National Defence Défense nationale

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CANADIAN ARMY AIR DEFENCE: TACTICAL NETWORK AGILITY

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JCSP 47

Service Paper

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CANADIAN FORCES COLLEGE - COLLÈGE DES FORCES CANADIENNES

JCSP 47 - PCEMI 47
2020 - 2021

SERVICE PAPER – ÉTUDE MILITAIRE

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Word Count: 2,524

Nombre de mots : 2.524

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AIM

1. Since the retirement of the Air Defence Anti-Tank System (ADATS) just after the Vancouver Olympics of 2010[1], the Canadian Armed Forces (CAF) has been without a dedicated Ground Based Air Defence (GBAD) system. This shortcoming has increased the CAF's vulnerability in future tactical theatres of operation while also highlighting Canada's susceptibilities at the operational and strategic levels. This paper will discuss the Canadian Army's (CA) future GBAD system needs, nested within the existing Air Defence (AD) artillery doctrine, for the land environment and provide a recommendation for the most appropriate GBAD system of action at the optimal integration level.

INTRODUCTION

2. This service paper examines the requirements for the future implementation of a GBAD system within the CA. The need for a GBAD system is a pressing concern for the CA as it is a stated priority within the Canadian government's White Paper *Strong Secure Engaged*[2]. Additionally, it is a capability, and credibility gap within the CA acknowledged due to recent conflict to deployed operations within Iraq and Latvia, and most recently with the 2020 war between Armenia and Azerbaijan. [3]

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[1] Department of National Defence. "Section II : Analysis of Programs by Strategic Outcome - RPP 2013-14," *Reports on Plans and Priorities 2013-14.* (Ottawa: Department of National Defence, 2014). https://www.canada.ca/en/department-national-defence/corporate/reports-publications/plans-priorities/2013-14.html

[2] Department of National Defence. Strong, Secure, Engaged: Canada's Defence Policy. (June 7, 2017), 102. https://www.canada.ca/en/department-national-defence/corporate/reports-publications/canada-defence-policy.html

[3] Lee Berthiaume, "Iran attack underscores need for new air defences: Canadian Army," The Canadian Press, *The National Post*, January 08, 2020, https://nationalpost.com/pmn/news-pmn/canada-news-pmn/iran-attack-underscores-need-for-new-air-defences-canadian-army

3. As a result of divesting the previous GBAD system before a direct replacement was available, the CA can now propel AD systems integration forward. This paper will look at what GBAD systems do, what the CA needs it to do, what our allies are doing with GBAD, and where it is best integrated into the CA. As the technology and capabilities of GBAD systems have increased drastically since the CA's last system, a holistic and thorough approach is required to examine what was needed to protect the CA now and into the future. This effort will protect the present force and increase its agility by fully integrating within a network-enabled combat system, a requirement for any future capability within the CA.

DISCUSSION

Role and Purpose of Air Defence

4. Air defence artillery's role in the CAF is to "prevent the enemy from interfering from the air with friendly force operations on the ground."[4] This definition is quite general in nature and subject to many possible action systems that could apply to kinetic and non-kinetic to achieve the desired effect. The Ministry of Defence (MoD) of the United Kingdom (UK), in their recently retired "Joint Air Defence" doctrine, defined air defence as "all measures designed to nullify or reduce the effectiveness of hostile air action."[5] As opposed to air defence's role in the CAF, this definition increases the scope of action sufficient to achieve the result. Regardless of the definition used, or nuance preferred, air defence's role is to prevent the enemy from interfering

[4] Canada. Department of National Defence. B-GL-372-001/FP-001, Air Defence Artillery Doctrine. Ottawa, ON: Chief of the Defence Staff, 1999: 2.
[5] United Kingdom, Ministry of Defence, *Joint Warfare Publication 3-63, Joint Air Defence (*Swindon, UK: Director General Joint Doctrine and Concepts, 2003), 1-1, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/784305/archive_doctrine_uk_joint_air_defence_jwp_3_63.pdf

with land operations. The reduction of the enemy effect is likewise essential as AD must not be viewed as a panacea against all CA air threats. Within the CA's constraints, no system is capable of shielding the force alone from all aerial threats.

5. The purpose of AD artillery on history's battlefields is reflected in the four tactical tasks they fulfill: early warning, protection, attrition, and airspace coordination.[6] These tactical tasks have not changed on the modern battlefield, but there are subtle alterations that will continue to influence the future's AD environment. The most significant change which will occur shortly is that networking will become an essential tactical task for any AD asset.[7] Tactical information is a critical component to today's sensor-shooter links and will evolve further pre-eminent in future conflicts. Differentiation between friend and foe, changes to rules of engagement or fire orders, and the development of a common operating picture for all air assets will define the air environment of the future.

6. The evolving air threat to the CAF and its allies is the determining factor in discussing the role and purpose of air defence artillery's future. The evolution of air threats within the operating environment directly influences what any future GBAD system will be used for and what its limitations will be. The likely threats remain fighter-bombers, reconnaissance aircraft, attack helicopters, transport aircraft, rockets, artillery, mortars, air to surface missiles and bombs, and remotely piloted aircraft systems (RPAS) or unmanned aerial vehicles (UAV).[8] These threats

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[6] Air Defence Artillery Doctrine, 8.
[7] US Army, *Army Air and Missile Defence 2028* (Huntsville AL: Air and Missile Defense Integration Division, USASMDC/ARSTRAT, 2019), 11, https://www.smdc.army.mil/Portals/38/Documents/Publications/Publications/SMDC_0120_AMD-BOOK_Finalv2.pdf
[8]Canada. Department of National Defence, "Ground Based Air Defence," *Defence Capabilities Blueprint*, (Ottawa: Directorate of Capability Integration National Defence, 2020), http://dgpaapp.forces.gc.ca/en/defence-capabilities-blueprint/project-details.asp?id=940

remain extant within the umbrella of full-scale conflict, but it is necessary to tailor future assets towards the most likely threat. Within the past two decades, there has been a surge in UAVs' acquisition and implementation across the full spectrum of conflict.[9] UAVs continue to play an ever-greater role in operations for both adversarial and friendly forces, as seen in the Crimea in 2014 and the Armenia/Azerbaijan conflict of 2020.[10] The adversary is not static in employing its air space platforms in an evolving process, and friendly air defence forces must be capable of fulfilling any tactical tasks assigned within this complex environment.

Methods of Engagement

7. Within the modern air defence community, either allied, neutral, or adversarial, there are two primary methods of direct engagement; guns and missiles.[11] Guns and missiles have a long history of operation within air defence operations but continue to evolve in the operational realm. While numerous other methods have been built upon niche requirements, such as static nets strung between buildings to combat small commercially available UAV's, these niche capabilities are just that, niche, and are not relevant to a pan-Army approach. [12]

8. The most common historical method of engagement against aircraft and air-based threats is anti-aircraft cannons or guns. This method has been in use since the First World War. It

[9] Matthieu J. Guitton, "Fighting the Locusts: Implementing Military Countermeasures Against Drones and Drone Swarms," *Scandinavian Journal of Military Studies*, 4(1), 26–36. DOI: http://doi.org/10.31374/sjms.53.
[10] Vasyl Mykhailyshyn, "The Influence of the Conflict in Ukraine on the Modernization of the Russian Armed Forces Since 2014," *Torun International Studies* Vol. 1, no. 10 (2018): 52, https://apcz.umk.pl/czasopisma/index.php/TSM/article/view/TSM.2017.004/14082
[11] John T. Correll, "Air Defense From the Ground Up," *Air Force Magazine*, July 01, 1983, https://www.airforcemag.com/article/0783air/
[12] Eric Schmitt, "Pentagon Tests Lasers and Nets to Combat a Vexing Foe: ISIS Drones," *The New York Times*, September 23, 2017, https://www.nytimes.com/2017/09/23/world/middleeast/isis-drones-pentagon-experiments.html

continues to be quite effective against low-level aircraft, helicopters, UAVs and targeting adversarial missiles and projectiles. Simultaneously, the most archaic and rudimentary of the air defence methods of engagement, technological advances have increased the effectiveness and responsiveness of gun systems. There are two primary platforms that allow for AD guns and are still used in peer and near-peer militaries across the world; self-propelled and static defence systems.

9. The technological advancement of AD can be best highlighted by examining the USSR/Russian ZSU 23-4, first deployed into the USSR forces in 1965.[13] Armed with four 23mm cannons, it was a potent weapon against low flying aircraft and has been continuously updated since its inception. The most recent ZSU 23-4 variant is equipped with modernized laser range finders, enhanced tracking and engagement radars, additional surface-to-air missiles capable of engaging multiple aircraft simultaneously and remains mounted on an updated self-propelled chassis. The ZSU 23-4 is a highly effective platform that remains a threat to conventional air platforms. The combination of guns and missiles is not only useful in its primary role of engaging aircraft but is highly maneuverable and sufficiently capable against ground forces as well.

10. Static projectile defences are a distinct type of air defence system that is more institutionally defensive but is extremely capable due to its natural characteristics. To combat aerial threats to fortifications such as forward operating bases (FOB) and airfields, allied armies looked for air defence systems that were capable of air defence but more specifically projectile

[13] *World Wide Equipment Guide - Volume 2: Air and Air Defense Systems*, "RUSSIAN 23-MM SP AA GUN ZSU-23-4," last modified December 2016, 344, https://community.apan.org/cfs-file/__key/docpreview-s/00-00-03-06-84/WEG-2016-Vol-2-Air-and-Air-Defense-Systems.pdf

and missile defence.[14] AD platforms have been in use on allied warships for several decades and were easily converted for land usage. Systems such as Phalanx CIWS and Oerlikon's Skyguard system were modified to fit this role and can defeat most projectiles in close proximity to these sensitive areas.[15] These point defensive platforms are incredibly potent, but they are extremely cumbersome and are not portable from a tactical perspective. They are not suitable for tactical operations but could be very useful in conducting point defence tasks, such as on bridging sites or in the protection of headquarters units.

11. Missiles remain a vital air defence capability that remains relevant and effective against both fast attack aircraft and medium to large-sized targets. As guns are relatively ineffective against fast-moving and targets at high altitudes, missiles are the only effective defence method in several scenarios.[16] Air defence missile systems are varied in their capabilities and have their inherent strengths and weaknesses. Tactical missile systems used to intercept low-level aircraft or helicopters are extremely capable and mobile but remain ineffective against high-altitude aircraft. Juxtaposing this capability with an operational level missile system, the Russian Federation S-400 High Altitude Air Defense System (HIMADS) is the inverse. It is exceptionally effective at mid to high-altitude aircraft and high-speed aircraft but is too cumbersome and expensive to engage helicopters and small UAVs.[17] Many missile systems are

[14] Andrew Feickert, "U.S. Army Short-Range Air Defense Force Structure and Selected Programs: Background and Issues for Congress," *Congressional Research Service*, (Washington D.C.: Congressional Research Services,2020), 7, https://fas.org/sgp/crs/weapons/R46463.pdf
[15] "Counter-Rocket, Artillery, Mortar (C-RAM) Intercept Land-Based Phalanx Weapon System (LPWS)," United States Army Acquisition Support Center, accessed 05 February 2021, https://asc.army.mil/web/portfolio-item/ms-c-ram_lpws/
[16] Christian Wachsberger, Michael Lucas and Alexander Krstic, "Limitations of Guns as a Defence Against Maneuvering Air Weapons," (Edinburgh South Australia: Defence Science and Technology Organization, 2004), 39, https://apps.dtic.mil/dtic/tr/fulltext/u2/a426717.pdf
[17] John V. Parachini and Peter A. Wilson, "Drone-Era Warfare Shows the Operational Limits of Air Defense Systems," *The Rand Blog*, July 02, 2020, https://www.rand.org/blog/2020/07/drone-era-warfare-shows-the-operational-limits-of-air.html

effective at their bespoke tasks and have varying degrees of marginal overlap between tactical, operational and strategic capabilities. Selecting the correct system relies not only on the system capabilities itself but also on the level of command for integration and the nature of its tactical tasks.

12. This analysis does not limit other approaches that have been taken in the past or some present circumstances, such as directed energy weapons, network hacking, using nets for micro-UAVs or methods of spoofing or jamming signal. It is only meant to reduce the plethora of current and emerging AD systems to provide realistic options with corresponding analysis to the CA.

Systems Approach to Air Defence

13. Regardless of a platform's engagement method, any future AD system needs to be wholly integrated into a systems approach. The nature of emerging doctrinal changes to the CA and its allies, most importantly the Unites States armed forces, requires that all multi-domain systems communicate to pass along pertinent information and conduct real-time de-confliction and engagement.[18] While a platform operating in isolation is still capable of engaging a target, the information fed through the pan-domain network will augment its ability to perform its tactical functions and increase all its networked partners' capabilities. Technologically superior forces will have a decisive edge on tomorrow's battlefield. The ability to influence the air domain will require superior networked forces, working in concert in a tactically feasible manner.[19]

[18] U.S. Army Short-Range Air Defense Force Structure and Selected Programs: Background and Issues for Congress, 17.
[19] Army Air and Missile Defense 2028, 12.

Integration Point

14. Multiple integration points would successfully employ, direct, and enable an emerging GBAD capability within the CA. Air defence assets could be integrated at the Army, Divisional, Brigade and Battle Group levels, depending on the asset's size, area of coverage, and its method of engagement. This is of critical distinction as many assets can integrate within existing networks and work on the system of systems, and others are entirely self-contained. The integration point for the future GBAD program requires a suitable level of coverage based on terrain and the authorities to perform its role without additional delay or procedure, such as an area weapon being used at a bridge site demolition.

15. Integration at the highest level, such as the corps or army level, is suitable for theatre and strategic level air defence assets, which are in operation for the CA's allies and adversaries. The US National Missile Defense (NMD) system, or more colloquially known as the anti-ballistic missile system, the Israeli Iron Dome, and the Russian S-400 integrated air defence system, are all capable air defence systems that operate at the strategic and operational level.[20] Due to their size, capabilities, and the sensitive nature of their operations, they are all integrated at levels surpassing the tactical.

16. Below the strategic level, the divisional level is the next possible integration point within the CA. At the divisional level, the joint environment is prevalent, and it would be possible to integrate a robust air defence platform with little difficulty seamlessly. With the relatively static nature of a divisional headquarters, greater connectivity for the system's network would be

[20] Mustafa Kibaroğlu, "On Turkey's Missile Defense Strategy: The Four Faces of the S-400 Deal between Turkey and Russia," *Perceptions* 24, no. 2 (Autumn, 2020): 171. https://search-proquest-com.cfc.idm.oclc.org/scholarly-journals/on-turkeys-missile-defense-strategy-four-faces-s/docview/2350102088/se-2?accountid=9867.

achieved, which would facilitate continuity and coverage, even in degraded environments. With our US allies, this level of protection is afforded by one of their remaining dedicated AD units.[21] It provides broad coverage to intercept both aircraft and missile strikes, enabling ground force manoeuvre.[22]

17. In addition to the Corps and Divisional levels, the Brigade level is an appropriate integration point for future air defence capabilities due to its connectivity and joint nature. As mentioned in Close Engagement, the Brigade (Bde) Group is the lowest level of joint effects integration and ability to operate under an allied or multinational division.[23] The Bde level offers a logical integration point for any GBAD system as it remains relevant, deployable, and networked for full operational capacity. At the tactical level, the variety of platforms increases dramatically, incorporating guns and missiles. Flexibility is inherent at the Bde level, which would increase the adaptability and effectiveness of any future AD system. The US Army recently offered tender on a new Initial Maneuver Short Range Air Defense (IM-SHORAD), which integrates guns and missiles on a converted Stryker platform.[24] Offering the tactical protection of a General Defence Land Systems (GLDS) Stryker with the flexibility of engaging targets with either a main cannon or surface to air missiles, future engagement and defensive

[21] U.S. Army Short-Range Air Defense Force Structure and Selected Programs: Background and Issues for Congress, 3.
[22] Ibid, 1.
[23] Department of National Defence, "Close Engagement," (Kingston, ON: Canadian Land Warfare Centre, 2019), 22, http://www.army-armee.forces.gc.ca/assets/ARMY_Internet/docs/en/close-engagement.pdf
[24] Defence News, "Leonardo DRS awarded USD 600+ Mn to provide mission equipment packages for US Army initial maneuver short-range air defense." Defence News. (22 Jan 2021). https://www.armyrecognition.com/defense_news_january_2021_global_security_army_industry/leonardo_drs_awarded_usd_600_mn_to_provide_mission_equipment_packages_for_us_army_initial_maneuver_short-range_air_defense.amp.html

capability will increase drastically for the US Army. Integration of this style of system into the Canadian Mechanized Brigade Group would be simple.

18. The last feasible integration point within the CA for an emerging GBAD system would be at the Battle Group (BG) level. As one of the smallest entities which are capable of operating independently, usually having both combat support and combat service support enablers integral, with network capability, it is feasible to integrate Very Short Range Air Defence (VSHORAD) assets into a BG. In practical terms, while the centre of gravity for the CA is the Bde, it is unlikely for a Bde to deploy unless hostilities reach conventional war levels. BG's have been the CA's standard deployment element since the redeployment of a Bde from Germany after the Cold War. While not a foregone conclusion or ideal, splitting a sub or sub-sub-unit of AD and attaching it to a BG is possible and, in some cases, necessary. Whether this is the ideal as a matter of doctrine is for future consideration,

CONCLUSION

19. The CA has a great capacity and potential to integrate several ground-based air defence varieties within its ranks in the immediate future. Many tried and tested systems can be integrated into different levels of command, depending on the asset capabilities and control requirements. The agility inherent within the CA allows for a robust solution that can easily shield the CA from the most pressing threats of today and tomorrow. In-kind, the CA is advantaged in its existing doctrine and thoughts behind its future GBAD capability where it would not require a significant change to the role of AD now and into the future. The CA will still be vulnerable to aerial attack if operating alone but nested within an allied coalition or partnership; the CA will be far more capable of not only shielding ourselves but that of our allies

as well. With future networking advantages and digitization agility, any future GBAD system can be optimized to defeat most threats to the force while keeping friendly forces flying safely.

RECOMMENDATION

20. The Canadian Army should invest in a tactically mobile air defence platform with the ability to engage a variety of aerial threats, from small UAVs to modern fifth-generation fighters. Additionally, this platform should engage with both guns and missiles to provide agility and flexibility in its engagements with aerial threats and possible ground threats. Lastly, these platforms should be integrated within the Bde construct, allowing seamless integration to all national and coalition digital networks.

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