





PAN-DOMAIN COMMAND AND CONTROL MODERNIZATION

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PAN-DOMAIN COMMAND AND CONTROL MODERNIZATION

AIM

1. Following the study of the three principal services of the CAF, the component theories, functions, and capabilities highlight the importance of mutually supporting effects across multiple domains. Because of emerging and disruptive technology trends¹, there is a requirement to modernize and improve Canadian Armed Forces (CAF) Command and Control (C2) capabilities and procedures across all operational domains. The following service paper will provide recommendations for a way forward for pan-domain C2 modernization to enable joint, interagency, multinational and public (JIMP) operations.

INTRODUCTION

2. *Strong, Secure, Engaged* emphasizes three security trends that will influence future activities: "the evolving balance of power, the changing nature of conflict, and the rapid evolution of technology."² The changing security environment will have implications for the CAF. The Defence Policy outlines these implications. The CAF will have to develop integrated cyber, space and information awareness capabilities.³ These implications will enable the CAF to improve anticipation, preparation and the conduct of multi-domain operations. Consequently, the CAF has to adopt novel pan-domain C2 models.

3. This service paper will provide recommendations to enhance and reform C2. This outcome will maximize effects in the pan-domain environment. Pan-domain C2 modernization can only occur by promoting pan-domain thinking, strengthening multi-domain force generation and development, and focusing on information and enabling integrated C2 networks. First, pan-domain capabilities improved integration can be achieved through the adoption of multi-domain organizational constructs.⁴ Second, the attention should shift to joint force generation and development to improve and empower pan-domain competencies.⁵ Third, information and the C2 supporting systems are the essential elements to ensure pan-domain integration and synchronizing multiple effects.⁶ Thus, the current service-based military models need to be revised.

¹ NATO Science & Technology Organization, *Science & Technology Trends 2020-2040: Exploring the S&T Edge*. (Brussels: Office of the Chief Scientist - NATO Headquarters, March 2020), vii.

² Department of National Defence, *Strong, Secure, Engaged: Defence Policy*. (Ottawa: Department of National Defence, 2017), 49.

³ Ibid., 57.

⁴ David A Deptula, "Twenty-First Century Air Power: Future Challenges and Opportunities," *Royal Air Force Air Power Review* 21, no. 3 (Autumn/Winter 2018): 167.

⁵ Michael E. Hutchens, et al. "Joint Concept for Access and Maneuver in the Global Commons: A New Joint Operational Concept," *Joint Force Quarterly*, no. 84 (1st Quarter 2017), 136.

⁶ David A Deptula, "Twenty-First Century Air Power: Future Challenges and Opportunities," *Royal Air Force Air Power Review* 21, no. 3 (Autumn/Winter 2018): 168.

DISCUSSION

First, a critical step to pan-domain C2 modernization is shifting the organizational 3. concept from the "surface centric organizational paradigms of the past" towards an integrated pan-domain combined arms approach for the future.⁷ The Royal Canadian Navy (RCN), the Canadian Army (CA), and the Royal Canadian Air Force (RCAF) have mostly established their operational concepts in silos. The services have evolved based on their responses to the challenges faced in their primary operational domain.⁸ As well, the three main services have developed tailored component packages to support joint operations. The CAF has to move away from these domain-specific solutions.⁹ The method to approach multi-domain operations is to institutionalize pan-domain thinking across the organization. Over numerous campaigns, the Canadian Army has evolved to a combined arms view of land warfare. This unified view has to be adopted by the CAF to function effectively across multiple domains. In truth, the essence of joint operations is the availability of numerous capabilities for a combined commander to employ when required.¹⁰ Joint is not a service-focused amalgamation of various components operating in their domain and having to deal periodically with a joint headquarters for combined activities.¹¹ At the operational levels, there are land, air, maritime coordination cells that deconflict joint operations. This methodology does not provide the flexibility and speed required to commanders for multi-domain operations. Consequently, the tactical level is not integrated fully. The C2 of joint activities is sporadically occurring at the warfighting level.¹² Today, jointness is about de-conflicting between domains, instead of maximizing the potential of capabilities across multiple domains. Nonetheless, component proficiencies need to be retained by CAF experts within their primary domain to support effective multi-domain C2.¹³ Having specialists in land, aerospace and maritime components remains instrumental to joint operations, but the seamless integration of components needs to be entrenched conceptually. Moreover, cyber and space capabilities will be involved likely in every future operation.¹⁴ The CAF will only be participating in pan-domain operations, because of cyber, space and information threats. Hence, there is a necessity to implement new constructs for pan-domain C2 improvements.

4. New perspectives of the operating environment have to be fashioned to enable C2. Major Sean Atkins of the United States Air Force (USAF) proposes re-imagining the battlespace "as a layered and interconnected multidomain maneuver-space."¹⁵ By considering the pan-domain as one unified space, the possibility of manoeuvre options to a commander across domains is

⁷ David A Deptula, "Twenty-First Century Air Power: Future Challenges and Opportunities," *Royal Air Force Air Power Review* 21, no. 3 (Autumn/Winter 2018): 167.

⁸ David G. Perkins and James M. Holmes, "Multidomain Battle: Converging Concepts Toward a Joint Solution," *Joint Force Quarterly*, no. 88 (January 2018), 54.

⁹ Ibid., 54.

¹⁰ David A Deptula, "Twenty-First Century Air Power: Future Challenges and Opportunities," *Royal Air Force Air Power Review* 21, no. 3 (Autumn/Winter 2018): 173.

¹¹ Ibid., 173.

¹² Shmuel Shmuel, "Multi-Domain Battle: AirLand Battle, Once More, with Feeling," *War on the Rocks*, 20 June 2017. https://warontherocks.com/2017/06/multi-domain-battle-airland-battle-once-more-with-feeling/

¹³ Alberts III Harris, "Preparing for Multidomain Warfare: Lessons from Space/Cyber Operations." *Air & Space Power Journal* 32, no. 3 (Fall 2018), 54.

¹⁴ Ibid., 49.

¹⁵ Sean A. Atkins, "Multidomain Observing and Orienting: ISR to Meet the Emerging Battlespace." *Air & Space Power Journal* 32, no. 3 (Fall 2018), 33.

sizeable. This type of thinking is required to take advantage of opportunities to defeat adversaries in a contested pan-domain situation. Thus, the application of combat power is not concentrated necessarily in a specific domain, but across the entirety of the multi-domain sphere. Similarly, US Army General David Perkins stresses building an appropriate battlefield framework as a tool to assist commanders to exercise C2.¹⁶ In effect, he has drafted a prototype with "six physical spaces: deep fires, deep area, close, support, operational support area, and strategic support area."¹⁷ General Perkins' framework allows commanders to visualize and understand the operational environment. This model promotes the pan C2 modernization to enable commanders to utilize a task force's capabilities during the multi-domain battle. Likewise, Captain Michael Hutchens of the US Navy and his combined team advocates the Joint Concept for Access and Maneuver in the Global Commons (JAM-GC) as a new joint operational concept. The JAM-GC concept is about re-conceptualizing all aspects of joint operations to combat Anti Access/Anti Denial (A2/AD) threats.¹⁸ This holistic concept is about re-orienting the US forces into a joint vision for the future. This acknowledgement of capability gaps reinforces that the CAF has to mimic and introduce novel thinking about pan-domain C2 challenges. Fundamentally, this mindset is about an organizational culture change to real jointness.¹⁹ The intent described by General Perkins and USAF General James Holmes is to establish "sensor-to-shooter webs."20 These sensor-to-shooter webs are about interconnectivity and being able to produce rapid effects in any domain at any time. Furthermore, this pan C2 modernization will have to reassess the delegation authorities, responsibilities, and authorities (ARAs) to ensure freedom of action is enabled for commanders.²¹ Old antiquated models of ARAs will hamper commanders' abilities to maximize their potential capabilities during multi-domain operations. Overall, all these concepts are fundamental considerations for promoting a pan-domain vision for the CAF. This combined arms concept also has to incorporate all partners, such as other government departments, non-government organizations, the private sector and the populace, during and outside periods of armed conflict.²² The contested and degraded environment will require the synchronization of all instruments of national power. Consequently, to support these efforts, the review of force generation and development will be essential for pan-domain success.

5. Second, pan-domain C2 structures should be cultivated through force generation and force development. The future operating environment will necessitate joint operations due to the inclusion of cyber and space capabilities. Hence, all force employment will effectively consist of multi-domain elements. These elements need to be designed, built, equipped, trained, and exercised as a pan-domain force before being employed in operations. Concerning force

¹⁶ David G. Perkins, "Multi-Domain Battle: Driving Change to Win in the Future," *Military Review* 97, no. 4 (July-August 2017), 9.

¹⁷ Ibid., 10.

¹⁸ Michael E. Hutchens, et al. "Joint Concept for Access and Maneuver in the Global Commons: A New Joint Operational Concept," *Joint Force Quarterly*, no. 84 (1st Quarter 2017), 138.

¹⁹ David G. Perkins and James M. Holmes, "Multidomain Battle: Converging Concepts Toward a Joint Solution," *Joint Force Quarterly*, no. 88 (January 2018), 57.

²⁰ Ibid., 57.

²¹ Kevin M. Woods and Thomas C. Greenwood, "Multidomain Battle: Time for a Campaign of Joint Experimentation," *Joint Force Quarterly*, no. 88 (January 2018), 17.

²² Stephen Townsend. "Accelerating Multi-Domain Operations: Evolution of an Idea," *Military Review* (August 8, 2018), 7.

generation, force elements need to "train and exercise multi-domain approaches."²³ This preparation is achieved at the tactical levels to improve C2. By exercising in a pan-domain environment as a combined component, multi-domain lessons will be learned and tactics will enhance.²⁴ The collaborating elements will get an enriched understanding of the intricacies of the various domains and joint challenges. Additionally, the forcing function of training and exercising will promote innovation and identify gaps in the pan-domain forces.²⁵ Integrated training, supported by education, will advance pan-domain capabilities and the necessary C2 structures. Tactical leaders will find efficiencies through these force generation endeavours. The tactical activities will inform and shape the operational and strategic C2 "battle management responsibilities."²⁶ Notwithstanding, operational and strategic levels should be conducting similar efforts and exercising planning of pan-domain operations. Interestingly, the US Army Pacific has created a multi-domain task force to "work toward joint interoperability, interdependence, and integration."²⁷ This logical approach has the potential to revolutionize the force generation of a joint force. In addition, Dr. Kevin Woods and Colonel Thomas Greenwood (Retired) from the US Institute for Defense Analyses highlight that integration of pan-domain capabilities has to be supported by "decades of peacetime 'experimentation' and wartime adaptation."²⁸ Joint experimentation has to occur in the training environment. Major joint exercises like NANOOK, RIMPAC, and JOINTEX should be leveraged accordingly as terrains for combined experimentation. In the past, the tendency was to provide service elements, engage in a few limited joint activities and then advertise the exercise as "joint". True jointness is attained when multi-domain integrated and capable forces can adapt to any situation in a pandomain contested environment. This coherent posture is in contrast with the way the CAF generates task forces. One method to implement a new joint perspective for force generation is by updating doctrine.

6. Doctrine can provide the guidance required for commanders to employ pan-domain capabilities. US General Perkins notes, "the most egregious doctrinal void has been the lack of principles for multi-domain capabilities in large-scale combat operations."²⁹ The CAF has joint doctrinal documents, the Canadian Forces Joint Publications (CFJP). Nevertheless, the documents concentrate on facilitating the coordination between the services in a joint environment. The C2 structures represent this reality by the importance placed on the various component commanders. Doctrine has to enable future commanders to maximize the potential "capabilities providing cross-domain effects, maneuver, and fires."³⁰ Joint force generation also requires to be supported by joint force development.

²³ Alberts III Harris, "Preparing for Multidomain Warfare: Lessons from Space/Cyber Operations." *Air & Space Power Journal* 32, no. 3 (Fall 2018), 46.

²⁴ Ibid., 46.

²⁵ Michael E. Hutchens, et al. "Joint Concept for Access and Maneuver in the Global Commons: A New Joint Operational Concept," *Joint Force Quarterly*, no. 84 (1st Quarter 2017), 136.

²⁶ Alberts II Harris, "Preparing for Multidomain Warfare: Lessons from Space/Cyber Operations." *Air & Space Power* Journal 32, no. 3 (Fall 2018), 55.

²⁷ Kevin M. Woods and Thomas C. Greenwood, "Multidomain Battle: Time for a Campaign of Joint Experimentation," *Joint Force Quarterly*, no. 88 (January 2018), 16.

²⁸ Ibid., 18.

²⁹ David G. Perkins, "Preparing for the Fight Tonight: Multi-Domain Battle and Field Manual 3-0." *Military Review* 97, no. 5 (September-October 2017), 11.

³⁰ David G. Perkins and James M. Holmes, "Multidomain Battle: Converging Concepts Toward a Joint Solution," *Joint Force Quarterly*, no. 88 (January 2018), 57.

7. Force development has to articulate the pan-domain capabilities required. The current CAF force development process is service-oriented. Project sponsors are primarily the RCN, the CA and the RCAF. This situation leads to capabilities that focus on service-based requirements. Capability-based planning has to recognize the pan-domain threat posed by A2/AD capabilities. This significant threat necessitates converging joint force capabilities to operate in three phases of multi-domain operations: "competition, defeat the enemy in armed conflict, and return to competition.³¹ Furthermore, the CAF leaders should advance the right force design to operate in this contested space with near-peers. A future force framework designed to provide converged and integrated options to commanders should guide the CAF.³² As an institution, the force development processes should be reassessed to enhance the joint capabilities required to function in a pan-domain environment. Advancements in force development and force generation are vital to improve multi-domain force employment and develop the appropriate C2 structures. The pan-domain C2 is empowered by information and the supporting systems.

8. Third, information is the critical element for the integration of all the domains. Commanders are the primary consumers of information. The Command function is the glue of the operational functions. An argument can be made that information is the glue in pan-domain operations. Moreover, the associated C2 systems are the enablers to ensure the right information gets to the commander at the right time. Interoperability is a result of positive information exchanges. Lieutenant-General David USAF (Retired) emphasizes that commanders should divert their attention to the significant effects brought forth from real-time information sharing.³³ He also correctly notes that the Combat cloud concepts render information as the focal point of pan-domain operations.³⁴ The speed required to produce combined arms effects in a contested environment is linked directly to information processing across domains. Currently, information stovepipes are widespread throughout the various CAF organizations and components. These silos pose obstacles to pan-domain C2 modernization. Maj Atkins describes the stovepipes present in information collection, which hamper the ability to offer the all-source intelligence commanders require to produce effects in multi-domain operations.³⁵ He adds that security, accessibility, and practices should be assessed for information distribution. Maj Atkins underscores that militaries should evolve to data-driven focused organizations.³⁶ Sensor-toshooter webs³⁷ embrace this data-driven focus by ensuring integrated sensors translate to offensive action across domains. This ability for commanders to synchronize effects has to be supported by interconnected systems rapidly exchanging information.

³¹ Kevin M. Woods and Thomas C. Greenwood, "Multidomain Battle: Time for a Campaign of Joint Experimentation," *Joint Force Quarterly*, no. 88 (January 2018), 16.

³² David G. Perkins and James M. Holmes, "Multidomain Battle: Converging Concepts Toward a Joint Solution," *Joint Force Quarterly*, no. 88 (January 2018), 57.

³³ David A Deptula, "Twenty-First Century Air Power: Future Challenges and Opportunities," *Royal Air Force Air Power Review* 21, no. 3 (Autumn/Winter 2018): 169.

³⁴ Ibid., 171.

³⁵ Sean A Atkins, "Multidomain Observing and Orienting: ISR to Meet the Emerging Battlespace." *Air & Space Power Journal* 32, no. 3 (Fall 2018), 40.

³⁶ Ibid., 40.

³⁷ David G. Perkins and James M. Holmes, "Multidomain Battle: Converging Concepts Toward a Joint Solution," *Joint Force Quarterly*, no. 88 (January 2018), 57.

9. The pan-domain integrated network is required to enable C2 across domains. General Perkins discusses how network convergence will provide "a common understanding of the operational environment while sharing information horizontally and vertically across all services and partners—managing information from home station to the tactical edge."³⁸ An integrated network allows seamless information exchanges throughout the pan-domain environment. The reach of this type of network ensures that commanders have visibility and manoeuvrability across all domains. Regarding network-centric warfare, cloud-based architectures offer solutions for military institutions, like the CAF. Major Atkins observes a cloud-based system "eliminates stovepipes and enables a true multidomain big-data approach."39 By achieving cross-domain efficiencies through an integrated network, information will be available to support the commander's decision cycle. Existing policies and protocols present challenges to network convergence. This reality implies that the embracing of open architectures that allow connectivity between various technologies and partner systems. Major Atkins notes open architectures provide agility, adaptability and leverage new technologies with ease at lower costs.⁴⁰ The prevailing challenges with network convergence are inhibiting the CAF's ability to operate in the A2/AD environment. To overcome these challenges, the Vice Chief of Defence Staff (VCDS) is leading two initiatives: information digitization and a Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) spine.⁴¹ These are critical first steps for enhancing the C2 networks and information sharing. Nonetheless, to remain relevant as a military force in an A2/AD environment, the CAF has to reform its C2 models for joint operations.

CONCLUSION

10. Due to emerging and disruptive technology trends,⁴² the CAF has to modernize its C2 structures and systems to operate effectively in a contested and degraded environment as a multidomain force. This service paper examined recommendations to support improved C2. C2 modernization requires adopting a pan-domain concept and culture, evolving joint force generation and development, and giving prominence to information and an integrated C2 network. First, CAF has to abandon the service-based models for multi-domain organizational thinking and constructs. Second, this shift also should be accentuated in force generation and development with the ultimate aim of fielding multi-domain adaptable and interoperable task forces. Third, CAF leaders should focus on the primacy of information sharing and the enabling integrated network. As an organization, the CAF has to learn, innovate and adjust for the multi-domain battle.⁴³ The security environment continues to evolve. Advanced technologies demand

³⁸ David G. Perkins. "Multi-Domain Battle: The Advent of Twenty-First Century War." *Military Review* 97, no. 6 (November-December 2017), 12.

³⁹ Sean A Atkins, "Multidomain Observing and Orienting: ISR to Meet the Emerging Battlespace." *Air & Space Power Journal* 32, no. 3 (Fall 2018), 41.

⁴⁰ Ibid., 39.

⁴¹ Mike N. Rouleau, "Commandant's Guest Lecture," Virtual Lecture, Canadian Forces College, Toronto, ON, 16 December 2020.

⁴² NATO Science & Technology Organization, *Science & Technology Trends 2020-2040: Exploring the S&T Edge*. (Brussels: Office of the Chief Scientist - NATO Headquarters, March 2020), vii.

⁴³ David G. Perkins. "Multi-Domain Battle: The Advent of Twenty-First Century War," *Military Review* 97, no. 6 (November-December 2017), 13.

agile, adaptable and robust militaries with modern command practices to operate effectively in a pan-domain environment.

RECOMMENDATIONS

11. The following recommendations support a C2 modernization for multi-domain operations. First, to promote a pan-domain concept and thinking, the CAF should emulate the US and adopt the JAM-GC as a joint operational concept.⁴⁴ The VCDS should lead these efforts due to the ties with the digitization and the C4ISR spine initiatives. Second, to shift to joint force generation and development, there are different paths required. Canadian Joint Operations Command (CJOC) should lead joint force generation. Multi-domain task forces should be established and participating in the joint exercises, such as NANOOK, RIMPAC, and JOINTEX. As for force development, the VCDS should empower the Chief of Force Development (CFD) to promote joint requirements for all capability development. Third, the Associate Deputy Minister (Information Management) should be spearheading the convergence of networks. One integrated warfighting network is required. As well, an analysis should occur regarding Combat cloud and open architectures. These recommendations should enable C2 modernization for the pan-domain environment.

⁴⁴ Michael E. Hutchens, et al. "Joint Concept for Access and Maneuver in the Global Commons: A New Joint Operational Concept," *Joint Force Quarterly*, no. 84 (1st Quarter 2017), 138.

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