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THE NEGLECTED CAPABILITY: RCAF TACTICAL DATA LINKS

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AIM

1. To highlight a current and future Tactical Data Link (TDL) capability gap in the Royal Canadian Air Force (RCAF), and discuss opportunities to align the capability with strategy. The adoption of a robust TDL capability is a strategic objective inferred by Canada's defence policy, *Strong, Secure, Engaged* (SSE), and outlined in the Canadian Armed Forces (CAF) Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) strategic vision, goals and objectives.

INTRODUCTION

2. The fundamental tenet of air power is centralized control, decentralized execution, in which "air forces are organized on sound Command and Control (C2) principles with the purpose of achieving operational effectiveness across the spectrum of conflict."[1] Today, the operational environment is "characterized by complexity, uncertainty and a rapidly changing tactical situation."[2] Here, TDLs play a crucial role in achieving operational effectiveness in a dynamic environment by providing means to disseminate information processed from multiple airborne platforms and ground systems via radio waves and data cables.[3] In the future, their role will grow imperative for any successful application of air power, as air force operations are

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[1] Department of National Defence, B-GA-401-000/FP-001, *Royal Canadian Air Force Doctrine* (Ottawa: DND Canada, 2016), 21.

[2] Department of National Defence, B-GA-402-001/FP-001, *Royal Canadian Air Force Doctrine: Command and Control* (Ottawa: DND Canada, 2018), 14.

[3] Northrop Grunmman Corporation, *Understanding Voice and Data Link Networking: Northrop Grumman's Guide to Secure Tactical Data Links* (San Diego: Northrop Grunmman Corporation United States, 2014), 1:1.

predicted to become network-centric, interdependent, and functionally integrated with available resources from different elements.[4]

3. The Canadian defence policy, SSE, states that RCAF capabilities must be "multipurpose – equally relevant to domestic and international operations, capable of incorporating and adapting to the latest technology, integrated with all of the capabilities in the CAF, and interoperable with core allies."[5] Further, the CAF C4ISR strategic vision states that "all CAF operational platforms will establish a TDL capability interoperable with the J-Series message format [Link 16] to enable joint and multinational C2, including targeting and situational awareness."[6] For the RCAF to meet these objectives, one of the investments planned in SSE is to "acquire new tactical integrated command, control, and communications, radio cryptography, and other necessary communications systems."[7] In turn, the RCAF strategic objective is to generate an integrated force that can "maintain and advance interoperability and pursue full networked capability to ensure Canadian air power remains a key enabler to the success of CAF operations."[8] To achieve a full-networked capability that is interoperable and integrated between the air force and other elements, a robust TDL architecture is essential. An analysis of the current and future TDL architecture highlights a capability deficiency that could compromise the RCAF's ability to fulfill its strategic integrated force objective. This service paper approaches the RCAF's TDL capability deficiency in four parts. First, it explores the concept of TDL and its

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[4] David A. Deptula, "A New Era for Command and Control of Aerospace Operations," *Air & Space Power Journal vol 28 issue 4* (July-August 2014): 14, https://www.airuniversity.af.mil/Portals/10/ASPJ/journals/Volume-28_Issue-4/SLP-Deptula.pdf

[5] Department of National Defence, *Strong, Secure, Engaged: Canada's Defence Policy* (Ottawa: DND Canada, 2017), 39.

[6] Department of National Defence, *The Canadian Armed Forces C4ISR Strategic Vision, Goals and Objectives* (Ottawa: DND Canada, 2016), 32.

[7] DND, *Strong, Secure, Engaged . . .*, 39.

[8] Department of National Defence, A-GA-007-000/AF-008, *Air Force Vectors: Agile, Integrated, Reach, Power* (Ottawa: DND, 2014), 36.

function in the RCAF. Second, it highlights the current deficiency by studying the coverage gap, and third, the future deficiency by analyzing the planned future capabilities. Finally, it explores the concept of advanced TDLs and what it means for the RCAF.

DISCUSSION

4. The design of TDLs was developed to enable mission computers to share near-real-time surveillance and command data, such as details about a platform or target data, to generate a Common Operating Picture (COP) for decision makers.[9] The most commonly known TDL is Link 16, which became operational in the United States military in the mid-to-late 1980s.[10] Whereas Link 16 is functionally similar to the capabilities of other legacy TDLs, namely Link 11, it provides added technology and capabilities such as secure voice, jam resistance, and data throughput capacity.[11] Today, the legacy Link 16 is still used on multiple North Atlantic Treaty Organization (NATO) platforms, such as the F-15, F-16, Eurofighter, F/A-18, and Mirage 2000.[12] In the RCAF, the first notable adoption of Link 16 occurred in 2006, via phase two of the CF188 modernization project, when CF-188 fighter aircraft were fitted with a Multifunction Information Distribution System (MIDS) Low Volume Terminal (LVT), which allowed them to stay in constant contact with other platforms via secure data and communication.[13,14] Currently, there are only two RCAF air fleets capable of TDL: the CF188 has Link 16, and the CP140

[9] Northrop Grunmman Corporation, . . ., 2-3.
[10] *Ibid.*
[11] *Ibid.*, 1-2.
[12] John Keller, "Air Force eyes next-generation tactical data links gateway for jet fighter communications," *Military and Aerospace*, 9 March 2016.
[13] National Defence and the Canadian Armed Force, "Archived - CF-18 Modernization," last accessed 12 October 2018, http://www.forces.gc.ca/en/news/article.page?doc=cf-18-modernization/hnocfoca
[14] Northrop Grunmman Corporation,. . ., 2-5.

operates Link 11.[15] There are plans to add Link 16 to the CP140 via the aurora incremental modernization project block 4 and to the CH148 cyclone via the maritime helicopter project.[16] Further, it is safe to assume that future RCAF acquisitions projected in SSE, specifically advanced fighter aircraft, strategic air-to-air tanker-transport, multi-mission aircraft, and remotely piloted system, will all be equipped with some form of TDL capability.[17] These new or upgraded aircraft capabilities that are planned for the RCAF can only be fully absorbed in the presence of a robust TDL architecture, which is currently lacking in Canada.

5. The RCAF relies on five ground units that operate Ground Entry Stations (GES) for its TDL network connectivity. These units are 12 Radar (12ER), 42 Radar (42 RS), 8 Air Communications and Control Squadron (8 ACCS), and two deployed mission support centres (DMSCs) on the east and west coasts.[18] It should be noted that these units generally have limited GES capability, mostly due to inadequate manning and due to some of their equipment being obsolete.[19] For air-to-air or ground-to-air communications, Link 16 is strictly communicated via Ultra High Frequency (UHF) Line of Sight (LOS), making it effective up to 300 nautical miles.[20] To overcome LOS limitations, such as range, terrain, and incompatible frequencies, the RCAF uses its GES as tactical gateways. These GES are connected to the national network via ground-to-ground Beyond Line of Sight (BLOS) connections, and fuse data into a COP. This concept works well when assets are operating in proximity of GES, which are usually co-located with

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[15] Department of National Defence, *The Royal Canadian Air Force C4ISR Concept* (Ottawa: DND Canada, 2017), 16.

[16] *Ibid*.

[17] DND, *Strong, Secure, Engaged . . .*, 39.

[18] Treasury Board of Canada Secretariat, *Royal Canadian Air Force Tactical Integrated Command, Control, Communications Air Business Case* (Ottawa: TBS Canada 2013), 29.

[19] 1 Canadian Air Division, *Royal Canadian Air Force Tactical Data Link Statement of Capability Deficiency* (Winnipeg: 1 Cdn Air Div Canada 2015), 2.

[20] Northrop Grunmman Corporation,. . ., 2-6

their Main Operating Bases (MOBs). However, the Joint and RCAF domain suffer from an insufficient number of GES, and when combined with the immensity of Canada's geography, this creates a lack of TDL redundancy across the nation and therefore prevents the RCAF from fully exploiting the capability of TDLs.[21] In the context of CAF core missions, such as Canada's participation in North American Aerospace Defense Command (NORAD), the limited TDL redundancy restricts the range at which Canadian NORAD assets can be seamlessly integrated into the network and the greater NORAD COP.[22] As an example, on an Operation Noble Eagle (ONE) mission, NORAD's response to homeland security following 9/11, NORAD CF188 aircraft could easily find themselves outside of radar and radio coverage while prosecuting a threat, and therefore become unable to communicate with the Canadian Air Defence Sector (CADS) to relay critical information. In this case, Link 16 would be a system of choice, due to its text message and secure voice capability, but the current gap in Canadian TDL coverage limit the RCAF's ability to do so.

6. The current gap in TDL capabilities and coverage reduces the RCAF's battle management ability to support commanders in visualizing the battlespace and in providing shared situational awareness to all warfighters.[23] The RCAF C4ISR concept identified TDL shortcomings related to interoperability, agility, and integrated intelligence and operations.[24] To address these shortcomings in the future and provide SA as well as dependable C2 of the battlespace, the RCAF Tactical Integrated Command, Control, Communications Air (TIC 3 Air) project plans on establishing new, replacing, and modernizing critical communications

[21] DND, *The RCAF C4ISR Concept . . .*, 14.
[22] DND, *Strong, Secure, Engaged . . .*, 17.
[23] TBS, *RCAF TIC 3 Air . . .*, 5.
[24] *Ibid.*, 6.

infrastructure across Canada.[25] Specifically for TDL, this means the deployment of a network of 16 fixed and remotely accessible Link 16 GES as well as five deployable RCAF ground units with TDL capabilities.[26] When combined, this new TDL infrastructure will support the near-real-time exchange of data between RCAF aircraft and C2 centres.[27] However, the TIC 3 Air project has been delayed since its inception. The project as it is currently defined will not receive implementation approval before late 2019, and will most likely not be fully implemented before 2025.[28] Aside from the delay, there are two critical issues with the project. First, as illustrated in Annex A, the layout of 16 GES bridges, to some extent, the TDL capability gap in southern Canada, but offers little coverage in the Arctic, where critical NORAD Forward Operating Locations (FOLs) are located, such as Iqaluit, NU.[29] Second, the project strictly plans for legacy Link 16 capabilities, which suggest that the RCAF risks falling behind technologically as Canada's NATO allies push to incorporate advanced TDL in their networks. While the TIC 3 Air project will be beneficial to the overall RCAF TDL infrastructure, it lacks the robustness required to offer redundant TDL coverage across Canada and does not encompass significant developments in advanced TDLs shown in recent years.

7. Since 2005, the United States and other NATO allies have been conducting tests to develop and incorporate advanced TDL in their networks with the goal of fully benefiting from advanced aircraft capabilities.[30] In permissive environments like Afghanistan and Iraq, legacy

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[25] *Ibid.*, 8.
[26] *Ibid.*
[27] *Ibid.*
[28] TBS, *RCAF TIC 3 Air . . .*, 54.
[29] Skies Magazine, "NORAD training planned across Canada's North," last accessed 12 October 2018, https://www.skiesmag.com/press-releases/noradtrainingplannedacrosscanadasnorth/
[30] Defense-Aerospace, "DARPA Successfully Demonstrates Tactical Targeting Network Technology," last accessed 12 October 2018, http://www.defense-aerospace.com/article-view/release/63921/darpa-demos-tactical-targeting-network-(oct-25).html

TDLs such as Link 16 have worked well; however, there are two distinct limitations when operating in complex and future environments, which entail Anti-Access Area Denial (A2AD) systems and tactics. First, Link 16 emits a Radio Frequency (RF) signature that can be detected and tracked by hostile aircraft.[31] Second, the type of data is highly restrictive in nature as it is based on 40 years old technology, meaning it uses an inflexible set of fields made of a prescribed set of number encoded bits (J-series message).[32] For these two reasons, fifth-generation aircraft like the F-35 Lightning II joint strike fighter use Multifunction Advanced Data Link (MADL) waveforms to retain their stealth capabilities.[33] This advanced data link "allows coordinated tactics and engagements that bring significant operational advantage to fifth generation aircraft operating in high-threat environments."[34] The MADL involves mostly air-to-air communications, but further advancements regarding the backbone of TDL networks are also occurring. One of which is the Tactical Targeting Network Technology (TTNT) developed and tested successfully by Rockwell Collins on several occasions.[35] The TTNT omnidirectional data link creates a "secure meshed network that can deliver megabits of voice, video, and data at speeds up to Mach 8, without the requirement of advanced pre-planning and Time Division Multiple Access (TDMA) based options".[36] When compared to Link 16, TTNT offers much more flexibility due to its speed, data capacity, and dynamicity, as it is based on the Transmission Control Protocol/Internet Protocol (TCP/IP) model, which is continuously being

[31] John Keller, . . ., 9 March 2016.
[32] Northrop Grunmman Corporation, . . ., 2-7.
[33] *Ibid.*, 8-4.
[34] *Ibid.*
[35] Rockwell Collins, "Tactical Targeting Network Technology," last accessed 12 October 2018, https://www.rockwellcollins.com/Products-and-Services/Defense/Communications/Tactical-Data-Links/Tactical-Targeting-Network-Technology.aspx
[36] *Ibid*.

modernized by the commercial sector.[37] In 2014, the United States Navy awarded a contract to the company Viasat for it to incorporate TTNT into to the Navy's MIDS Joint Tactical Radio System (JTRS) terminals.[38] By doing so, the MIDS JTRS will enable the United States Navy to operate the near-real-time operating picture of today via Link 16, but also integrate into future network-centric communications, such as those conducted over TTNT, as the terminal is capable of operating on four different channels.[39] The MIDS JTRS is an excellent example of how the RCAF could start incorporating advanced TDLs into its network infrastructure. However, there are currently no definitive plans or projects in the RCAF to embrace advanced TDL. Still, the Government of Canada plans on phasing in new advanced fighter aircraft as soon as 2025, at which point, the TIC 3 Air project should be delivering legacy Link 16 infrastructure that does not encompass advanced TDLs.[40] At that point, considering that Link 16, a technology from the 1980s, will only be passably implemented in Canada in 2025, it will be extremely challenging for the RCAF to implement advanced TDLs with reasonable success unless they are embraced immediately.

CONCLUSION

8. Given the strategic imperative to implement TDLs and considering the current and future capability gap, the RCAF and consequently the greater CAF are at a crucial decision point. As identified in the CAF C4ISR strategic vision, a failure to coordinate tactical and operational actions in the battlespace would likely produce ineffective operations and at worst, result in self-

[37] N.C. Stuckey, "Airpower in the information age: Embracing TCP/IP within airborne networks" (Air Command and Staff College Course Paper, Maxwell AFB Air University, 2015), 20.

[38] United States Department of Defense, "Contracts for Aug. 19, 2014," last accessed 12 October 2018, https://dod.defense.gov/News/Contracts/Contract-View/Article/606002/

[39] Viasat, "MIDS JTRS 4-Channel Radio," last accessed 12 October 2018, https://www.viasat.com /products/link-16-mids-jtrs

[40] David Pugliese, "Canada's CF-18s to fly until 2032 as new fighter jets expected to be slowly phased in," *The National Post*, 28 January 2018.

defeat.[41] In turn, TDL capabilities connect decision makers in networks and support continuous sharing of near-real-time information that allows warfighters to make optimal employment of sensors and weapons.[42]

9. For the RCAF, given the nature of domestic and expeditionary operations, as well as the acquisition of assets planned in SSE, the air force should ensure that it has a robust TDL network to enable interoperable, agile, and integrated operations. Without the ability to command and synchronize airborne platforms that make use of TDL, investments in new advanced platforms will be for naught. Likewise, without leadership willpower and a clear vision that result in the adoption of advanced TDLs, the RCAF's ability to conduct operations in A2AD environments will most likely be restrained, or worse denied, by its inability to exchange information with allies on advanced networks.

RECOMMENDATION

10. The following recommendations are provided for consideration:

a. Prioritize and accelerate the procurement of TDL capabilities via the TIC 3 Air project, focusing on Link 16, to bridge the RCAF's current TDL capability gap;

b. Fund research projects on how to best incorporate advanced TDLs such as TTNT into the RCAF TDL infrastructure;

[41] DND, *The Canadian Armed Forces C4ISR . . ., 32.*
[42] *Ibid*.

c. Based results from research of advanced TDLs, expand and expedite funding for the acquisition and delivery of additional TDL capabilities, to bridge the RCAF's future TDL capability gap;

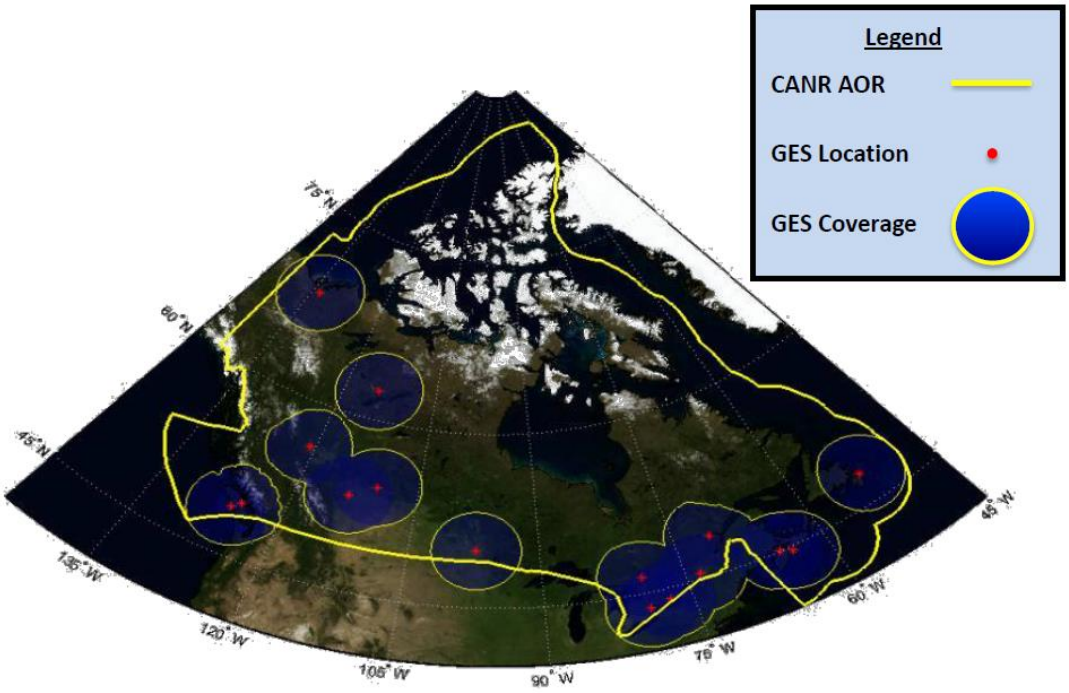
d. Develop and support a centralized RCAF TDL training capability to generate an adequate number of trained personnel that can maintain and sustain the TDL infrastructure; and

e. Embrace the Concept of Operations (CONOPs) developed by 1 Canadian Air Division Staff Officer Data Links (1 Cdn Air Div SO DL) and spearhead the development of CAF Joint TDL CONOPs.

Annex: A. Proposed Link 16 GES by TIC 3 Air.[43]

[43] TBS, *RCAF TIC 3 Air . . .*, 70.

Annex A. Proposed Link 16 GES by TIC 3 Air.



3 Wing Bagotville *	19 Wing Comox *	12 Wing Shearwater/Halifax	Inuvik (FOL)
8 Wing Trenton	17 Wing Winnipeg	Toronto	Ft St John
14 Wing Greenwood *	Montreal	Edmonton	St Johns
4 Wing Cold Lake *	22 Wing North Bay	Yellowknife (FOL)	Tofino

NOTES:

(1) All GES locations have Link-16 capabilities
(2) Sites annotated with an * have both Link-16 and SV capabilities
(3) Gaps in coverage will be filled using deployable GESs

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