareness-program.html.

[29] Ibid.

[30] Ibid.

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