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TARGETING-QUALITY VIDEO: OPTIMIZING THE TACTICAL DATA LINK WIDE AREA NETWORK

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Maj Peter Williams

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AIM

1. To argue for the use of the purpose-built Tactical Data Line (TDL) Wide Area Network (WAN) infrastructure for the dissemination of Intelligence Surveillance Reconnaissance (ISR) video to provide targeting-quality, near-real-time video from Canadian ISR assets for use on operations by the Canadian Armed Forces (CAF) and coalition partners.

BACKGROUND

2. Two Canadian CP-140M Long Range Patrol aircraft and six CF-18 fighter aircraft were deployed to Operation (Op) *Impact* in October 2014 as part of the initial Canadian commitment against Da'esh in Iraq and Syria.¹ The CP-140 and CF-18 both possess formidable ISR capability: the CP-140's Wescam MX-20 camera and the CF-18's Sniper Advanced Targeting Pod.² However, it was not until early 2017, on rotation four of Op *Impact*, that targeting-quality, near-real-time ISR video was provided to the Coalition Air Operations Centre (CAOC) in Qatar.³ This is concerning as the sole role of the CP-140 was to provide overland surveillance capability to the coalition and the CF-18s were redeployed in March 2016, during rotation two of Op *Impact*.⁴

¹ Canada, "Operation IMPACT," Ottawa: Department of National Defence, 2018. Last accessed on 30 January 2018. <http://www.forces.gc.ca/en/operations-abroad-current/op-impact.page>

² Iain Huddleston, "Changing with the Times: The evolution of Canada's CP-140 Aurora," *Canadian Naval Review*, Volume 11, Number 1(2015), Halifax: Dalhousie University's Centre for the Study of Security and Development, 2015, 10-15; Lockheed Martin, "Sniper Advanced Targeting Pod," Bethesda: Lockheed Martin Corporation.

³ Mael Roy-Richard, "iBLOS paints a clearer picture," *The Maple Leaf*, Ottawa, Department of National Defence, 2017.

⁴ Canada, "Operation IMPACT"...

3. The provision of targeting-quality, near-real-time ISR video to the coalition was delayed due to a combination of factors: the adoption of the CP-140's interim Beyond Line of Site (iBLOS) capabilities in late 2014, improper equipment configuration, and use of a SECRET network that was not optimized for multicasting⁵ of near-real-time, streaming video from ISR assets. A DGAEPM⁶ Technical Assistance Visit in October 2016 quickly rectified the iBLOS and Tactical Common Data Link⁷ (TCDL) equipment configuration issues.⁸ The decentralizing of the iBLOS ground entry segment, from Ottawa to an in-theatre enclave, was a transformational change that will be included in the solution proposed in this service paper. However, the network solution implemented for transmission of ISR video over the Canadian SECRET Network infrastructure (CSNI) network was an isolated instance developed in support of Op *Impact*. It would require a comparable level of time and effort to develop a similar network solution to support a future mission's ISR requirements.

DISCUSSION

The Deficiency

4. The absence of a SECRET network optimized for the dissemination of ISR video continues to be a CAF capability deficiency. The current practice is dissemination of ISR video via CSNI. CSNI is the CAF's classified corporate system of record for purposes such as, but not limited to, Command and Control (C2) of forces, planning for and monitoring of operations, classified correspondence, classified administration, desktop Secure Video Teleconferencing,

⁵ "Multicasting enables a single transmission to be split up among multiple users, significantly reducing the required bandwidth." Per Christenson, "Multicasting Definition," *TechTerms*, Minneapolis: Sharpened Productions, 2011. Last accessed Feb 3, 2018. <https://techterms.com/definition/multicasting>.

⁶ Assistant Deputy Minister – Material, Director General Aerospace Equipment Program Management.

⁷ Tactical Common Data Link is a formatting standard for passage of video over a Tactical Data Link network. NATO, *STANAG 7085 Ed.3 Oct 2011, NATO Interoperable Data Links for ISR Systems*, NATO Standardization Agency (NSA), 2011.

⁸ Maël Roy-Richard, "iBLOS paints a clearer picture"...

and distribution of situational awareness products and digital classified documents. CSNI is designed using the Information Security (IS) tenants of Confidentiality, Integrity, and Availability (CIA), which include multiple layers of user certification and authentication at the procedural, personal, application, and physical levels.⁹ Additionally, the Chief of Defence Staff (CDS) and Strategic Joint Staff (SJS) have placed an emphasis on efforts to reduce DND's corporate network infrastructure footprint while maximizing the physical security, efficiency, and cost of operating DND networks.¹⁰

5. The adherences to IS tenants and cost-saving activities that have been implemented to ensure the CIA of CSNI have resulted in an enterprise architecture that is not optimized for the dissemination of ISR video. CSNI's Threat Risk Assessment Statement of Sensitivity (SoS) assesses the CIA of CSNI to be SECRET MEDIUM MEDIUM, versus the SoS for dissemination of the CP-140's ISR which is assessed to be SECRET HIGH HIGH.¹¹ The original route for the CP-140's ISR video included passing through 20-plus nodes and transiting of the Atlantic Ocean twice before being available in the theatre of operations from which the video originated.¹² CSNI does not employ an appropriate Quality of Service (QoS) scheme that prioritizes ISR video over non-time-sensitive data packets, such as emails.¹³ ISR video requires multiple layers of compression, encapsulation, encryption, decryption, decapsulation, and decompression in order

⁹ International Organization for Standards (ISO) / International Electrotechnical Commission (IEC), *ISO/IEC 27001*, Geneva: ISO, 2013.

¹⁰ Canada. "CDS Directive: CAF Integrated Command and Control Information System" Ottawa: Chief of Defence Staff, 3 December 2015; Canada. "DND/CAF Communications and Information Systems (CIS) Authority Assignments." Ottawa: Strategic Joint Staff, 10 November 2017.

¹¹ CSNI SA&A SoS (SECRET); PMO Aurora Block IV SA& SoS (SECRET).

¹² Canada, Director Aerospace Equipment Aerospace Management, "Near Real-Time C4ISR Airborne Platform Connectivity: CP-140 interim Beyond Line of Site (iBLOS) Lessons Learned" PowerPoint presentation, Ottawa: Department of National Defence, 2017.

¹³ Cisco, "Quality of Service Networking," San Jose: Cisco Systems Inc., 2012. Last accessed on 4 February 2018. http://docwiki.cisco.com/wiki/Quality_of_Service_Networking

be passed through the CSNI network, which has a negative effect on the quality of the video imagery.

Proposed Solution

6. A decentralized, purpose-build TDL WAN has been developed by the CAF to provide situation awareness on Canadian aircraft, ships and vehicles, as per the network diagram found at Annex A of this paper. TDL is a protocol standard for the passing of information over an automated digital network.¹⁴ The information passed via TDL can include an aircraft, vehicle or ship's location, weapon status, radar data, enemy position, text messages or video images. ISR video from Canadian ISR assets is encoded using TCDL protocol, which is a TDL WAN compliant format. The TDL WAN is not presently configured to support multicasting and the QoS required for targeting-quality, near-real-time ISR video; however, it would be relatively easy to change the TDL WAN's configuration due to its small size and decentralized governance.

7. CSNI is a strategic asset that is centrally governed by SJS, and managed and supported by 76 Communications Regiment in Ottawa. The TDL WAN is a tactical asset with operational functionality that necessitates decentralized governance, management and support to enable flexibility in the support of operations. The security requirements for both the TDL WAN and CSNI are the same, but are addressed via different security mechanisms due to the functions that the networks fulfill. For instance, the corporate services provided by CSNI require user

¹⁴ NATO. *STANAG 4586 Edition 4, Standard Interfaces of UAV Control System (UCS) for NATO UAV Interoperability*, Brussels: NATO Standardization Organization, 2017. Last accessed on 30 January 2018. <https://nso.nato.int/nso/zPublic/stanags/CURRENT/4586EFed04.pdf>

verification and domain authentication; whereas security on the TDL WAN is enforced via firewalls and network rules such as access control list. The use of CSNI as the bearer for ISR video traffic is inefficient: it places an increased demand on the CSNI infrastructure at the same time as CSNI's configuration is degrading the quality and complicating the dissemination of ISR video

8. ISR video is raw, time-sensitive information. No intelligence analysis has been applied to the information and the majority of ISR video is unlikely to hold intelligence value after the ISR mission has ended. Furthermore, ISR video captures what is visible to the naked eye and thus is unlikely to be of threat to the national interest, with the exception of any video segments that capture a kinetic effect. The argument for the time-sensitivity of data transmitted via TDL by aircraft and ships is the same: important during the mission, but less-so after the aircraft has landed or the ship has pulled into port. Therefore, time-sensitive data does not need the same level of protection that is required to permit user access to CSNI.

9. Capitalizing on the model developed for Op *Impact*, ISR imagery should be collected via decentralized enclaves connected to a common network backbone. An ISR enclave would consist of an independent instance of ISR equipment capable of receiving, processing, exploitation, and dissemination of ISR video. The TDL WAN and CSNI share the same SECRET network backbone, Command-Net (C-Net). The QoS applied to ISR video on the TDL WAN would need to be applied to the C-Net backbone in order to ensure that ISR video on the TDL WAN would be prioritized over CSNI traffic on C-Net.

10. The decentralized governance is an important concept that differentiates the TDL WAN from CSNI. CSNI does permit the existence of deployed instances which provide limited local functionality, such as email, and file and print services. However, the majority of services on CSNI are hosted on servers installed in a limited number of data centers across Canada. The TDL WAN enclaves would be configured to operate independently, with local data storage customized to support the anticipated local processing, exploitation, and dissemination of the locally produced ISR video. A central data repository could be established for the archiving of ISR video that is considered of historic, but not immediate, operational value. The multiple “peer” enclaves would constitute the “flat” nature of the TDL WAN versus the server-client architecture that exists when accessing network services on CSNI.

11. Creating a standard configuration for decentralized TDL WAN enclaves would allow for the expedient establishment and addition of new tactical enclaves, such as in a deployed theatre or temporary domestic operation. This would allow Air Force, Army, Navy, and Special Operations elements to quickly activate new TDL WAN enclaves where and when required. Current practice by the elements is to use an ISTAR ISR Conditioning Box to disseminate ISR video via their service’s independent networks or sub-domains on CSNI, such as CANSOFCOM’s JSIS, the Army’s LCSS, or RCAF’s MSC.¹⁵ The TDL WAN would improve the efficiency of disseminating targeting-quality, near-real-time ISR video to the appropriate agencies for intelligence analysis or receipt of Target Engagement Authority. After completion of the mission, the tactical enclaves would be decommissioned.

¹⁵ Canadian Forces Special Operations Forces Command (CANSOFCOM); Intelligence, Surveillance, Target Acquisition, and Reconnaissance (ISTAR); Joint Strategic Information System (JSIS); Land Command Support System (LCSS); Mission Support Centre (MSC).

12. A network design that permits federation is also a key distinction proposed for the TDL WAN. Federated network design uses predetermined configurations, data formats, and security policies to allow independent networks to pass data and access services across different networks despite unique enterprise architecture.¹⁶ The Afghan Mission Network was a federated network used by the ISAF coalition partners. This federated network allowed individual countries to connect their national systems, such as the U.S.'s CENTRIX-ISAF or Canadian LCSS-ISAF, to the common coalition network operated by NATO. The CAF has expanded the use of federated networks since the Afghanistan experience, such as establishing the PEGASUS Information Exchange Gateway (IEG) to provide connectivity between CSNI and the SECRET networks of the Five Eyes partners.

13. A federated design would allow the CAF to support ISR data requirements for coalition partners that operate outside of the Canadian TDL WAN. Access to the native TDL WAN would be provided to Canadian operators and analysts, such as the Commanders of CJOC, 1CAD, MARLANT, and CFINTCOM intelligence analysts.¹⁷ Configuration as a federated network would allow the CAF to pass ISR video to other coalition TDL networks, such as the global Unified Video Dissemination System (UVDS) network used by the CAOC in Qatar. Federation of the TDL WAN would permit one-way flow of traffic to CSNI to support situational awareness requirements where targeting-quality video is not required. Implementing a federated design to the TDL WAN would result in a network intended to be connected to other networks. The design would include configuration and security policy considerations to meet DND's Security

¹⁶ NATO, "Federated Mission Networking," Norfolk: Allied Command Transformation, 2017. Last accessed on 31 January 2018, <http://www.act.nato.int/fmn>

¹⁷ Canadian Joint Operations Command (CJOC); 1 Canadian Air Division (1CAD); Maritime Forces Atlantic (MARLANT); Canadian Forces Intelligence Command (CFINTCOM).

Assessment and Authorization (SA&A) process.¹⁸ This in turn would expedite the approval process for the addition of tactical enclaves and connection to coalition networks. The federation of the TDL WAN would provide the CAF with a flexible and scalable network for the distribution of ISR.

Current and Future ISR Requirements

14. *Op Impact* is only the most recent operation with a demand for ISR video. The CAF has seen a consistent increase in the demand for ISR video since the initial use of the Sperwer Unmanned Aerial Vehicle (UAV) on *Op Athena*.¹⁹ In 2011, the RCAF deployed CP-140 and CF-18 aircraft in support of NATO's *Op Unifier* in Libya.²⁰ The CAF currently has over six ISR capable platforms: CF-18 Hornet, CP-140 Aurora, CH-146 Griffon and CH-147 Chinook, both with a MX-15 camera, RQ-21A Blackjack UAV, and undisclosed SOF UAVs.²¹ Furthermore, the CAF intends to include ISR capabilities in many of its future platforms, such as the CH-148 Cyclone, Next Generation Fighter, and Joint Unmanned Surveillance and Target Acquisition System (JUSTAS).²² The CAF is able to use Line of Site (LOS) methods for dissemination of near-real-time ISR video, but does not have the Beyond LOS (BLOS) infrastructure in place to

¹⁸ The SA&A process is designed to ensure that DND networks are configured in compliance with the Government Security Policies set by Treasury Board in *ITSG-33* and Canadian Security Establishment in *MITS*.

¹⁹ Canada, "Details/Information for the Canadian Forces Operation ATHENA," Ottawa: Canadian Forces Directorate of History and Heritage, 2016. Last accessed on 1 February 2018. <http://www.cmp-cpm.forces.gc.ca/dhh-dhp/od-bdo/asia/ATHENA-eng.asp>

²⁰ Canada, "Canada 'Punched Above its Weight'," *Crew Brief, Volume 9 Number 3*. Ottawa: Air Force Public Affairs, 2012, 10-11.

²¹ Canada, "CH-147 Chinook," Ottawa: Royal Canadian Air Force, 2017. Last accessed on 1 February 2018. <http://www.rcaf-arc.forces.gc.ca/en/aircraft-current/ch-147f.page>; Canada, "Canada Buys Blackjack Unmanned Aircraft System from United States," Ottawa: Public Services and Procurement Canada, 2016. Accessed 29 January 2018.

<https://www.canada.ca/en/public-services-procurement/news/2016/08/canada-buys-blackjack-unmanned-aircraft-system-from-united-states.html>

²² Danny Garrett-Rempel, "Will JUSTAS Prevail? Procuring a UAS Capability for Canada," *RCAF Journal – Winter 2015, Volume 4 Issue 1*, Trenton: Canadian Forces Aerospace Warfare Centre, 2015, 19-26. <http://www.rcaf-arc.forces.gc.ca/en/cf-aerospace-warfare-centre/elibrary/journal/2015-vol4-iss1-05-will-justas-prevail.page>

leverage the full electro-magnetic spectrum to support its current ISR needs. The procurement of additional ISR assets will only increase the demand on both LOS and BLOS capabilities.

15. The present state of ISR infrastructure has limited the CAF to local exploitation of ISR video. The inability to disseminate targeting-quality, near-real-time video to dispersed analysts and commanders requires the CAF to set-up facilities in-theatre for processing and exploitation of CAF ISR video. This has involved the deployment of an All Source Intelligence Centre (ASIC) on Op *Athena* and Op *Impact*. Having an effective TDL WAN would enable the CAF to distribute targeting-quality, near-real-time ISR video to locations in Canada, such as CFINTCOM, for processing and exploitation. Transferring the processing and exploitation to a location in Canada would reduce the number of personnel required to man an in-theatre ASIC. This would not only reduce the demand for Intelligence Operators, but also the associated Communications Information Systems (CIS) and Construction Engineering support, thus reducing the overall manning for deployed operations.

Funding

16. There would be a financial cost to upgrading the TDL WAN to support multicast. New crypto units, classified routers and other equipment would be required to support compliance with multicast protocol. New IEG equipment would be required to support federation with CSNI and allied networks. There would be a one-time professional services cost to install the equipment and implement the configuration changes. C-Net bandwidth would need to be increased, but this requires engagement between DND, Shared Services Canada, and Telus, and thus is out-of-scope for this paper. The rough estimate to upgrade the TDL WAN equipment to

support targeting-quality, near-real-time ISR video is \$700,000. The calculations for this estimate are shown in Annex B of this paper.

Counterargument

17. There is an argument that CSNI could be used to distribute ISR video as it has been done for Op *Impact*. This is a valid proposal, but would require significant effort to achieve the desired effect. CSNI has evolved over several decades, consolidating pre-existing networks into the present network infrastructure. ISR video is most efficiently distributed using the multicast protocol, which would require ISR data packets to be re-encapsulated using Generic Routing Encapsulation for transmission over CSNI.²³ This would involve optimizing CSNI's 600-plus Points of Presence (PoP) to reduce degradation of streaming ISR video feeds, vice approximately 20 TDL WAN PoP. With enough time, money, and re-engineering, it would be possible to use CSNI as the bearer for ISR video. However, the re-engineering would be subject to the competing demands between CSNI's core services and ISR video. The SA&A process would continue to be restrictive due to the aggregation of data on CSNI and the operational requirement to provide ISR video to coalition forces. Finally, a standard configuration would still have to be developed for the establishment of temporary enclaves in support of deployed ISR requirements. The TDL WAN offers advantages in the dissemination of ISR video due to its decentralized governance, smaller network size, and lower aggregation of data. These factors simplify the SA&A process, thereby facilitating the expansion and federation of the TDL WAN to support the dissemination of ISR video.

²³ Cisco, "Multicast over a GRE Tunnel." San Jose: Cisco Systems Inc., 2016, Last accessed on 30 January 2018, <https://www.cisco.com/c/en/us/support/docs/ip/ip-multicast/43584-mcast-over-gre.html>

CONCLUSION

18. Modern military operations require the availability of targeting-quality, near-real-time ISR video to analysts and decision makers in order to maintain the advantage over adversaries. Militaries must be able to easily and expeditiously deploy the CIS network infrastructure to support the distribution of targeting-quality, near-real-time ISR video notwithstanding the geographical separation of the battlefield from coalition headquarters. The CAF's CIS network infrastructure must be optimized in order to facilitate the distribution of ISR video to meet the challenges of future operations.

RECOMMENDATION

19. Leveraging, adapting and federating the existing TDL WAN to support TCDL dissemination would give the CAF greater flexibility in meeting future ISR requirements. The flat, decentralized structure would reduce the complexity and maintenance of the network. A federated design would expedite the expansion of the network to meet operational requirements and facilitate the sharing of targeting-quality ISR video with our coalition partners. A separate WAN for TDL traffic would reduce the demand on CSNI and lower risk both networks due to a lower aggregation of data. A WAN optimized for the dissemination of ISR video would permit the processing and exploitation of near-real-time ISR video outside of theatre, reducing the number of positions required to support deployed operations. Finally, the optimization of the TDL WAN would best position the CAF to capitalize on the capabilities of our current and future ISR platforms.

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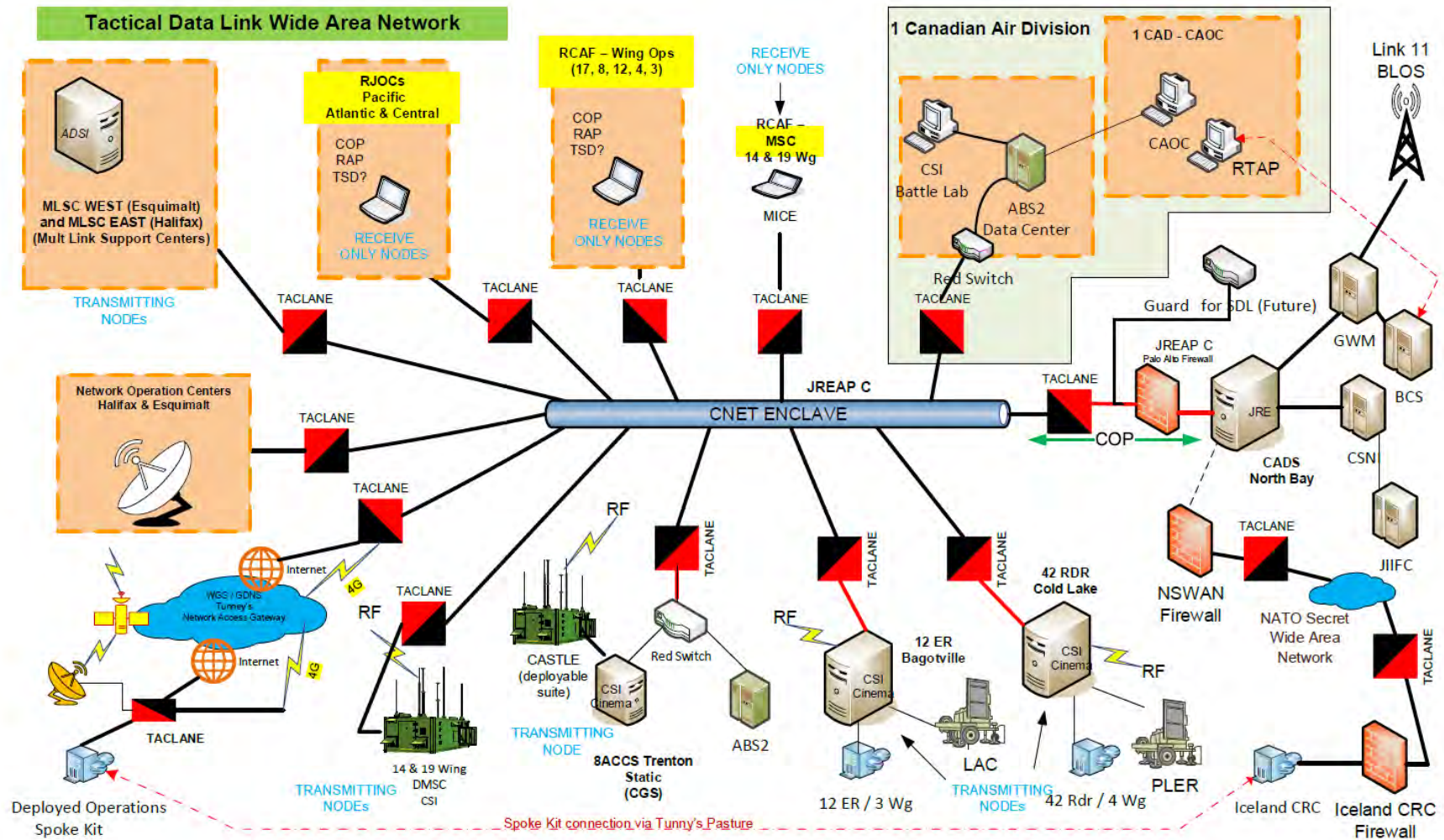
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ANNEX A – TDL WAN NETWORK DIAGRAM



ANNEX B – COST ESTIMATE TO ENABLE MULTICAST ON THE TDL WAN

Description	Cost	Number of Sites	Subtotal
Hardware Upgrade to Existing Sites	\$10,000.00	15	\$150,000.00
New Sites	\$20,000.00	5	\$100,000.00
IEG	\$250,000.00	1	\$250,000.00
Professional Services	\$200,000.00	1	\$200,000.00
		Total	\$700,000.00

Note: Equipment estimate and figures provided by ADM(Mat) DAEPM R&CS 5-5