

Canadian  
Forces  
College

Collège  
des  
Forces  
Canadiennes



## ACHIEVING MULTINATIONAL TACTICAL RADIO INTEROPERABILITY

Maj Chad Johannes

**JCSP 44**

**PCEMI 44**

**SERVICE PAPER**

**ÉTUDE MILITAIRE**

**Disclaimer**

Opinions expressed remain those of the author and do not represent Department of National Defence or Canadian Forces policy. This paper may not be used without written permission.

© Her Majesty the Queen in Right of Canada, as represented by the Minister of National Defence, 2018.

**Avertissement**

Les opinions exprimées n'engagent que leurs auteurs et ne reflètent aucunement des politiques du Ministère de la Défense nationale ou des Forces canadiennes. Ce papier ne peut être reproduit sans autorisation écrite.

© Sa Majesté la Reine du Chef du Canada, représentée par le ministre de la Défense nationale, 2018.

*SERVICE PAPER - ÉTUDE MILITAIRE*

**ACHIEVING MULTINATIONAL  
TACTICAL RADIO INTEROPERABILITY**

Maj Chad Johannes

*“This paper was written by a student attending the Canadian Forces College in fulfilment of one of the requirements of the Course of Studies. The paper is a scholastic document, and thus contains facts and opinions, which the author alone considered appropriate and correct for the subject. It does not necessarily reflect the policy or the opinion of any agency, including the Government of Canada and the Canadian Department of National Defence. This paper may not be released, quoted or copied, except with the express permission of the Canadian Department of National Defence.”*

Word Count: 2532

*“La présente étude a été rédigée par un stagiaire du Collège des Forces canadiennes pour satisfaire à l'une des exigences du cours. L'étude est un document qui se rapporte au cours et contient donc des faits et des opinions que seul l'auteur considère appropriés et convenables au sujet. Elle ne reflète pas nécessairement la politique ou l'opinion d'un organisme quelconque, y compris le gouvernement du Canada et le ministère de la Défense nationale du Canada. Il est défendu de diffuser, de citer ou de reproduire cette étude sans la permission expresse du ministère de la Défense nationale.”*

Compte de mots: 2532

## ACHIEVING MULTINATIONAL TACTICAL RADIO INTEROPERABILITY

### AIM

1. This paper is intended to inform the Chief of Staff Canadian Army Strategy (COS CA Strat) on the significant multinational tactical radio interoperability challenge facing the CA in the next decade, and to propose areas of focus to help alleviate the problem. The paper will reflect on the current environment and explore possible methods and forums for addressing current tactical radio interoperability shortfalls, suggesting that close alignment with the United States (US) is the best means of ensuring future success. This service paper has been produced to the UNCLASSIFIED level.

### INTRODUCTION

2. Interoperability with allies remains a key challenge as few foreseeable military operations are likely to occur outside of an alliance or coalition construct. Canada's new Defence Policy: *Strong, Secure, Engaged* continues to highlight the importance of working with allies and ensuring multi-national interoperability.<sup>1</sup> Accordingly, advancements in communications interoperability will play a key role to the successful achievement of Canada's defence objectives. *Land Operations 2021* highlights that the CA's Battle Groups (BGs) continue to be the building-block for the projection of land power and the "key manoeuvre elements capable of

---

<sup>1</sup> Department of National Defence, *Canada's Defence Policy: Strong, Secure, Engaged* (Ottawa, ON: Canada Communications Group, 2017), 13, 33.

being “plugged in” to coalition forces.”<sup>2</sup> While the CA continues to train up to the brigade level, the mission sets laid out in *Strong, Secure, Engaged* further support that the BG remains the most likely element the CA will deploy in multinational combat operations.<sup>3</sup> While significant advances have been made in the establishment of interoperability of networks at the brigade and battle group headquarters levels through the Canadian Deployable Mission Network (CDMN), tactical radio interoperability has not received the same level of focus.<sup>4</sup> Leading the recent deployment of the North Atlantic Treaty Organization (NATO) enhanced Forward Presence (eFP) multi-national BG mission to Latvia has served to highlight the challenges the CA faces in achieving meaningful tactical radio interoperability with its allies.

3. In order to Force Generate combat-capable forces for a multinational environment, the CA needs to provide focus for its limited Force Development capabilities. In order to identify areas of focus, it is vital to understand the environment surrounding the interoperability challenges faced today. To that end, this paper will outline the challenge with achieving multinational tactical radio interoperability, the methods by which interoperability can be achieved, the key partners and venues for interoperability work, and the key modernization programs. It will be suggested that the CA should consider focusing on aligning radio interoperability with the US as the number one priority, while leveraging the American, Britain,

---

<sup>2</sup> Department of National Defence, *Land Operations 2021: Adaptive Dispersed Operations – The Force Employment Concept for Canada’s Army of Tomorrow* (Kingston, ON: Directorate of Land Concepts and Design, 2007), 33.

<sup>3</sup> *Canada’s Defence Policy: Strong, Secure, Engaged...*, 17.

<sup>4</sup> E.R. Laliberte and I.A.M. MacLellan, “CDMN Capabilities Project Phase Plan (P3),” Project Report, Canadian Joint Operations Command J6 Integration, Ottawa, ON, 14 April 2017.

Canada, Australia, New Zealand (ABCANZ) forums to establish relevant interoperability standards.

## DISCUSSION

4. Tactical Radio Interoperability Challenge. Achieving interoperability between radios is a complicated endeavour. In order for two radios to communicate, there are a number of factors that need to be interoperable, including frequency, waveform, and cryptography. Frequency refers to the portion of the electromagnetic spectrum being used, most commonly High Frequency (HF), Very High Frequency (VHF) and Ultra-High Frequency (UHF) in tactical radios. Each of these frequencies has advantages and disadvantages when it comes to range and potential bandwidth (for data transmission), with a trend towards sacrificing range for data transmission in support of the “network enabled” fight.<sup>5</sup> Aligning radios that use a specific portion of the frequency spectrum with allies is historically one of the least problematic challenges as most allies make use of similar frequency bands. Waveform options are becoming increasingly more diverse as nations develop advanced waveforms capable of transmitting additional data over the airways. Canada’s own Combat Net Radio Enhancement project is developing a Canadian specific waveform that will allow increased data transmission, at the cost of not being interoperable with allies when operating in this advanced data mode.<sup>6</sup> For this reason, the upgraded radios will be maintaining the ageing NATO standard Single Channel

---

<sup>5</sup> Department of National Defence, *Towards Land Operations 2021: Studies in Support of the Army of Tomorrow – Force Employment Concept*, (Kingston, ON: Directorate of Land Concepts and Design, 2009), 2-30, 7-3.

<sup>6</sup> Department of National Defence, *C.000004 Combat Net Radio Enhancement (CNRE) Statement of Operational Requirement* (Ottawa, ON: Directorate of Land Requirements, 20 June 2012), D-1.

Ground and Airborne Radio System (SINCGARS) waveform support to remain interoperable with allies. Although an old and quickly becoming obsolete standard, it remains the only commonly recognized standard available for ensuring operability in the near future. Lastly, achieving secure radio interoperability is reliant on cryptographic compatibility. This is an aspect where national interests and levels of trust between nations play a significant role and is a reason why many allied nations remain non-interoperable. In this area Canada is reliant on the US for the provision of Type 1 cryptography for tactical radios, severely limiting the freedom the CA has on how the systems are handled and employed.

5. Methods of Achieving Tactical Radio Interoperability:

a. Liaison Detachments. Historically liaison detachments have been the means by which interoperability between multi-national forces is achieved. Creating a detachment with the necessary communications equipment (both in terms of radios and increasingly data/network capabilities) provides a linkage between otherwise non-interoperable forces. As a package, a liaison detachment typically has the additional benefit of including a liaison officer to ensure messages and information are accurately passed, working around a number of other non-technical interoperability challenges.

b. Liaison detachments can be very effective at the brigade and BG levels, plugging into headquarters and assisting with the appropriate relaying of information. One of the reasons it is effective is that the time sensitivity of the information being passed between these higher headquarter levels is customarily not the same as the real-time requirement to pass information between lower tactical levels engaged in combat. A major challenge

with the use of liaison detachments at levels below the BG include the trouble of scaling. The number of detachments required starts rising exponentially as you move down the levels from BG to platoon (or lower) levels. This, coupled with the potential “air-gap” of information from one radio net to another makes it a functional, but sub-optimal option for the future battlefield.

c. Common Radios. Ideally all allies could make use of the same radio system(s). Indeed, combat operations in Afghanistan served as a forcing function that resulted in numerous allies purchasing the same radios employed by US forces in theatre. In conducting interoperability testing, NATO notes the overwhelming reliance on commonly purchased radios for achieving limited interoperability between nations.<sup>7</sup> Although a number of Canada’s closest allies have aligned on number of similar radios, issues with national procurement rules and cryptography regulations make a complete convergence extremely difficult. In the absence of a strategic forcing function such as a clear and present threat to make significant national policy adjustments, complete alignment between allied forces remains unlikely.

d. In order to achieve common radios in an alliance such as NATO, the alliance could choose to provision radios to participating nations. This is not seen as a realistic option in today’s environment due to fiscal realities, although it would not be out of the question in the future. In fact, NATO does currently have the ability to supply limited radios for particular mission sets. While this does not help the CA’s interoperability

---

<sup>7</sup> North Atlantic Treaty Organization (NATO) Communications and Information Systems Group (NCISG), *Steadfast Cobalt 16 Final Exercise Report* (Brussels: NATO, September 20, 2016), A-8.

capabilities today, it does suggest that the future integration of different radio fleets should be a consideration for upcoming development efforts.

e. Radio “Bridging”. Non-interoperable radios are increasingly being connected using “bridging” technologies. In the simplest form, these devices are capable of taking the voice output from one radio and inputting into the second radio, akin to placing two telephone headsets together to allow people on each side to communicate. This approach faces significant security concerns as patching between radio nets of different security classifications is concerning, especially in the case that one of the nets operates in a non-secure mode (as some of Canada’s eFP allies do). Even when bridging two radios with the same security classification there are significant challenges to making this an effective means of communication in a mobile tactical setting. If an allied radio was connected to a Canadian radio in the back of a “hatches down” armored vehicle during combat operations, the radio would not be able to pass a signal without first being integrated into the vehicle to access an external antenna. Numerous other integration efforts in terms of the provision of power, training on the radio, ability to load cryptography, etc. contribute to it being a significant endeavour to adequately integrate each nation’s radios into Canadian systems (or vice versa). Although an area worth exploration for near-term requirements like the current eFP mission, a combat-capable solution would require significant engineering efforts and likely be excessively manpower intensive for integration below the BG level.

f. Radio Provisioning. The option of providing secure radios to allies proves challenging as Canada’s cryptographic technology and codes are owned by the US. The rules and regulations the CA operate under are, for good reason, extremely strict and



prohibits the provision of cryptographic technology to other nations absent approval from the highest levels of the US government. Even if granted permission to share radios with others, integration into vehicle platforms would be a long and costly process subject to numerous other nations' security requirements/concerns as they are integrated/installed near their national systems. Outfitting other nations with equipment is not seen as an achievable Canadian option.

g. Technical Interoperability. Alignment of technical radio specifications has been an ongoing endeavour for many years between alliance and coalition partners. While approaching the end of its usefulness, the SINCGARS waveform standard is one that has enabled most NATO nations to have radios capable of communicating with each other, although cryptographic differences make some only compatible in non-secure mode. Previous standards have not resulted in complete radio interoperability largely as a result of national decisions on what cryptography to support and national procurement regulations and approaches. Indeed, a review of the ample literature surrounding the shortfalls of interoperability amongst emergency services in the US provides an indication of the level of complexity in the bureaucracy surrounding the achievement of interoperability, even within a single nation.<sup>8</sup> Nevertheless, given the significant challenges presented by other potential solutions, aligning nations on common standards remains one of the most promising methods of achieving interoperability between future radio platforms.

---

<sup>8</sup> Nancy L. Huyck, "Interoperability Challenges Among Public Safety Radio Systems: Surveyed Research Addressing These Challenges," *International Journal of Business & Public Administration* 12, no. 1 (Summer 2015): 22.

6. Key Interoperability Partners. *Strong, Secure, Engaged* continues to promote the key relationship Canada has with the US, the 5-Eyes community and NATO.<sup>9</sup> As one moves down the list from a bilateral arrangement with the US to a grouping of 29 nations within NATO, interoperability gets increasingly difficult. In terms of focus, the recent defence policy highlights the fact that the US remains the only superpower and that “the United States continues to be Canada’s most important military ally.”<sup>10</sup> From a tactical interoperability perspective, prioritizing efforts with the closest ally, and largest military in the world would be prudent. The CA currently works with the US through the bilateral Army Staff Talks (AST), however Canada has relatively limited influence on US Force Development efforts through this forum and these talks preclude a key partner as the US Marine Corps is a separate branch.

7. Within the 5-Eyes nations, the ABCANZ forum provides an excellent venue for the promotion of tactical interoperability objectives between these closely aligned nations.<sup>11</sup> This provides a forum where, collectively, non-US nations may have stronger voices than in their individual bilateral engagements. The interoperability work completed under the ABCANZ forums are now designed to be shared with NATO as a way to promote interoperability through the updating of aging NATO Standardization Agreements (STANAGs). Although NATO was instrumental in the establishment of the limited standardization that exists today, sensitive security aspects and the sheer size of the grouping make it a cumbersome forum for achieving technical alignment. Although the US remains Canada’s closest ally, the ABCANZ forum currently provides the best venue for generating future interoperability standard agreements.

---

<sup>9</sup> *Canada’s Defence Policy: Strong, Secure, Engaged...*, 16, 91.

<sup>10</sup> *Canada’s Defence Policy: Strong, Secure, Engaged...*, 50, 60.

<sup>11</sup> Mike Harris and Mike Cassie, “ABCANZ Tactical Radio Statement of Requirement,” Briefing Note to Director Royal Canadian Corps of Signals (DRCCS), Ottawa, ON, 8 September 2017, 1.

8. Tactical Communications Modernization. Canada's Tactical Communications Modernization (TacComms Mod) project, which represents the follow-on project to the Tactical Command Control and Communication Systems (TCCCS) project that delivered the CA's current tactical radio fleet, is currently entering its identification phase.<sup>12</sup> The decision on how to approach this project will have significant impacts on future CA interoperability with its allies. In approaching the CA's own large communications modernization project, it should draw lessons from the US experience through the Joint Tactical Radio System (JTRS) program. This \$37 billion program commenced in 1997 and ran for almost a decade before most of the radios scheduled for delivery to the land forces were ultimately cancelled.<sup>13</sup> The program ran into problems as it attempted to deliver a radio capable of performing multiple functions for numerous users. Ultimately the technological advancements were not able to overcome the laws of physics in the manner envisioned at the outset, and the primary tactical radios delivered failed their field trials.<sup>14</sup> As a result, US forces have purchased a number of off-the-shelf radios with incremental upgrades to temporarily outfit their fleets. This indicates that the CA should be cautious in its approach to its next generation tactical radios and consider leveraging already-existing technologies. As recent history has shown a trend towards acquiring radios on an "as required" basis, maximum flexibility should be exercised in vehicle installation designs to enable multiple radios exchanges throughout a vehicle's lifespan.

---

<sup>12</sup> Ian Graham, "Land Command Support System (LCSS) Tactical Communications Modernization (TacComms Mod)," Presentation to Army Capability Development Board, Ottawa, ON, June 2016, 14.

<sup>13</sup> United States Government Accountability Office Report to Congressional Committees, *Defense Acquisitions – Restructured JTRS Program Reduces Risk, but Significant Challenges Remain* (Washington, DC: Government Accountability Office, September 2006), 1-3.

<sup>14</sup> The Under Secretary of Defense, *Cancellation of Joint Tactical Radio System Ground Mobile Radio Program* (Washington, DC: Department of Defense, 13 October 2011), 2.

9. It is apparent that the US has spent a considerable amount of money developing radio technologies to meet the next generation of requirements and threats. Although a number of radios failed to deliver, there were a number of advances achieved, most notably the development of effective waveform standards to meet next generation requirements. As identified in *The Future Operating Environment: 2013-2040*, adopting an agile and flexible procurement approach will be required to take advantage of such technological advances in a timely manner.<sup>15</sup> If sufficiently agile and timed properly, TacComms Mod could leverage US advancements once they commit to a direction and work with industry to advance their advanced tactical communications capabilities. The US remains the recognized technological leader as well as most likely partner and provider of combat enablers in future conflicts. Ensuring the CA radio development remains aligned with the US is the surest way to ensure interoperability with key allies in future alliance and coalition operations.

## CONCLUSION

10. This paper outlined the current landscape and challenges faced in achieving the fundamental task of multinational tactical radio interoperability in the next decade. It reviewed the current options for the achievement of interoperability and identified that although short-term radio interoperability efforts may be best achieved using radio “bridging” technologies, alignment on technical standards is a more promising approach for achieving long-term interoperability success. In reviewing key interoperability partners and forums, it recognized the ABCANZ forum as a key venue for creating technical standards, and one that will also help

---

<sup>15</sup> Department of National Defence, *The Future Operating Environment: 2013-2040* (Ottawa, ON: Chef of Force Development, 2014), 67, 79.

influence the broader NATO community. Finally, it suggested that the CA's future TacComms Mod project should leverage and align itself with the US efforts. Additionally, based on lessons learned on the manner in which interoperability has been achieved to date, TacComms Mod should prioritize flexibility as a key principle, ensuring future vehicle platforms are able to integrate and interchange future radio fleets.

11. Achieving operational success through tactical interoperability with alliance and coalition partners is a complicated endeavour, but Canada is not alone. Having its most trusted partner and ally as the largest military power in the world is a significant advantage, and one that the CA should leverage as much as possible. It is difficult to foresee any CA major military operations that will not involve a significant US presence. Leveraging the ABCANZ interoperability standardization forum for forging tactical interoperability with the US will give Canada the greatest chance of being interoperable with its key allies in the future application of land power in multinational operations.

## BIBLIOGRAPHY

- Burroughs, James E. “Three Factors Leading to the Failure of Communications in Emergency Situations.” Doctoral dissertation, Walden University, 2017.
- Canada. Department of National Defence. *Canada’s Defence Policy: Strong, Secure, Engaged*. Ottawa, ON: Canada Communications Group, 2017.
- Canada. Canadian Joint Operations Command. *Canadian Deployment Mission Networking Capability Concept of Operation (Draft)*. Ottawa, ON: CJOC, August 2007.
- Canada. Department of National Defence. *C.000004 Combat Net Radio Enhancement (CNRE) Statement of Operational Requirement*. Ottawa, ON: Directorate of Land Requirements, 20 June 2012.
- Canada. Department of National Defence. *Land Operations 2021: Adaptive Dispersed Operations – The Force Employment Concept for Canada’s Army of Tomorrow*. Kingston, ON: Directorate of Land Concepts and Design, 2007.
- Canada. Department of National Defence. *Senior Review Board Minutes, Project C.000004 Combat Net Radio Enhancement (CNR-E)*. Ottawa, ON: Directorate of Land Requirements, 20 May 201.
- Canada. Department of National Defence. *Senior Review Board Minutes, Project C.002383 Integrated Slider System Project*. Ottawa, ON: Directorate of Land Requirements, 16 February 2017.
- Canada. Department of National Defence. *The Future Operating Environment: 2013-2040*. Ottawa, ON: Chief of Force Development, 2014.
- Canada. Department of National Defence. *Towards Land Operations 2021: Studies in Support of the Army of Tomorrow – Force Employment Concept*. Kingston, ON: Directorate of Land Concepts and Design, 2009.
- Grant, Ryan and Chris Dannehl, “Combat Net Radio Enhancement C.000004.” Presentation to Senior Review Board, Ottawa, ON, 29 June 2017.
- Graham, Ian. “Communications and Information Systems (CIS) Mechanisms for Interoperability.” Presentation to Army Capability Development Board, Ottawa, ON, 16 November 2016.
- Graham, Ian. “Land Command Support System (LCSS) Tactical Communications Modernization (TacComms Mod).” Presentation to Army Capability Development Board, Ottawa, ON, June 2016.
- Harris, Mike and Mike Cassie. “ABCANZ Tactical Radio Statement of Requirement.” Briefing Note to Director Royal Canadian Corps of Signals (DRCCS), Ottawa, ON, 8 September 2017.

Huyck, Nancy L. "Interoperability Challenges Among Public Safety Radio Systems: Surveyed Research Addressing These Challenges." *International Journal of Business & Public Administration* 12, no. 1 (Summer 2015):12-24.

Laliberte E.R., I.A.M. MacLellan. "CDMN Capabilities Project Phase Plan (P3)." Project Report, Canadian Joint Operations Command J6 Integration, Ottawa, ON, 14 April 2017.

Latulippe, Isabelle and Daniel Thibodeau. "Integrated Soldier System Project (ISSP) Project Number 2383." Presentation to Senior Review Board, Ottawa, ON, 16 Feb 2017.

Montplaisir, J.S.O. and D.M. King. "Request for Funding in Support of Canadian Deployable Mission Networking Capability." Briefing Note to Deputy Commander Canadian Joint Operations Command, Ottawa, ON, 17 August 2016.

North Atlantic Treaty Organization (NATO) Communications and Information Systems Group (NCISG). *Steadfast Cobalt 16 Final Exercise Report*. Brussels: NATO, September 20, 2016.

North Atlantic Treaty Organization (NATO). *NATO Federated Mission Networking Implementation Plan, Volume 1*. Brussels: NATO, July 8, 2014.

Timmons, Ronald P. "Interoperability: Stop Blaming the Radio." *Homeland Security Affairs* 3, no.1 (February 2007): 1-17.

United States. United States Government Accountability Office Report to Congressional Committees. *Defense Acquisitions – Restructured JTRS Program Reduces Risk, but Significant Challenges Remain*. Washington, DC: Government Accountability Office, September 2006.

United States. The Under Secretary of Defense. *Cancellation of Joint Tactical Radio System Ground Mobile Radio Program*. Washington, DC: Department of Defense, 13 October 2011.