Canada–US Enhanced Resiliency Experiment Series "CAUSE III"

Western Scenario – Wireless Communications Interoperability

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Abstract

On December 7, 2011, President Obama and Prime Minister Harper released the Beyond the Border (BTB) Action Plan, which set out joint priorities and specific initiatives for cross-border collaboration. A common goal within this partnership focused on enhancing the coordination of responses during binational disasters. Specifically, the plan states that Canada and the United States will *"focus on cross-border interoperability as a means of harmonizing cross-border emergency communications efforts."*

The Canada–US Enhanced Resiliency (CAUSE) experiment series addresses this binational goal and hypothesizes that technologically enhanced multi-agency and cross-border Situational Awareness (SA) measurably improves regional resilience.

The third experiment in this series, CAUSE III was jointly sponsored by the US Department of Homeland Security (DHS) Science and Technology Directorate (S&T) First Responders Group (FRG), the Defence Research and Development Canada (DRDC) Centre for Security Science (CSS), and Public Safety Canada (PS Canada). This cross-border initiative consisted of two experiments, performed in November 2014 based on two disaster scenarios—the first a Northeast hurricane, and the second a rangeland brush fire in the Western Plains, affecting Alberta, Saskatchewan and Montana.

In the case of the Western scenario, which is the focus of this report, emergency management agencies in Saskatchewan, Alberta and Montana worked together to assess the effectiveness of Land Mobile Radio (LMR) and Long Term Evolution (LTE) broadband wireless technologies for emergency communications. The scenario first focused on assessing the ability to interconnect Saskatchewan and Alberta's provincial LMR radio systems with the Montana statewide radio system across jurisdictions in response to a simulated remote brush fire spanning both sides of the border. In order to further enhance communications, the operational efficiency of using deployable LTE networks to provide interoperable communications and introduce many feature rich applications was also evaluated.

The interoperable technology enhanced situational awareness of the multi-jurisdictional response organizations by allowing all response organizations to exchange information in real-time. The report describes the impact of the interoperable technologies on emergency operations, provides guidance related to the types of information that are most useful during a remote bush fire emergency and identifies benefits and challenges with introducing complex data sharing applications to emergency responders.

This document reports on the design, execution and findings of the two-day experiment concerned with the Western scenario. Recommendations, at the end of the report, are derived from the findings and propose actions to further push the envelope of communications interoperability between Canada and the US.

Significance to Defence and Security

This report documents how separate LMR systems were connected to allow emergency response organizations from two Canadian provinces and one US state to exchange critical information during a multi-agency emergency event. Subsequently, the LMR capability was augmented, for the first time, with a high-speed broadband LTE capability that allowed responders to exchange real-time data (maps, pictures, videos, conferences) in addition to voice communications. The report examines the key benefits of enhancing situation awareness through the use of interoperable technologies and the impact on decision-making and coordination of emergency responses in remote regions of Canada and the US.

Résumé

Le 7 décembre 2011, le président Obama et le premier ministre Harper ont rendu public le Plan d'action « Par-delà la frontière », qui énonce les priorités communes et les initiatives particulières de collaboration transfrontalière. L'un des objectifs communs qui sous-tendent ce partenariat est d'améliorer la coordination des interventions lors de catastrophes binationales. Plus précisément, le plan indique que le Canada et les États-Unis doivent « *mettre l'accent sur l'interopérabilité transfrontalière comme moyen d'harmoniser les efforts de communication en situation d'urgence.* »

L'Expérience canado-américaine de renforcement de la résilience (CAUSE) vise cet objectif binational et pose l'hypothèse selon laquelle une meilleure connaissance de la situation interorganisationnelle et transfrontalière, à l'aide d'outils technologiques, accroîtrait sensiblement la résilience régionale.

La troisième expérience de cette série, CAUSE III, a été parrainée par le Groupe des premiers intervenants de la Direction de la science et technologie du département de la Sécurité intérieure des É.-U., le Centre des sciences pour la sécurité de Recherche et développement pour la défense Canada (RDDC CSS) et Sécurité publique Canada. Cette initiative transfrontalière comportait deux expériences, effectuées en novembre 2014, sur deux scénarios de catastrophe – un ouragan dans le nord-est et un feu de broussailles dans les pâturages des plaines de l'Ouest touchant l'Alberta, la Saskatchewan et le Montana.

Dans le cas du scénario dans l'Ouest, sur lequel est fondé le présent rapport, les organismes de gestion des urgences de la Saskatchewan, de l'Alberta et du Montana ont collaboré afin d'évaluer l'efficacité des technologies sans fil à large bande d'évolution à long terme (LTE) et de la radio mobile terrestre (RMT) dans le cadre des communications d'urgence. Le scénario était d'abord axé sur l'évaluation de la capacité d'interconnecter les systèmes RMT provinciaux de la Saskatchewan et de l'Alberta avec le système radio du Montana entre les administrations en vue d'intervenir dans le cas d'un feu de broussailles fictif en région éloignée qui s'étend des deux côtés de la frontière. Afin d'améliorer davantage les communications, on a également évalué l'efficacité opérationnelle des réseaux LTE déployables pour assurer l'interopérabilité des communications et intégrer plusieurs applications riches en fonctionnalités.

On a pu accroître la connaissance de la situation des forces intergouvernementales d'intervention au moyen de la technologie interopérable en permettant à l'ensemble des forces d'intervention de partager des renseignements en temps réel. Le rapport décrit l'incidence des technologies interopérables sur les opérations d'urgence, fournit des directives concernant les types de renseignements les plus utile lors d'un feu de broussailles en région éloignée et énonce les avantages et les défis relatifs à l'intégration d'applications complexes de partage des données au sein des forces d'intervention en cas d'urgence.

Ce document traite de la conception, de l'exécution et des résultats de l'expérience de deux jours portant sur le scénario dans l'Ouest. À la fin du rapport, on énumère des recommandations découlant des résultats et on propose des mesures pour repousser les limites de l'interopérabilité des communications entre le Canada et les États-Unis.

Importance pour la défense et la sécurité

Ce rapport indique la façon dont les systèmes distincts de RMT ont été reliés pour permettre à des organismes d'intervention en cas d'urgence provenant de deux provinces canadiennes et d'un état américain de partager des renseignements essentiels dans le cadre d'une situation d'urgence dans laquelle interviennent de nombreuses organisations. Par la suite, on a renforcé la capacité RMT, pour la première fois, au moyen d'une capacité LTE à large bande haute vitesse qui ont permis aux intervenants autorisés d'échanger des données en temps réels (cartes, images, vidéos, conférences) en plus des communications vocales. Le rapport présente les avantages clés de l'amélioration de la connaissance de la situation au moyen des technologies interopérables ainsi que l'incidence du processus décisionnel et de la coordination des interventions en cas d'urgence dans les régions éloignées du Canada et des États-Unis.

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Acknowledgements

An experiment of the magnitude of the CAUSE III Western Experiment is carried out with the help, dedication and enthusiasm of a great number of people and organizations. The authors wish to thank all of the following participating organizations who have helped to advance Canada and US interoperability:

1 Introduction

The objective of the CAUSE Resiliency series is to measure the impact of interoperable technology during a multi-agency cross-border emergency response and recovery operation. This on-going series is a collaborative effort between Defence Research and Development Canada – Centre for Security Science (DRDC CSS), Public Safety Canada (PSC) and the Department of Homeland Security (DHS) Science and Technology (S&T) Directorate, First Responders Group.

It is hypothesized that improving shared situational awareness and interoperable communications during multi-agency emergency events leads to enhanced community resilience. Incremental improvements in response and recovery operations within the affected regions from a time or efficiency perspective can be used to demonstrate resilience. Mutual aid, based on binational agreements, is necessary to provide operational support between Canada and the US during these cross-border emergencies.[1][2][3]

1.1 Context

The construct of Emergency Management (EM) in Canada, as in the United States (US), recognizes that local and regional entities are at the critical front end of a response to any crisis or emergency.[4] National or federal support is typically delivered as required and upon request, and is dependent on the nature of the emergency and the need for augmentation or a specialized response capability.[4][5] On December 7, 2011, President Obama and Prime Minister Harper released the Beyond the Border (BTB) Action Plan (Action Plan), which set out joint priorities and specific initiatives for cross-border collaboration.[6][7][8]

The goal of the joint BTB Action Plan is to build upon the existing perimeter approach to security and economic competitiveness and thereby lead to security enhancements and an accelerated flow of people, goods and services.[6][7] Further, this partnership is intended to ensure that binational coordination is not geographically limited to border crossings but rather is extended to public safety issues that simultaneously affect both nations, regardless of where incidents occur. Indeed, the design of the simulated events during CAUSE III confirmed that the response to an event near the border greatly benefits from the cooperation between officials in both countries. The shared goal within this partnership centers on enhancing the coordination of emergency responses during binational disasters.

The BTB Action Plan called for the establishment of a Communications Interoperability Working Group (CIWG) that:

- Coordinates national-level emergency communications plans and strategies
- Identifies future trends and technologies related to communications interoperability
- Promotes the use of standards in emergency communications
- Promotes governance models and structures
- Shares best practices and lessons learned

The BTB Action Plan focuses on developing and facilitating multi-jurisdictional and cross-border interoperability to harmonize binational emergency communication efforts. More specifically, it calls for the interoperability of emergency communications on both sides of the border and improved sharing of incident-specific information.[6][7] This enhancement leads to improved response coordination by EM authorities during binational disasters.

The DHS Communications Interoperability Continuum[1] shown in Figure 1 depicts a framework of core elements and key attributes of a mature interoperable capability.[9] Canada uses a similar framework of these five pillars and attributes for its own Communications Interoperability Continuum. The same five core elements, namely governance, Standard Operating Procedures (SOPs), technology, training and exercises, and usage apply to cross-border interoperability.[10] CAUSE III focused primarily on technology integration while recognizing the importance of the human element in building a binational capability and making these systems truly interoperable. As such, the recommendations in this report go beyond integrating technology to include other lanes of the interoperability continuum. These recommendations are grouped separately under People, Process/Policy and Technology.

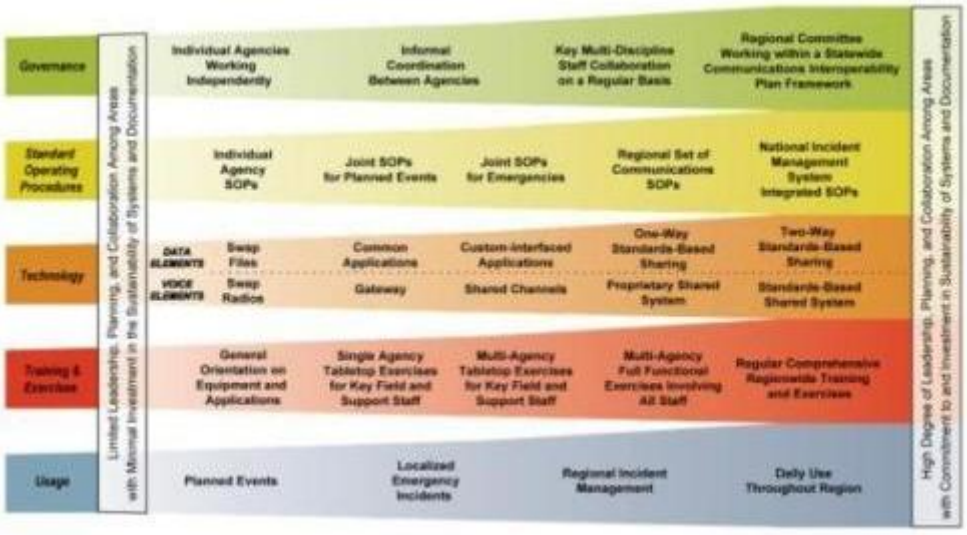

Figure 1: *The Communications Interoperability Continuum.*

1.2 CAUSE Experiments

For several years, Canada and the US have been working to develop the capability to enhance SA between EM organizations through the application of interoperable technology.[11] The use of integrated awareness tools and technology to enhance SA during emergencies was investigated during CAUSE I [1][12][13] held on the West Coast in 2012 and CAUSE II [11][1][15], which took place between New Brunswick and Maine in March 2013. These experiments highlighted the benefits of enhancing SA along the CANUS border regions. CAUSE III took this approach to information exchange a step further by using these tools to direct cross-border alerts that targeted

[1] The Interoperability Continuum was developed by the DHS SAFECOM Program, more information here: http://www.dhs.gov/safecom.

information exchange between specific emergency management authorities. The specific objectives of CAUSE are as follows:

- Connect, test, and demonstrate emerging operational technologies that enhance resilience and reduce local, regional and national risks through enhanced multi-jurisdictional and cross-border interoperability, particularly with respect to sharing SA information that supports prevention, mitigation, response, and recovery from major trans-border incidents;
- Advance emergency management and responder SA capabilities along the border for all stakeholders, including municipal, regional, provincial/state, federal, non-governmental organizations, and key critical infrastructure owners;
- Demonstrate the value of federal Science and Technology investments with and for the responder community, and identify emerging technological trends;
- Test, evaluate and validate various operational and technical workflows, and develop recommendations for a binational Concept of Operations;
- Identify and catalyze action on policy, regulatory and operational challenges and gaps;
- Provide an assessment of the impact of the experiments on resiliency as a result of the enhanced capability to share information.

CAUSE III used a scenario-based approach to simulate two cross-border emergencies that required a coordinated response and recovery from partnering EM organizations in Canada and the US. The first scenario involved a hurricane affecting the Northeastern US and making landfall in Halifax, Nova Scotia, Canada.[11] The second scenario involved a rangeland brush fire in the border region of Saskatchewan, Alberta and Montana. Both scenarios required a cross-border response from Canadian and US agencies. The Northeastern scenario was a follow-on to the CAUSE I and CAUSE II experiments, whereas the Western scenario was the first iteration on wireless communications interoperability in the CAUSE series.

The subject of this report, the Western scenario involving a rangeland brush fire, was focused on enhancing cross-border response to, and recovery from the incident through the deployment of interoperable LMR systems, which was then complemented by a high-speed 700 MHz broadband LTE capability. The LMR connected all responder organizations from Canada and the US by connecting three different systems together. The LTE capability allowed operators on the ground to exchange information using laptops, tablets or smart phones (e.g., real-time interactive maps, pictures, emails, live video) and to engage in real-time communications by voice and audio/video conferencing. This type of information is relevant to all responders engaged in multi-agency emergencies and the capability to exchange these types of data in real time enhances situational awareness and supports decision making and response coordination.

Five technological enhancements to multi-agency and cross-border SA that measurably improve regional resilience, as extracted from the above, are

- Providing LMR voice communications to a remote area where no communications previously existed;
- Allowing emergency responders and managers on three distinct systems to communicate by voice, made possible by an LMR interoperability gateway (introducing LMR interoperability where it was otherwise not possible);

- Providing LTE broadband communications and information sharing to a remote area where no communications previously existed;
- Through wireless backhaul, leveraging the world wide web to allow all emergency responders and managers in Saskatchewan, Alberta and Montana to communicate using feature-rich broadband applications;
- Leveraging the use of these applications to reduce response times from 10+ minutes to seconds.

1.3 Document Scope

This report documents the CAUSE III Western Scenario experiment. Section 2 of this report describes the experimental design and methodology of the experiment. Section 3 describes the method by which the experiment was evaluated and provides details on the execution of the two day experiment. Section 4 contains the analysis of the responses of the participants to the pre-experiment survey and the post-experiment survey. Section 5 presents the findings. The conclusions and recommendations are found in Section 6. Annexes A to E at the end of the document contain details of the scenario scripts and the measurements that were taken.

2 Experiment Description

This section describes the participants, the experiment scenario and the experiment design used to execute the CAUSE III Western experiment.[16]

The Western component of the CAUSE III live experiment was carried out on November 24–25 with primary locations in the western prairies of Canada and the US (Saskatchewan, Alberta and Montana). The main objective was to examine how situational awareness could be increased by augmenting interoperable LMR communications with broadband mobile LTE.

On the first day, innovative technology was used to connect two Canadian provinces (Alberta and Saskatchewan) and a US state (Montana) by voice through an LMR interoperability gateway that connected the three distinct LMR systems together. On the second day, high-speed broadband LTE (700 MHz) capability was added and allowed operators from all three jurisdictions to exchange data using feature-rich wireless applications. This included a real-time interactive map-based SA tool, the exchange of files such as pictures and videos as well as streaming video, video and audio conferencing, email and Voice over IP (VoIP). Table 1 provides details on the daily schedule that was planned to be followed during the experiment.

The scripts for the scenarios can be found in Annex A for Day 1 and Annex B for Day 2.

Table 1: *Experiment Schedule (Nov 24–25, 2014).*

Time	Event
0930 (CST) 0830 (MST)	Daily Participant Briefing / Communications Check
1000 (CST) 0900 (MST)	StartEx
1000–1400 (CST) 0900–1300 (MST)	Various injects / vignettes as per Participant scripts
1400 (CST) 1300 (MST)	EndEx
1430 (CST) 1330 (MST)	Participant hotwash

2.1 Participating Organizations

The principal Canadian agencies and organizations participating in the Western Plains brush fire experiment included: the province of Saskatchewan (Saskatchewan Emergency Management and Fire Safety—SEMFS), province of Alberta (Alberta Emergency Management Agency, Alberta First Responders' Radio Communications System—AEMA/AFRRCS), City of Calgary, Department of National Defence (DND), Communications Research Centre Canada CRC, Public Safety Canada, the University of Regina and the CSS.

The participating agencies in the US included DHS, US Customs and Border Patrol, the Hill County Sherriff's Department (MT), Blaine County Emergency Management (MT), the Havre Police Department and Texas A&M University.

Observer's in both countries included DHS S&T and CSS.

The following agencies, working groups, and companies provided support to the experiment: Motorola Solutions, Parallel Wireless and Triangle Communications.

2.2 Experiment Scenario

The construct of the Western scenario was to simulate a rangeland brush fire of a magnitude that required a cross-border response in order to evaluate the use of emerging interoperable technologies for information exchange, situation awareness and emergency response capabilities. The incident required a coordinated response where all responders could communicate and exchange data with one another, which was achieved with the advanced interoperability technologies.

On November 17, 2014 an intense lightning storm passed through Northern Montana. Several lightning strikes were also recorded in the vicinity of Wild Horse Alberta, and Willow Creek Saskatchewan that ignited the dry prairie grass. Despite the best efforts of the local fire fighters, the windy conditions enabled the fires to spread. The Wild Horse fire, proving particularly intense, had spread into Montana towards Havre and had also joined the Willow Creek fire (Figure 2). The overall fire now spanned an area greater than 150 sq.km.

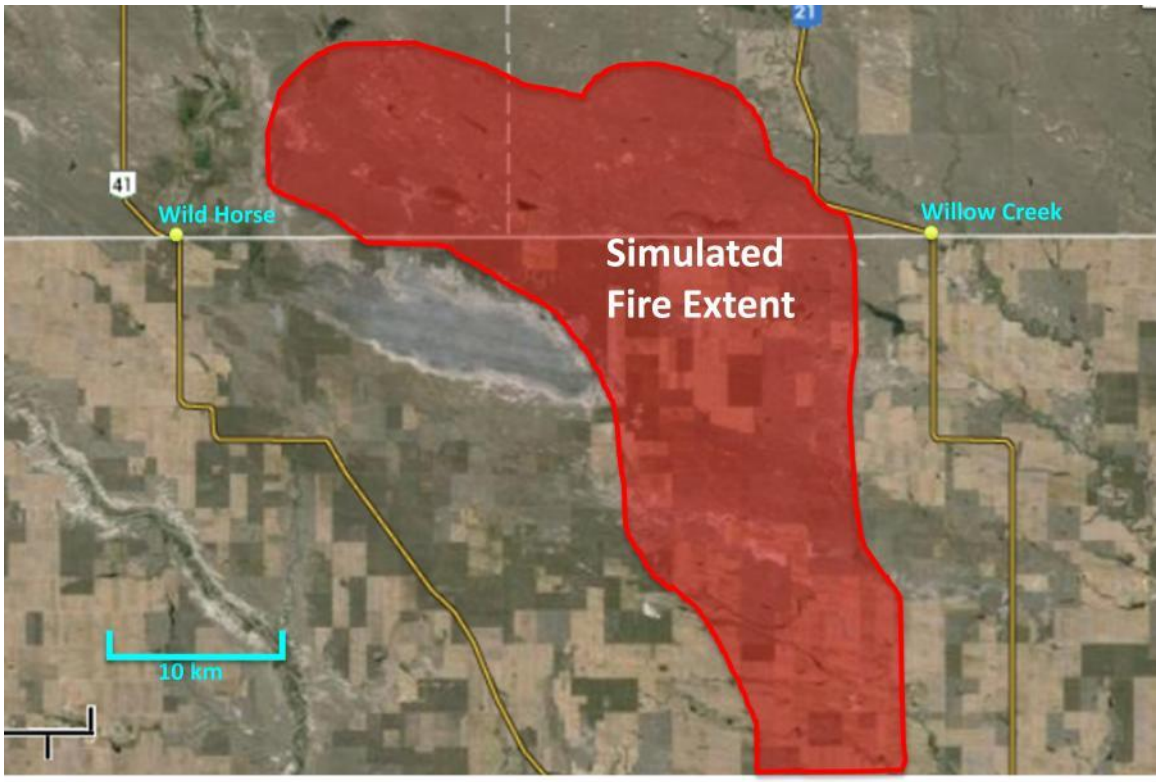

Figure 2: *CAUSE III Western Scenario Fire Extent.*

With the rapidly spreading nature of the fire and rapidly changing high winds, the ongoing firefighting operations required extensive cross-border and multi-agency collaboration and cooperation in order to successfully fight the fire. Unfortunately, due to its remoteness, the area was void of any available communications infrastructure, and as such, an urgent communications strategy needed to be established. The Saskatchewan Emergency Management Operations (EMO) decided to deploy its Mobile Command Post (MCP) at the Willow Creek border crossing between southwestern Saskatchewan and Montana and invite Montana and Alberta EM representatives to participate in a Joint Incident Command (JIC) at that location. Additional primary locations included the Wild Horse border crossing in southeastern Alberta and Havre in Montana.

Figure 3: *Willow Creek Joint Incident Command.*

Each of the three organizations that were represented (live or remotely) within the JIC had one or more mobile teams responsible for the response to the brush fire. The mobile team members were provided with a set of instructions and scenario material while receiving direction in real-time through voice and/or data applications (depending on the technologies in use) from the Lead Controller during the experiment (Figure 4). The mobile team members received technical support from specialists that were either based at the JIC or rode with them in their vehicles.

Figure 4*: Mike Fraser and Howard Georgeson of Saskatchewan at the JIC.*

2.3 Experiment Design

The experiment was coordinated from the JIC at Willow Creek. The experiment showcased two wireless communication technologies, LTE and LMR that enhanced the SA of first responders. An important consideration in the construct of the experiment was the lack of existing communications infrastructure in the area. As such, a critical component of the experiment was to establish temporary LTE and LMR communication networks and systems and demonstrate how

augmenting operational LMR communications with LTE capabilities could lead to increased situational awareness.

On Day 1, emergency response teams in each jurisdiction were limited to the use of Land Mobile Radio (LMR) to communicate by voice with other users in multiple jurisdictions. This was accomplished by installing a gateway at the Wild Horse border crossing in Alberta that allowed users in all three jurisdictions to communicate with one another, thereby significantly improving their communication interoperability. Radio communications using LMR followed normal communications procedures and voice protocols.

The same scenario was carried out on Day 2 of the experiment, but this time making use of deployable broadband mobile LTE wireless technology operating in Band 14 of the 700 MHz band (758-768 MHz downlink / 788-798 MHz uplink) to demonstrate increased situational awareness and enhanced communications capability over Day 1. This was accomplished by establishing three distinct, rapidly deployable LTE networks and enabling emergency responders in all three jurisdictions to seamlessly communicate with one another. From an application perspective, an interactive map provided shared situational awareness across the border and included data from the MASAS system, which was used by first responders during the experiment to submit reports from the field and to monitor real-time information on a map-based application. Other specific capabilities on Day 2 included the test and evaluation of VoIP, voice/video conferencing, email, exchange of a large file (capture picture/video) and access of a live video feed off of an aerostat (Figure 5).

Figure 5: *Live Aerostat Video Feeds.*

On both days of the experiment, controllers from the Joint Information Center (JIC) used either the LMR or LTE capabilities to communicate with first responders in the field. The communications centered on the following vignettes:

- Fire line perimeter definition
- Logistics and personnel requests
- Weather reports and updates
- Passage of aerial update info (from a/c to MCP to all lines)
- Road closure updates
- Aerial survey updates

These injects were introduced early in the planning stage to help guide the type and quality of information that would be communicated to generate participant situational awareness throughout the experiment. In order to establish a proper comparative reference, the same injects were used on both days of the experiment.

The scenario scripts for Day 1 and Day 2 of the experiment are presented in Annex A and Annex B, respectively. These scripts were devised to simulate communications that would be transmitted from various participants in an actual rangeland fire situation and were intended to represent an array of communications across a wide area that is being supported by deployable public safety broadband technologies. The call-in locations and coordinates associated with each of these participant locations are identified in Annex C.

2.3.1 LMR—Day 1

The primary objective of Day 1 was to establish LMR communications interoperability amongst user radios on the Alberta First Responder Radio Communications System (AFRRCS), Saskatchewan's Provincial Public Safety Telecommunications Network (PPSTN) and the Montana Statewide Radio System (MSRS). To this end, the EMO in each province and state set up their own stand-alone LMR system that allowed users on their own system to speak with one another, but not with users on the other systems. To then achieve interoperability amongst users on the three systems, an Interoperability Gateway (IOG) manufactured by Harris [17] was set up in an AFRRCS portable radio site at Wild Horse as seen in Figure 6 (white trailer).

Figure 6: *Wild Horse, Alberta.*

Essentially, a user radio from each system was connected to the IOG, providing a cross-system patch. Such a setup is only possible if the interoperability patch gateway is located within radio range of all three systems, which was the case in this experiment (Figure 7). Using satellite backhaul to the AFRRCS network switches located in Edmonton, a common talk group was then established allowing responders in all three jurisdictions to engage in multi-jurisdictional radio conversations.

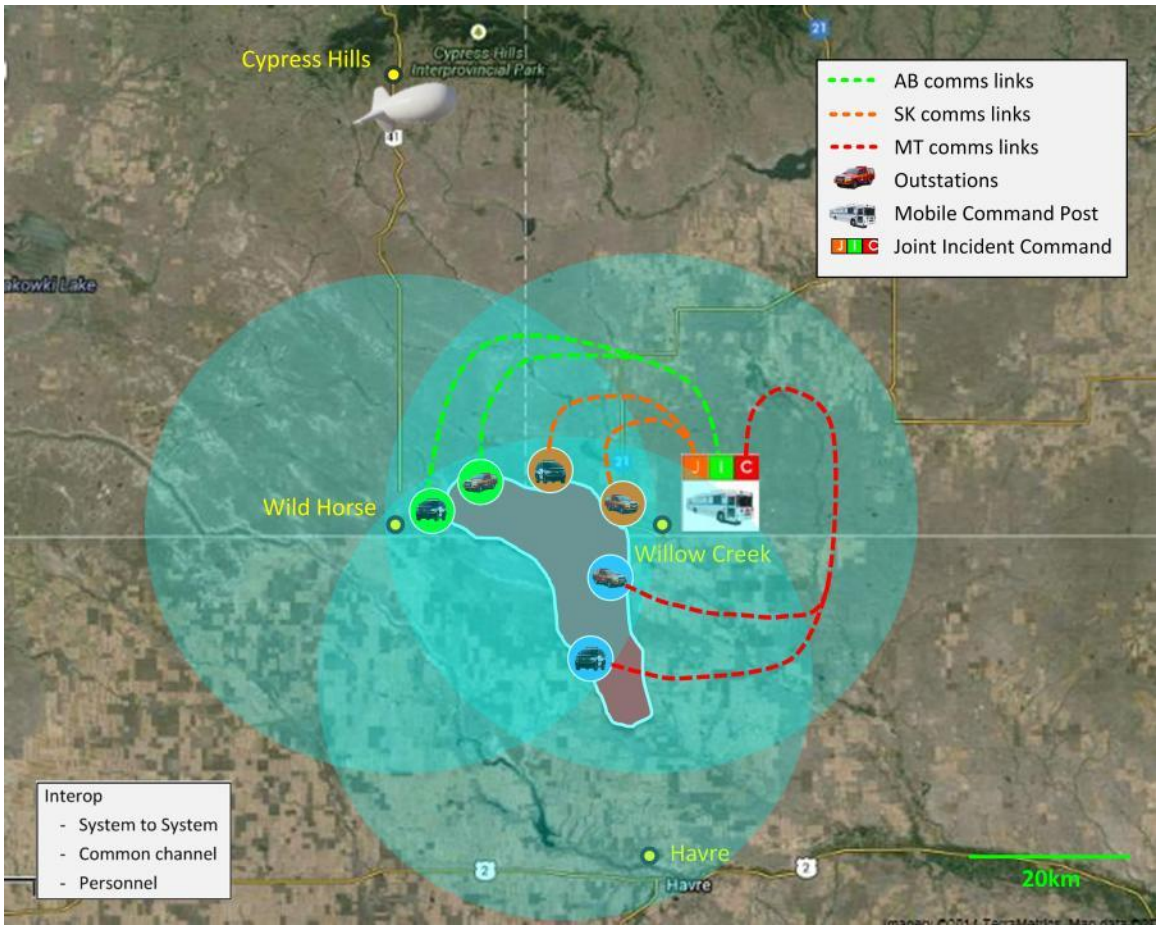

Figure 7: *LMR Scenario—Day 1.*

In addition to the above, each handheld radio was configured to support operation in a "blue channel" mode, which essentially allows any and all handheld devices to communicate directly (device-to-device) with one another on a common, dedicated VHF radio channel, as long as they are within range. Due to time limitations, this capability was not tested during the experiment but is known to be an established working capability of LMR.

A step by step vignette (Annex A) was produced and driven by the EMO in the Saskatchewan Mobile Command Post at Willow Creek. Emergency responders used voice communications to exchange/share information such as geographical coordinates for perimeter definition, logistic and personnel requests, weather reports, aerial updates and road closure information. At the end of Day 1, an information exchange session held to review how well the set up performed, what were the lessons learned, what worked well and what could be improved.

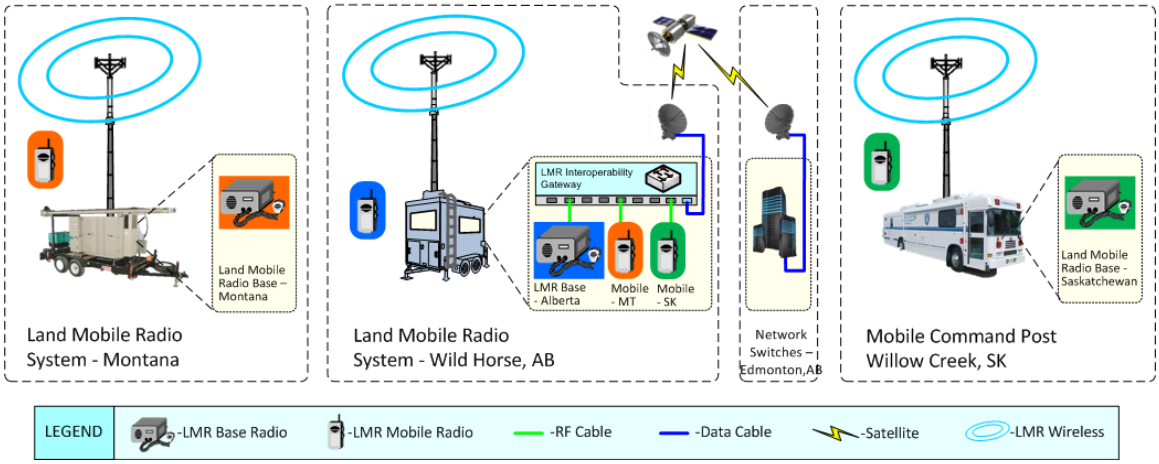

Figure 8: *LMR System Diagram—Day 1.*

2.3.2 High-Speed Broadband LTE—Day 2

The primary objective of Day 2 was to demonstrate the enhanced response to and recovery from a cross-border emergency by adding LTE capability to existing LMR. For relative comparison purposes, the same vignette was used as Day 1, but this time taking advantage of an added LTE capability beyond that of voice only LMR. In order to achieve this, the same three sites as Day 1 were used (Willow Creek, Wild Horse and Havre) with the addition of a fourth site at Cypress Hills, Alberta to provide overall LTE coverage and internet connectivity for first responders. All aspects of the LTE networks including application sets in Canada were designed, configured and installed by CSS and CRC. Additionally, Motorola installed and operated a deployable LTE system in Wild Horse, Alberta. The US LTE network installation and operation in Montana was led and coordinated by Texas A&M. In addition to this, there was also a mobile LTE system in Montana supplied and operated by Parallel Wireless to provide coverage closer to the border than Havre. A high level view of the experiment is provided in Figure 9, with details of each site included in the following sections.

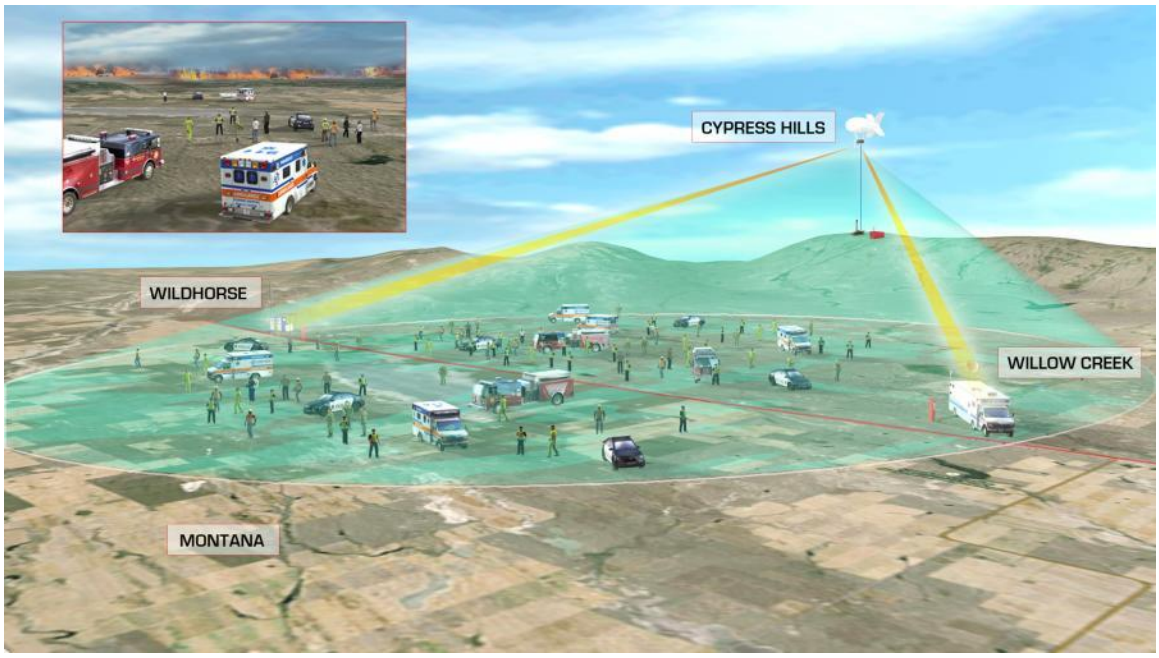

Figure 9: *CAUSE III West Experiment Methodology.*

2.3.2.1 Sites

2.3.2.1.1 Cypress Hills, Alberta

Cypress Hills was the key site where an Oceus deployable LTE system was flown off of an aerostat located 70 km north of the border (Figure 10). The aerostat was provided, installed and operated by the Director Land Command Systems Program Management (DLCSPM) of DND for the duration of the experiment. The payload of the aerostat that carried the evolved Node B (eNB) bas station equipment can be seen under the aerostat in Figure 10 and in Figure 11.

Figure 10: *Cypress Hill LTE on an Aerostat.*

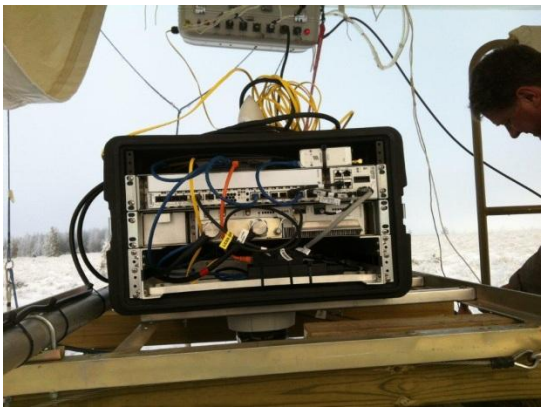

Figure 11: *Aerostat LTE eNodeB Payload.*

This distant location was selected as it was one of the closest locations to the border that had cellular coverage, and a cellular link was required to provide backhaul of the LTE network to the Internet for inter-jurisdictional interoperability purposes and application support. It is for this reason that an aerostat, essentially a 17 meter long helium-filled tethered balloon was flown at approximately 200 meters above ground to provide coverage down to the border (typical cell towers would not have the required reach). Users connecting to this system were the emergency responders from Saskatchewan and in some cases, Alberta. Furthermore, the LTE coverage off of the aerostat also provided backhaul connectivity to the MCP in Saskatchewan and the Alberta Communications Trailer allowing them to connect to the Internet as well. With a moderate amount of training, the aerostat can be set up start to finish in less than a day, and can be raised and lowered in less than 15 minutes.

The aerostat network used a total of 10 MHz (758-763 MHz downlink and 788-793 MHz uplink) of the available Band 14 spectrum. The eNB equipment was transmitting at 40W with a 6 decibel-isotropic (dBi) omnidirectional antenna resulting in 52 decibel-milliwatt (dBm) of Effective Isotropic Radiated Power (EIRP).

2.3.2.1.2 Willow Creek, Saskatchewan

As described in the LMR description of the experiment, the MCP, which served as the Joint Incident Command (JIC) was located at Willow Creek, Saskatchewan. This was the only fixed site in the experiment that did not have any LTE capability, but this was not an issue since first responders in Saskatchewan had good LTE coverage off of the system at Cypress Hills. The MCP also received backhaul to the Internet via the Cypress Hills LTE system. This was accomplished by installing a backhaul link at Willow Creek made up of a Band 14 LTE Motorola VML modem (Figure 12), yagi directional antennas, a switch, a laptop, cabling and ancillary equipment. A 14 meter rapidly deployable mast was also included but was not required since the roof of the MCP was used to install the antennas.

Figure 12: *Motorola VML LTE Modem.*

2.3.2.1.3 Wild Horse, Alberta

The second LTE network infrastructure was a Motorola System-on-Wheels (SoW) located at the Wild Horse border crossing point used to provide broadband communications to Alberta emergency responders (blue trailer in Figure 5). The system was able to deliver 40 Watts of transmit power but was configured to operate at 50 milliwatt transmit power off an 11 dBi directional antenna on a 5 meter mast. A total of 10 MHz (763-768 MHz downlink and 793-798 MHz uplink) of the available Band 14 spectrum was used at this location.

When these responders fell out of coverage range of the SoW, they would then connect to the aerostat LTE system at Cypress Hills, which also provided good coverage in Alberta. Similar to the Willow Creek site, a backhaul link to the Cypress Hills LTE system was established in order to provide the SoW with Internet connectivity. The backhaul system was made up of a band class 14 LTE modem, yagi directional antennas, a switch, a laptop, a 14 meter rapidly deployable mast, cabling and ancillary equipment.

2.3.2.1.4 Havre, Montana

The third LTE capability was in Montana where Texas A&M provided an LTE system at Havre, Montana with wireline backhaul to the Internet from Triangle Communications. This system was used to allow Montana responders to communicate with one another and to connect to the Internet, which allowed them to communicate with responders in Canada.

2.3.2.1.5 Mobile LTE, Montana

The fourth LTE capability was also in Montana where Parallel Wireless provided a deployable backpack system that had its own satellite backhaul for Internet connectivity. This system was used to allow Montana first responders close to the Canada-US border to communicate with one another and to connect to the Internet, which then allowed them to communicate with responders in Canada. Figure 13 shows the Parallel Wireless system with satellite backhaul.

Figure 13: *Montana Deployable LTE System.*

2.3.2.2 LTE Equipped Vehicles

In addition to the sites described in the above sections, there were also 4 vehicles (2 x Saskatchewan, 2 x Alberta) with LTE end user setups designed and installed by CRC in order to allow first responders to connect to the various LTE networks (Figure 14). Each of these included a Band 14 VML modem, a UM1000 USB LTE modem, omni-directional antennas at 2.5 meters above ground, non-intrusive roof mount kits, a GPS antenna, a laptop, a power source, cabling and all required ancillary equipment. In addition, each vehicle had a Motorola LEX LTE smartphone as a backup to the primary VML modems.

Figure 14: *First Responder Vehicles Equipped with LTE User Equipment.*

2.3.2.3 Internet Connectivity

From the descriptions provided in Sections 2.3.2.1.1 to 2.3.2.1.5 and 2.3.2.2, it is evident that connectivity to the Internet was a vital component of the Day 2 scenario as it was required to provide interoperability amongst users in all three jurisdictions. For instance, the applications used to provide enhanced communication capability over the push-to-talk voice in Day 1 included Multi-Agency Situational Awareness System (MASAS), voice and video conferencing, email, photo and video clip exchange, Voice over IP (VoIP), and an aerostat high definition video feed, most of which were hosted remotely over the Internet.

For the purpose of this experiment, a Session Initiated Protocol (SIP) server was set up at Texas A&M University to support the VoIP calls, audio conferencing and video conferencing. All participants in the experiment irrespective of jurisdiction could connect to the server via the Internet. Similarly, all participants connected through the Internet to the Multi-Agency Situational Awareness System (MASAS) server located near Montreal. All other applications were either hosted locally (including a SIP backup system) or cloud-based through the Internet.

A step by step vignette (Annex B) was produced and driven by the EMO in the Saskatchewan Mobile Command Post at Willow Creek. Emergency responders used the above mentioned suite of applications to exchange/share information by means of real time map-based situational

awareness updates, bi-directional voice, multi-party conferencing, photos, video clips, real time weather information, environmental conditions and detailed logistic and personnel requests. At the end of Day 2, an information exchange session held to review how well the set up performed, what were the lessons learned, what worked well and what could be improved upon.

Figure 15 illustrates the Day 2 broadband wireless LTE communications scenario.

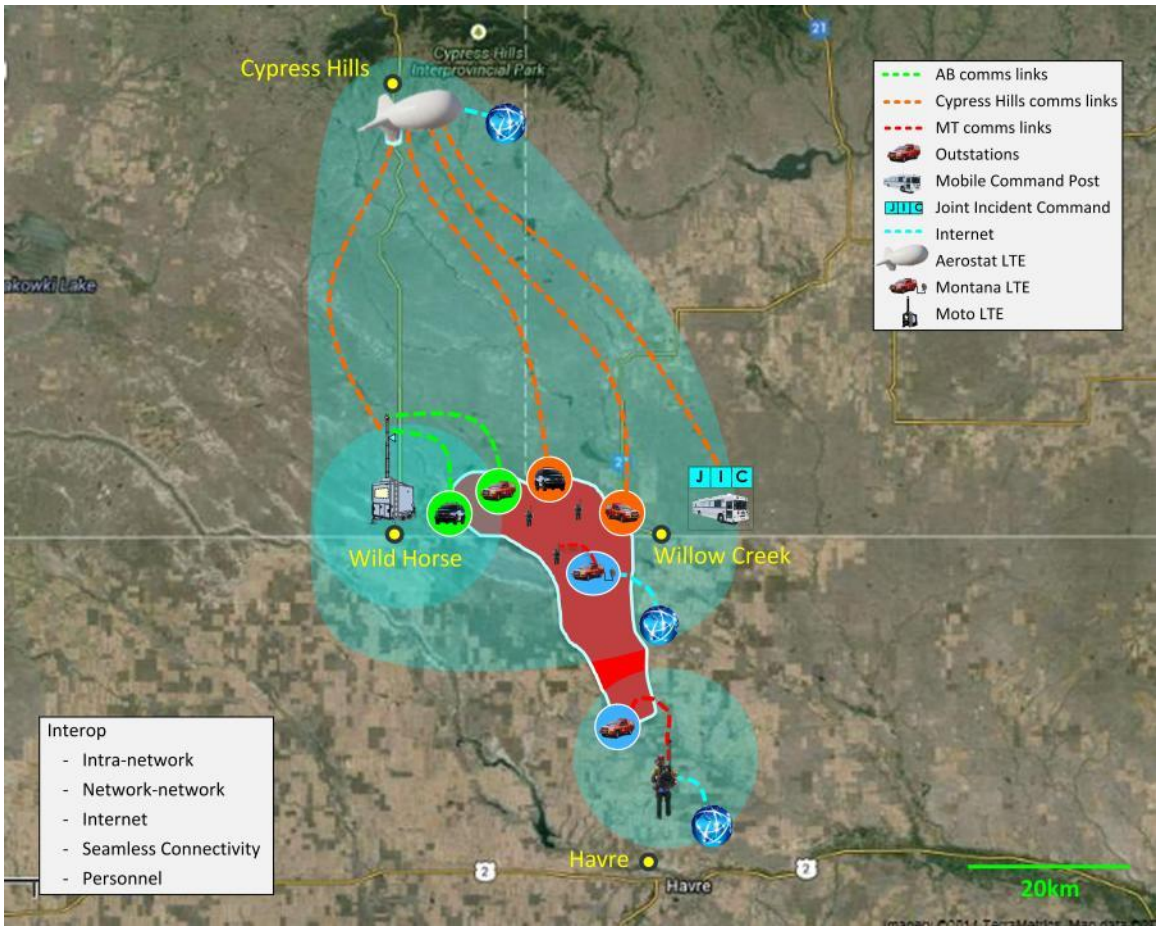

Figure 15: *LTE Scenario—Day 2.*

2.3.2.4 Network Architecture

Figure 16 provides further details on the systems used on Day 2 of the experiment and illustrates how interoperability via the Internet was achieved among the three systems.

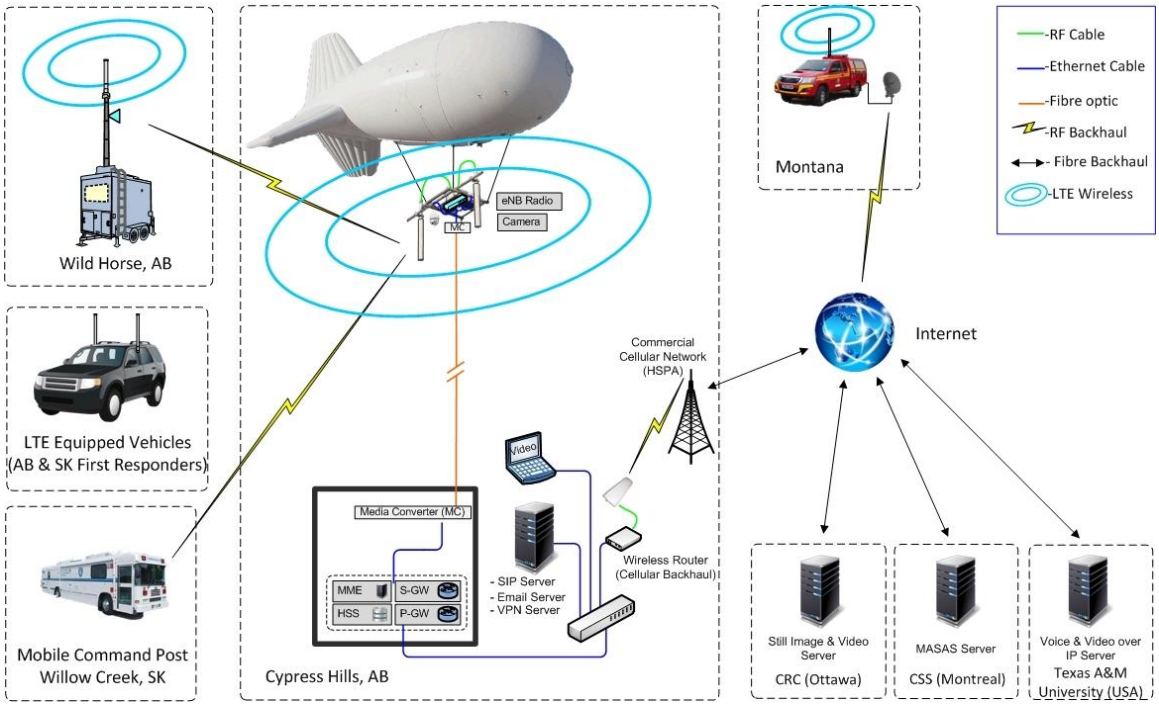

Figure 16: *LTE System Level Diagram.*

Figure 17 is the network level diagram that provides networking details on the switches, routers and addressing scheme used during the experiment.

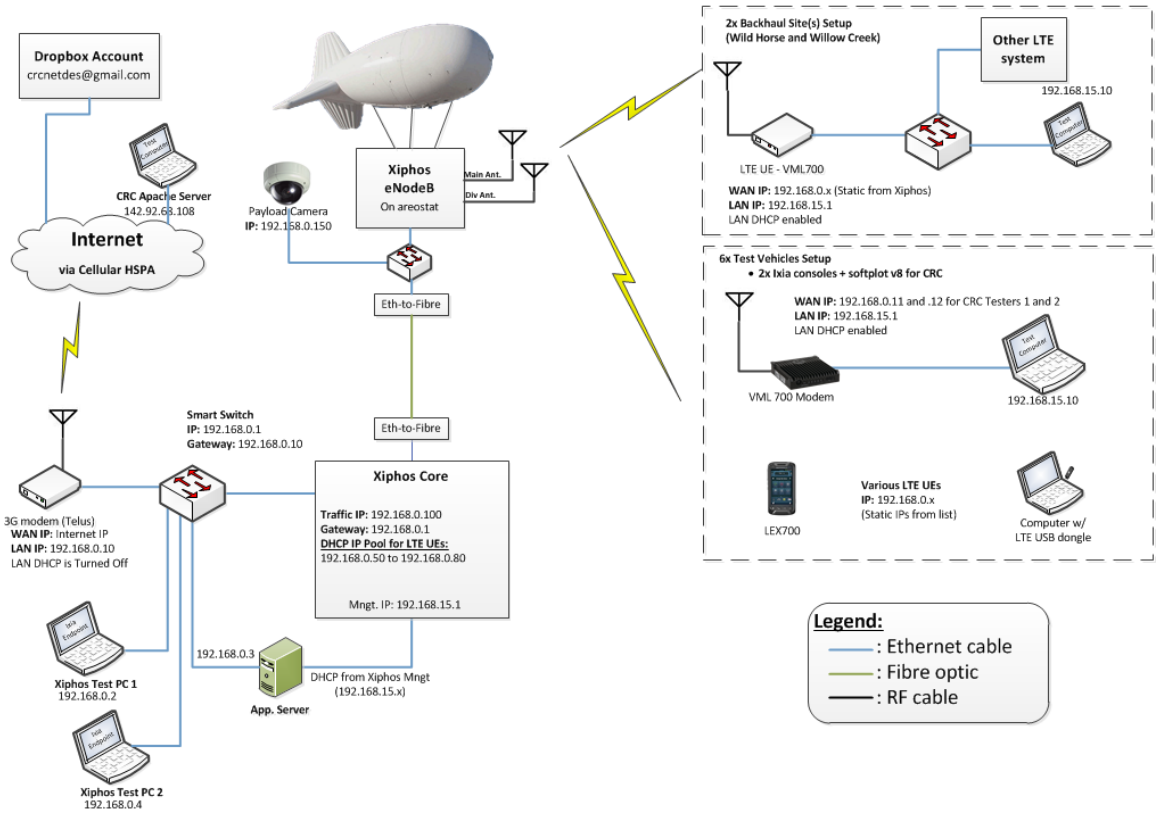

Figure 17: *LTE Network Level Diagram.*

2.3.2.5 Network performance

With four separate instances of LTE in the experiment, it was important to design the LTE network in a manner that optimized performance. Table 2 lists the LTE and HSPA+ (Telus backhaul) configuration parameters of each network component. The Cypress Hills LTE antenna was flown at 200 meters Above Ground Level (AGL), whereas the Wild Horse LTE antenna was approximately 10 meters AGL. The Wild Horse backhaul antenna was at approximately 8 meters AGL with the Willow Creek backhaul antenna at 3 meters AGL (on top of the mobile command post).

Table 2: *System Configuration Parameters.*

Description	Units	LTE Network Elements								HSPA
		Cypress Hills Aerostat	Wild Horse	US Border	Havre	Willow Creek Backhaul	Wild Horse Backhaul	Handheld Devices (LEX700)	Laptops + Modems (VML750)	Cellular Backhaul (Telus HSPA+)
Transmit power	[dBm]	46	46*	30	30	23	23	23	23	23
Antenna gain	[dBi]	6		0	0	16	16		6	11
Effective Isotropic Radiated Power [EIRP]	[dBm]	51.5	57*	30	30	37	37	23	28.5	31
Channel bandwidth	[MHz]	5+5	5+5	5+5	5+5	5+5	5+5	5+5	5+5	5+5
Downstream channel	[MHz]	758-763	763-768	758-763	758-763	758-763	758-763	**	**	885-890
Upstream channel	[MHz]	788-793	793-798	788-793	788-793	788-793	788-793	**	**	840-845
Maximum upstream throughput	[Mbps]	9.5	12	10	10	3.2	9	9.5	9.5	4.3
Maximum downstream throughput	[Mbps]	17	30	20	20	17	17	17	17	14.9
* Transmit power was lowered for part of the experiment, affecting both the transmit power and the EIRP										
** Channels set to the corresponding Cypress Hills or Wild Horse LTE networks										

Prior to deployment, the Oceus deployable LTE system was benchmarked for performance in a laboratory environment. User Equipment (UE) transmit power and throughput performance were measured using the VML 700. In lab performance of VML 750 modems yielded comparable results. Key findings are presented below.

Unlike the eNB equipment which transmits at a constant power, LTE user devices transmit using power control. With uplink power control, the UE tries to maintain a constant uplink Received Signal Level (RSL) in order to minimize interference and reduce end user device power consumption. Figure 18 depicts the transmit power for a VML 700 modem as a function of uplink RSL. It can be observed that when there is ample margin on the uplink path (e.g., as the UE gets closer to the eNB), the VML modem's power control algorithm will adjust the transmit power accordingly in order to maintain an uplink target RSL of -86.5 dBm when using a 5 MHz channel and -83.5 dBm when using a 10 MHz channel.

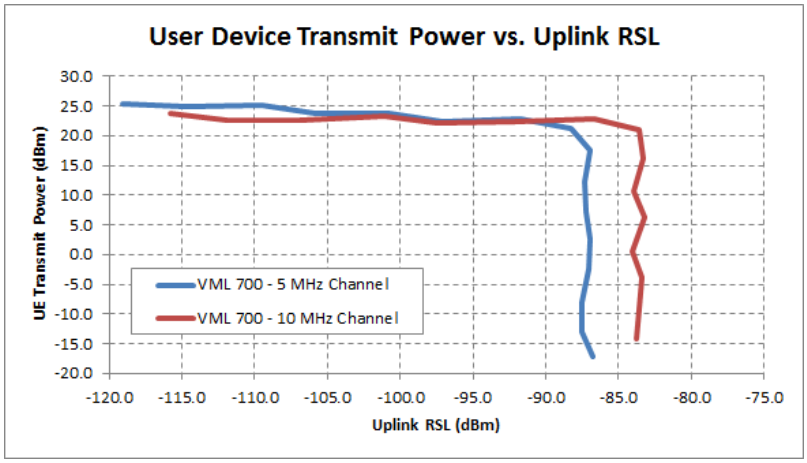

Figure 18: *VML 700 Modem Transmit Power Control.*

Downlink and uplink threshold of operation measurements were conducted using a VML 700 modem when the LTE system is set to operate in both 5 MHz and 10 MHz channel configurations. The tests were performed with the deployable system set to transmit at 20 Watts (43 dBm) as to better reflect the asymmetry that would be seen in the field between the aerostat radio and the vehicular modems. End user Data throughput as a function of downlink and uplink receive signal levels are presented below in Figure 19.

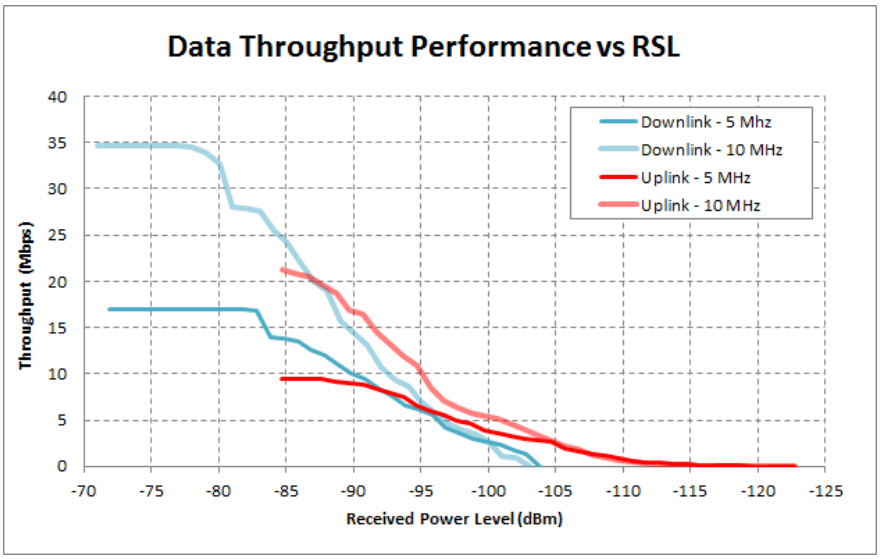

Figure 19: *Deployable LTE System Throughput against Downlink & Uplink RSL.*

2.3.2.6 Radio Frequency (RF) Coverage Maps

The RF coverage maps for the various LTE systems temporarily deployed in the CAUSE experiment are provided in this section. They are the uplink-limited coverage maps in order to indicate the true coverage that can be expected. Figure 20 illustrates the coverage (blue) of the LTE network flown off of the aerostat at Cypress Hills 70 km north of the border. The signal strength at the outer limits of the coverage is -100 dBm while delivering approximately 3.7 Mbps of capacity. The downlink with more system gain yields 17 Mbps. Figure 21 is a zoom of the Cypress Hills network at the border, with the varying colours indicating the levels of received signal strength. The dark green coverage is -90 dBm or better, yielding a throughput of 9.1 Mbps. Again, the downlink yields 17 Mbps. The signal strength at the outer limits of the coverage in dark blue is -115 dBm while delivering approximately 0.2 Mbps of capacity (downlink 9.2 Mbps). Figure 22 depicts the coverage (yellow) of the Motorola LTE network installed at Wild Horse, Alberta. Figure 23 is the predicted coverage (yellow) of the Havre Montana LTE network operated by Texas A&M. Both of these systems have similar capacities to the aerostat LTE coverage (minimum 3.7 Mbps).

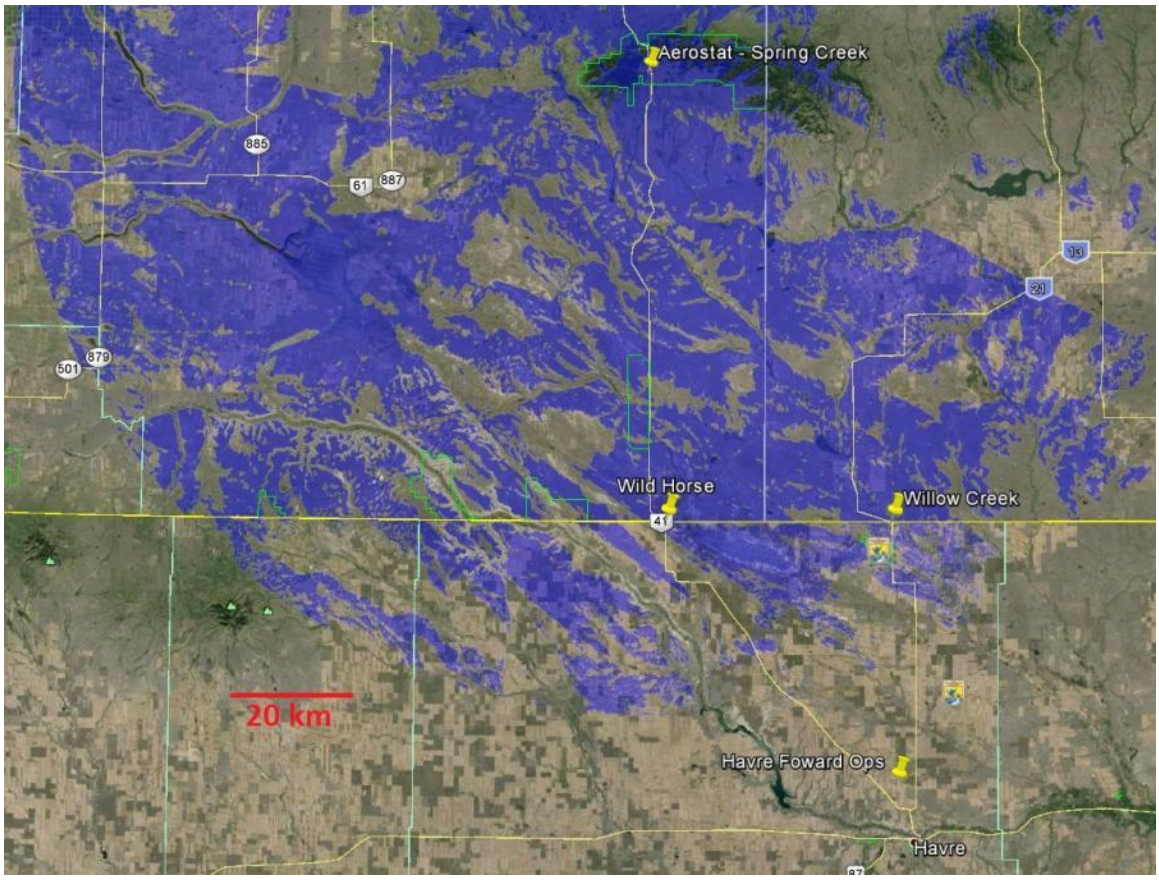

Figure 20: *Cypress Hill LTE Coverage from Aerostat at 200 meters Above Ground.*

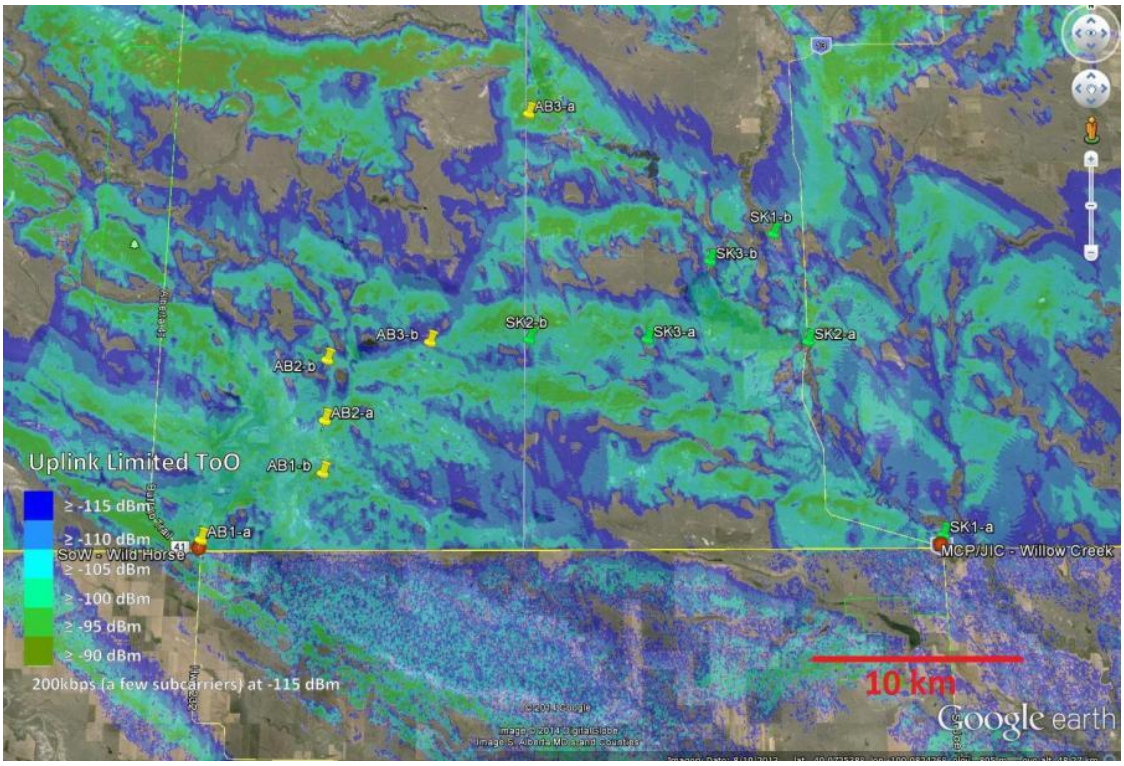

Figure 21: *Zoom of Cypress Hills Coverage at Border Area.*

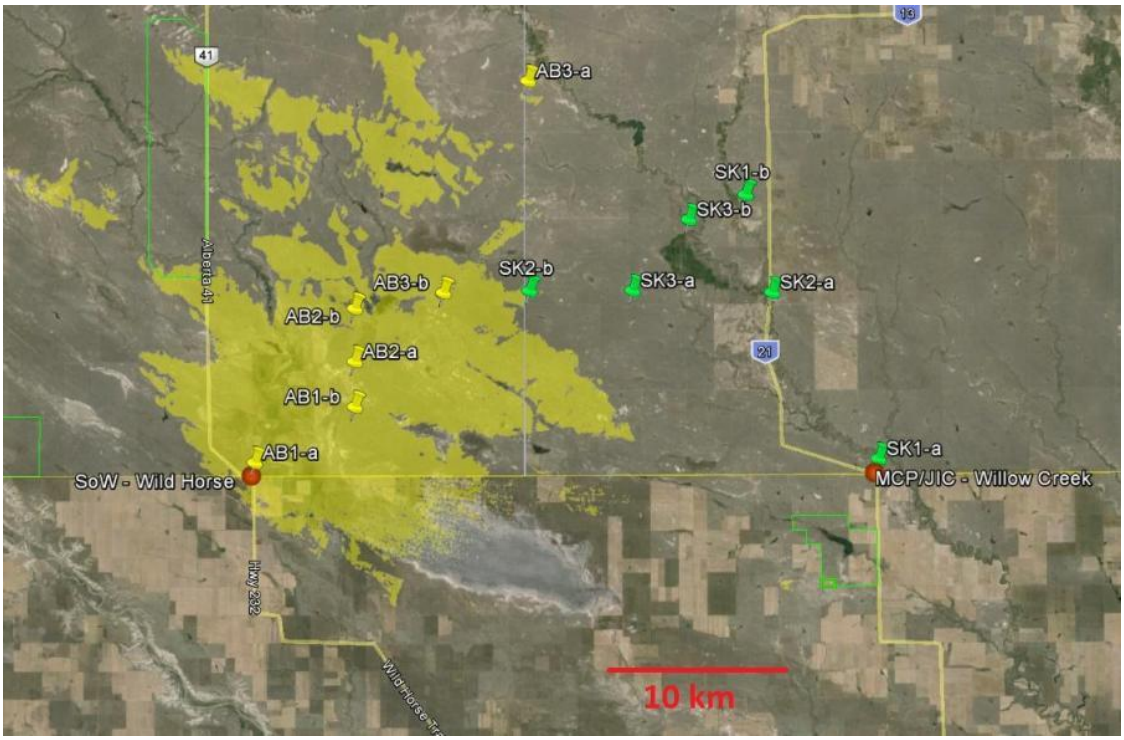

Figure 22: *Wild Horse LTE Coverage—Motorola SoW.*

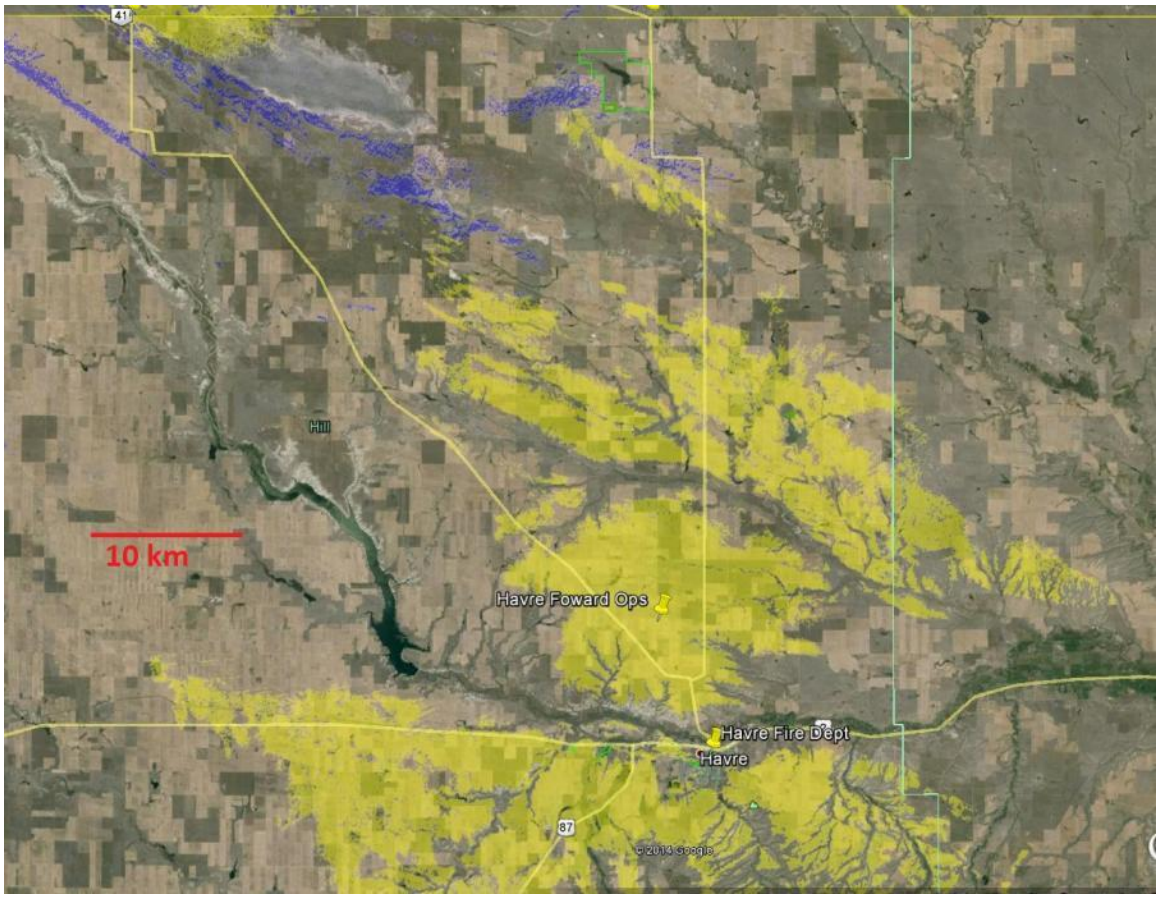

Figure 23: *Havre LTE Coverage.*

2.3.3 Broadband Data Sharing Applications

Long Term Evolution (LTE) was introduced in the CAUSE III experiment in order to provide a broadband data service to the participants. The LTE wireless communications capability provided the participants broadband access to the Internet at three Points of Presence (POP) that essentially provide access to the Internet. The first POP was instantiated by a Telus Mobility mobile station located at Cypress Hills, Alberta. In Montana there were 2 POPS. One was established by a satellite terminal that was part of the LTE System-on-Wheels (SoW), located in a remote area of Montana close to the Canadian border. The second was provided by Triangle Communications optical fibre termination at the Hills County Sheriff's Office. Without the LTE infrastructure, the participants would have only been able to rely on voice-based communications over traditional Land Mobile Radios (LMR) and potentially, low-speed data (9.6 kbps) to exchange information about the simulated incident. The LTE infrastructure gave the participants the ability to exchange multimedia information and to participate in real-time audio-video conferencing. What follows is

a more detailed description of the applications that were used over the broadband connections to the Internet.

The introduction of the LTE networks resulted in additional requirements for participants, beyond normal practices and procedures. This is to be expected as the use of LTE in response to such incidents is new.

2.3.3.1 Multi-Agency Situational Awareness System (MASAS)[2]

The MASAS application is a cloud-hosted collaboration tool that allows authorized users to share information of an event or incident with other users. Users can input information to the MASAS tool by annotating a multi-layered geographic map with icons, text, images, hyperlinks, etc. The information thus entered becomes visible and accessible to anyone that is registered as part of the incident team, regardless of jurisdictional affiliations. The information collected by officers in the patrol vehicles from both sides of the border was entered into MASAS and, within seconds, was available to the staff at the Emergency Operations Centres (EOC) at both the Havre, Montana site and the Willow Creek, Saskatchewan site.

The users were able to enter notes and upload files to the MASAS server. Figures 24 and 25 illustrate screen-capture scenes from MASAS during the experiment. The note blocks contain text as well as hyperlinks to related files, which can be images or videos.

Location information, as captured from a mobile device's Global Positioning System (GPS) function, can be associated to where the note was entered, as well as images and video files. This requires a mobile MASAS application client to be resident on the mobile device. For some mobile devices it was necessary to modify the MASAS client app for the Android platform. For the vehicular modems, GPS information was not accessible and needed to be manually entered in order for location to be associated with the incident information.

[2] https://www.masas-x.ca/en

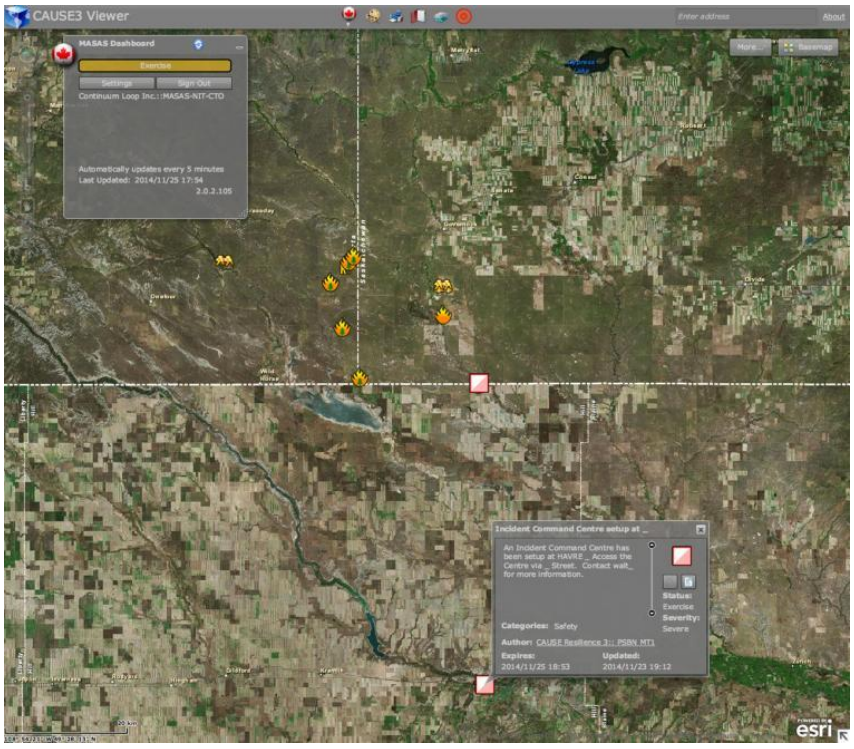

Figure 24: *User-Annotated Map of the Incident Area—Terrain View.*

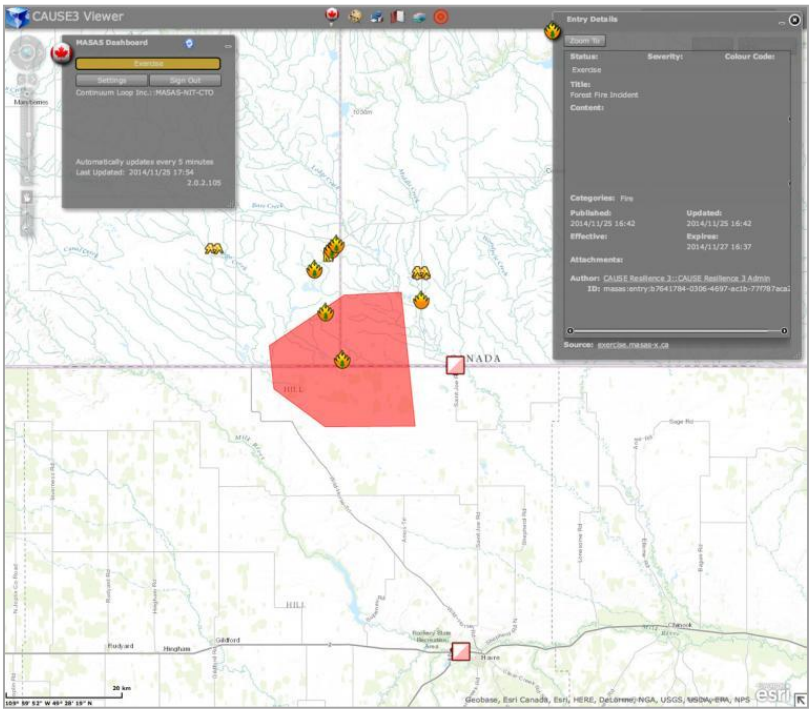

Figure 25: *User-Annotated Map of the Incident Area—Geo-Political and Road View.*

2.3.3.2 Voice and Video over IP

An audio/video conferencing application was hosted by Texas A&M University using Broadsoft's Unified Communications product, UC-1 (http://www.broadsoft.com/service-providers/products-applications/broadworks/unified-communications).

UC-1 uses SIP that enables Voice-over-IP (VoIP), video collaboration, and other forms of communications. Firewall issues on some handheld devices and vehicular modems prevented video collaboration to function fully. However, when a Virtual Private Network (VPN) server was used to encapsulate the video packets and support a tunneling capability, then video conferencing was made to work between some of the devices that had the VPN client installed and the EOCs. Users had to be registered on the UC-1 SIP server in order to be authorized to access the application. It is expected that a Federated Identity and Credentials Management (FICAM) system would have alleviated the need to register users separately on each platform. The utility of FICAM to automate the authentication and authorization processes for access to information and applications is an area of future study and experimentation.

2.3.3.3 Access to Still Images and Video Clips

There were two principle sources of still images and video clips—the aerostat at Cypress Hills that had an ongoing video capture and the emergency responders in the field. The aerostat payload was mounted with an IP camera and the images that were collected were recorded in a Digital Video Recorder (DVR) at the ground station. The DVR was accessed by a User Equipment (UE) device, dedicated for this purpose. The image files were then uploaded to an Apache server. Users were provided with a URL to be able to view the images over the Internet.

Images that were captured by field personnel were uploaded to the MASAS server. All users that were authorized to access MASAS could then view the images.

2.3.3.4 Email and Social Media Platforms

By virtue of having access to the Internet, any cloud-hosted messaging applications such as Gmail™ and messaging, as well as social media applications were accessible to whoever had access to the Internet. For example, at the Havre EOC, US Customs and Border Protection officers were able to monitor Twitter™ feeds.

2.4 Interoperable Systems

CAUSE III followed a System-of-Systems (SoS) approach whereby existing systems were connected based on open standards. Table 3 identifies and summarizes the systems that were used during the experiment.

Table 3: *Canada and US Systems Used During CAUSE III.*

Technology	Details
Multi-Agency Situational Awareness System (MASAS)	
Owner:	Government of Canada (i.e., DRDC-CSS / PSC)
Intended Use	The system enables creation, consumption, and publication of official incident-specific data, alerts, and warnings required to support shared SA at the local, provincial and national level. Information shared in MASAS is visible to all MASAS users but not to the general public
Sub-technology	MASAS at its core is a server-based, non-visible system that supports a graphical user interface. The CSS/MASAS team made available two components that enable users to consume and publish MASAS data from within a Flex Viewer (e.g., CAUSE III Viewer) and a mobile application that enables users to use MASAS from iOS™ or Android™ devices
Session Initiated Protocol (SIP) Server	
Owner:	Texas A&M University
Intended Use	Enables voice over IP (VoIP) communication. Enables SIP-based audio and video conferencing.
Sub-technology	Broadsoft, Unified Communications SIP client (UC One), Linphone SIP client
IP Video Server	
Owner	Communications Research Centre
Intended Use	Provide access to a high definition video feed mounted in the payload of the aerostat. Any user with the proper permission can access the real-time video feed. All users can download time-delayed video clips and photos from a video server
Sub-technology	Axis Communications
Deployable LTE Network – Cypress Hills, Alberta	
Owner	Department of National Defence
Intended Use	Provide broadband connectivity to emergency personnel in Saskatchewan and Alberta
Sub-technology	Oceus deployable LTE network, T-Com aerostat system (17 meter), CRC hosted application servers
Deployable LTE Network – Cypress Hills, Alberta	
Owner	Province of Alberta, Motorola
Intended Use	Provide broadband connectivity to emergency personnel in Alberta
Sub-technology	Motorola LTE system-on-wheels
Deployable LTE Network – Border Region	
Owner	Parallel Wireless
Intended Use	Provide broadband connectivity to emergency personnel in Montana

Technology	Details
Sub-technology	Parallel Wireless LTE deployable network, satellite backhaul, Triangle Communications wireline backhaul
Deployable LTE Network – Havre, Montana	
Owner	Texas A&M
Intended Use	Provide broadband connectivity to emergency personnel in Montana.
Sub-technology	LTE network, Triangle Communications wireline backhaul
LMR Interoperability Gateway	
Owner	Province of Alberta
Intended Use	Allows users on separate LMR systems to communicate with one another, both within their own jurisdiction and outside of their jurisdiction.
Sub-technology	Harris LMR Interoperability Gateway
LMR System – Saskatchewan	
Owner	Province of Saskatchewan
Intended Use	Provide voice service to emergency responders in Saskatchewan
Sub-technology	LMR
LMR System – Alberta	
Owner	Province of Alberta
Intended Use	Provide voice service to emergency responders in Alberta
Sub-technology	LMR
LMR System – Montana	
Owner	State of Montana
Intended Use	Provide voice service to emergency responders in Montana
Sub-technology	LMR
Mobile Command Post – Willow Creek, Saskatchewan	
Owner	Province of Saskatchewan
Intended Use	Act as the Joint Incident Command (JIC) centre for the experiment
Sub-technology	MCP
Internet Portal – Cypress Hills, Alberta	
Owner	Communications Research Centre
Intended Use	Provide Internet connectivity to the Motorola LTE network at Wild Horse, the MCP, and all LTE users in Saskatchewan and Alberta
Sub-technology	Telus 3G service plan

As a complement to Table 3, Table 4 lists each of the physical sites that were used in the experiment as well as the toolsets of technologies and applications at each location.

Table 4: *Integrated Situational Awareness Tools Across Physical Sites.*

Physical Location	Technology
Cypress Hill, Alberta	High definition video feed, video server, backup SIP server, aerostat, LTE network, commercial broadband service, Internet portal
Laval, Quebec	MASAS server
College Station, Texas	Texas A&M SIP server
Wild Horse, Alberta	Land Mobile Radio (LMR) interoperability gateway, LTE network, LMR system
Willow Creek, Saskatchewan	MCP, JIC, LMR system
Havre, Montana	LMR system, wireline Internet portal
Montana Border Region	Satellite Internet portal, deployable LTE network, wireline Internet portal

3 Experiment Evaluation Process

This section describes the basis and the methods used to evaluate the experiment, which were based on observations and on feedback collected from various participants before and after the experiment using targeted questionnaires (Annexes F, G, and H).

Annex D contains the questions used in the two self-assessments of situation awareness—one for Day 1 and another for Day 2.

Annex E contains the qualitative metrics that were used to evaluate the impact of LTE technology on information exchange on Day 2. Participants results of the evaluation are qualitative in nature and are presented in §4.

3.1 Participants' Roles

The stakeholder organizations fell into one of four participant groups: players, controllers, observers, and CAUSE III champions. At the beginning of the experiment, seven (7) participants completed a demographic questionnaire. Following the experiment, five (5) of the seven participants that replied to the pre-experiment questionnaire also replied to a post-experiment questionnaire. Each participant's role was identified in the questionnaires and pertained to one of the four groups. Not all roles were represented in the population of those who responded to the questionnaires. A brief description of each participant group is provided below.

- Players: The players consisted of the operational personnel from the EM organizations represented during the experiment;
- Observers: The observers were invited to attend the experiment by the exercise controllers and represented stakeholder organizations at the local, provincial/state, and federal levels;
- Controllers/Experiment Design Team: The controllers designed the scenarios, facilitated the pace of the experiment and managed the interoperable toolsets;
- CAUSE III Champions: The CAUSE III Champions were responsible for leading and facilitating the experiment, which their respective organizations funded. The Champions were Jack Pagotto (Canada) and Dan Cotter (US), who observed the experiment either in person or via webinar.

The experiment was coordinated from the JIC located immediately adjacent to the Willow Creek, SK, border crossing. The Experiment Director and the Lead Controller were located in the JIC. It was also planned for Emergency Management (EM) representatives from Alberta, Saskatchewan, and Montana to be located at the JIC to address any issues that might arise within their own areas of responsibility. For some of the experiment, EM representatives participated remotely.

The technology hardware that was provided to the participants for the study was installed, set up and managed by organizations who worked directly with the Centre for Security Science. The installation of the hardware onto the vehicles was designed and carried out by the CRC, requiring three to four hours to complete per vehicle. The MCP, which housed the JIC during the

experiment, was owned and provided by the province of Saskatchewan during the experiment. The MCP had an existing LMR capability that was also used in the experiment.

3.2 Experiment Conduct

Attendance on both days varied as responders were tasked with participating in the experiment in addition to their normal duties. As a result of this, some participants became unavailable when the technology was in service. This resulted in a smaller set of participants that was originally planned.

On Day 1, the Canadian provinces and the US state were each provided with two LMR radios for use by the players throughout the experiment. Therefore the total number of LMR participants that could be engaged was 7; 2 for Alberta, 2 for Saskatchewan, 1 for the US state of Montana and 2 in the JIC.

On Day 2, an end user system essentially consisting of a laptop, an LTE modem and antennas and cabling was provided for use in the mobile units when the broadband LTE capability was used. In order to demonstrate a variety of available devices, a LTE mobile handheld smartphone was also available as a complement and backup to the laptop. Therefore, there were 2 devices per vehicle in each Canadian province. With two vehicles per province (§2.3.2.2), there was then a total of 8 devices. All of this was provided by the CRC and Motorola. The US had one mobile unit with the technology provided by Texas A&M University, for an overall total of 9 LTE devices in the experiment. The data sharing capability was enabled in the JIC with their existing technology and a LTE modem and laptop computer configuration provided by CRC and CSS. The total number of players on Day 2 was impacted by delays that were caused by equipment infrastructure and weather, where certain players could no longer participate due to their schedules. At the time the technology was available for the experiment a total of 4 players were available; 2 for Alberta, 1 for Saskatchewan and 1 for the JIC. Command for Alberta and Montana was played by the Lead Controller.

The study team conducted the evaluation of the impact of the interoperable technology on information exchange as facilitated by the LMR (voice only) on Day 1 and the LMR when augmented by broadband LTE capability (voice plus data sharing) on Day 2.

3.3 Evaluation Methodology

A multi-step evaluation framework was generated prior to the experiment.[16] This framework was used to guide the data collection and measure the effects of the interoperable technologies investigated during the experiment on operations supporting a response to a fire event. The data collection plan was developed to ensure that the observations that were gathered would support the development of qualitative findings. In addition, pre- and post-experiment questionnaires were provided and a situational awareness rating scale was developed.

3.3.1 Data Collection Plan—Phase 1

Phase 1 of the data collection plan was designed to gather feedback directly from the study participants at each of the physical sites associated with the Western scenario (i.e., Willow Creek, SK, Wild Horse, AB and Havre, MT) and a set of surveys and rating scales were administered to the participants at specific milestones during the experiment. Each instrument is briefly described below.

Pre-Experiment Questionnaire

This questionnaire gathered feedback related to the participants' knowledge and experience using the technologies under investigation. This information was used to support the conduct of the experiment and was compared to participant feedback that was gathered using the End of Day 1 and End of Day 2 questionnaires, and the Post-Experiment questionnaire at the end of the experiment. The Pre-Experiment questionnaire was administered as an online survey that was accessible to participants via the Internet.

Post-Experiment Questionnaire

This questionnaire gathered feedback related to the participants' experience with the activities that were associated with each of the vignettes. Participant feedback related to the exchanges of information during a cross-border response. The questionnaire was designed to develop an understanding of how the technology can be deployed in support of operations and how the participants' opinions may have changed as a result of the experiment. This questionnaire also gathered feedback related to the design and execution of the experiment and was also an online survey that was administered at the end of the second (i.e., final) day of the experiment.

Situational Awareness Ratings on Day 1 and Day 2

Three statements were developed for each of the six vignettes that were included in the experiment. These statements were related to the information that was being exchanged between the players in the experiment. Players provided a self-assessment to reflect their level of situational awareness with respect to the information that was exchanged during the vignettes. A self-assessment was completed at the end of Day 1 and at the end of Day 2. A 5-point rating scale was used by the players to complete their self-assessment. A rating of '1' indicated that they had 'no situational awareness' regarding the information that was exchanged. A rating of '5' indicated that they had 'high situational awareness' for the information that was exchanged. A moderate rating of '3' indicated that they had 'some situational awareness' regarding the information that was exchanged. For details, refer to Annex D – Situational Awareness Measures.

3.3.2 Data Collection Plan—Phase 2

Phase 2 of the data collection plan was designed to gather and assess observational data. Observations were gathered through a discussion with the experienced first responders from the province of Saskatchewan and through observations gathered during the conduct of the experiment. These data collection activities are described below.

First Responder Discussion Group

On Day 2, a group discussion was held with several Logistics personnel from the province of Saskatchewan's first responder team. The purpose of this discussion was to gather information related to the Logistics team's information requirements and operational tasks that are performed at the fire line. This group of responders has experience using an LMR system that has already been implemented within the province of Saskatchewan.

Metrics-based Analysis

Observational data deemed relevant to the metrics that were developed prior to the experiment were gathered during the conduct of the experiment. These were then used to perform a qualitative evaluation which was developed from earlier research studies.[16][18]

The Western experiment metrics were categorized in accordance with the Canadian Communications Interoperability Continuum.[10] The model defines the core elements and key attributes of a mature interoperable capability. The metrics were applied to the observations that were gathered during the experiment and were tailored to the dimensions identified in the CICM (i.e., Governance, Standard Operating Procedures (SOPs), Technology, Training & Exercises and Usage) and were scored by the study team on a 5-point scale. The scale reflected the extent to which information exchange, facilitated through the use of LMR and LTE, supported the development of situational awareness which could potentially lead to a more coordinated, effective organizational response.

A score of '1' reflected that there was little demonstration of information exchange or how situational awareness was generated or enhanced within any organizations. In contrast, a score of '5' reflected that the extensive information exchange allowed multiple organizations to plan a coordinated response. A moderate score of '3' reflected that information was gathered from other organizations and used to determine an organization's own actions. The evaluation was performed based on observations by the study team. The metrics used are attached in Annex E – Broadband LTE Metrics.

4 Results

4.1 Data Analysis

The data gathered were analyzed using the evaluation framework that was established prior to the experiment.[16] The participants were highly experienced first responders and therefore were very knowledgeable on the information exchange requirements that must be met during a multi-agency emergency event. The sample size was too small to infer any statistically significant differences. However, the general patterns of response provide guidance with respect to the potential impact that the LMR and broadband LTE technologies had on enhancing situational awareness during the execution of a cross-border emergency response.

4.2 Replies to Pre-Experiment Survey

Prior to the experiment, an online survey was completed by seven (7) players of the Western scenario. The pre-experiment survey questions can be found in Annex F. The players represented the fire lines for Alberta (n=2), Saskatchewan (n=1) and Montana (n=1) as well as the JIC (n=2). One player did not identify their role. It is important to note that this group of participants were the only participants who actually used the LTE and LMR systems. Therefore, although the sample size is small, this dataset constitutes the full set of directly involved participants. Further, these participants are highly knowledgeable and experienced with respect to the operational tasks that they performed during the experiment.

The majority of respondents were employed by organizations that respond to cross-border events. Approximately half of these organizations typically rehearse multi-agency emergency responses and have experience responding to real or simulated prairie brush fires.

The replies to the pre-experiment survey indicated that participants are interested in using a wide range of tools (if accessible) during an emergency to enhance their situational awareness. These tools can be used to transmit voice and/or data to responders who are distributed across multiple remote locations. For LTE they include:

- Deployable LTE networks
- Real-time map-based situational awareness
- Government data sites (e.g., weather, maps)
- VoIP
- Audio/video conferencing
- Images and video clips from real-time video feeds
- The Internet
- Email
- Smart mobile devices (smart phones)

- Modem + laptops
- Text messaging
- Office tools (MS Office)

For LMR they include:

- Push-to-talk voice radios
- LMR systems
- An LMR interoperability gateway

Although most participants were inexperienced with using LTE technology they indicated that sending and/or receiving the following types of information would be useful:

- Maps and real-time location-based data related to the affected area;
- Documentation (Situation Reports, briefings, field observations, mutual aid agreements);
- Confirmation of information that is sent and received;
- Real-time status updates and tracking (resources, equipment, organizations, shift changes);
- Alerts and notifications.

Most respondents had experience using a stand-alone radio system but less than half of the respondents had any direct experience using an LMR system. Despite the lack of experience using LMR the respondents did understand the capability that the LMR technology would provide to their team during an emergency. With this in mind, all respondents indicated that having the ability to talk to multiple response organizations would improve their situational awareness and lead to more effective task performance during an operation. Respondents indicated that they would most likely communicate with other response teams located in the affected area but would also see value in communicating with other teams that are more geographically distributed (Figure 26).

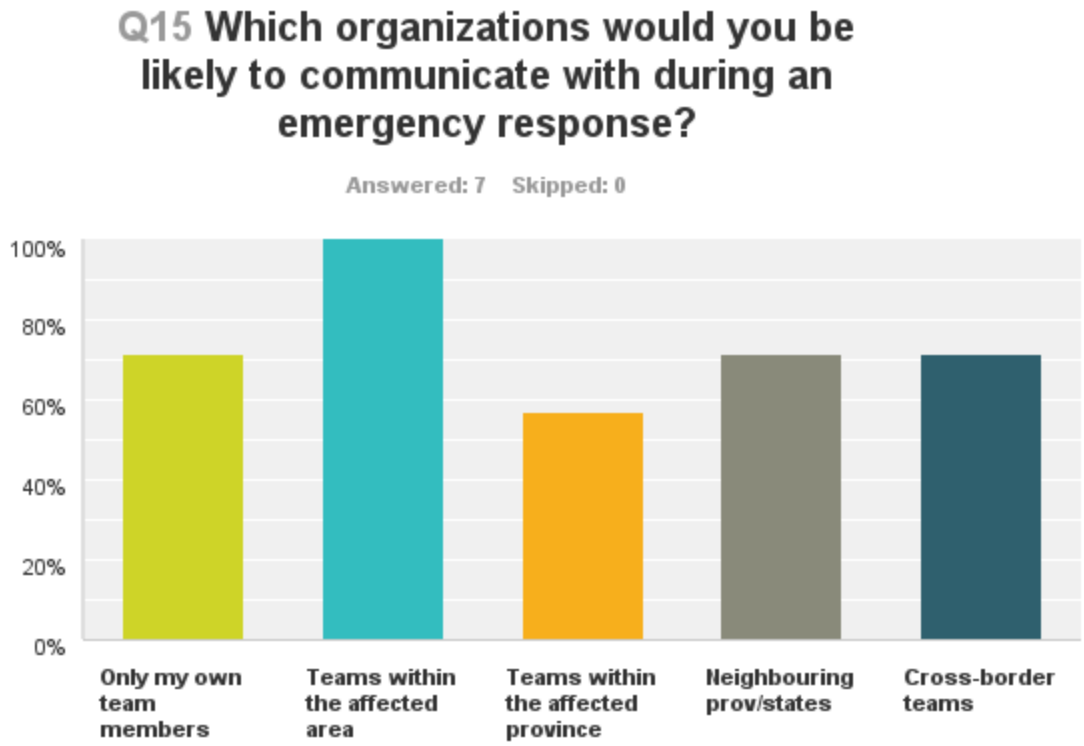

Figure 26: *Expected Communications between Teams.*

4.3 Replies to Post-Experiment Survey—LMR

At the end of Day 1, five (5) players who represented the fire lines for Alberta, Saskatchewan and Montana as well as the JIC (n=1) completed an online survey. The questions of the Day 1 post-experiment survey are contained in Annex G (N=5). Although the sample size is small, this dataset constitutes the majority of participants. Furthermore, these participants are extremely knowledgeable and experienced with respect to the operational tasks that they performed during the experiment. Therefore, the feedback from this group is considered to be significant for the qualitative evaluation of the experiment.

The majority of respondents indicated that sending and/or receiving information via the LMR system was easy to do. However, some of the players indicated that they had difficulty transmitting information when using the LMR system. Certain information needed to be repeated or clarified such as the physical description of the lost hunter during that vignette, details of the fire line location, latitude and longitude coordinates, etc., which appeared to be due, at least in part, to the audio quality and communication faults (e.g., the radio cutting out) and the players' familiarity with the LMR system.

Most of the respondents indicated that the LMR system was very effective with respect to transmitting information during an emergency response.

Observations:

Respondents tended to use common communications methods that reflect command structures (i.e., Incident Command System and National Incident Management System) when speaking over the radio system. This ensured that the players' roles were clearly identified using common language. A wide range of information was exchanged by voice using the LMR technology between players during the experiment such as geographical coordinates, personnel and equipment updates, alerts, and descriptive details of the evolving situation.

Once the experiment was underway, participants experienced technical difficulties with the LMR system. At the beginning of Day 1, there were two mobile units that were keyed to the wrong radio channel. Rather than being on the radio channel that was designated for the experiment, these mobile units were operating on a live channel for the province of Saskatchewan. This created an issue for the province of Saskatchewan since information was being transmitted on the simulated emergency event. The mobile units did not know they were transmitting over a live radio channel and the operators for the live radio channel had no way to contact the mobile units directly.

The issue was resolved by the technical support teams and the mobile units were keyed to the correct experimental radio channel. Once the setup was completed the interoperability among the separate LMR systems was seamless and appeared to function as a single system from the perspective of the participating responders. At this point, all players were tuned to the same radio channel and were exposed to all of the chatter on the radio.

4.4 Replies to Post-Experiment Survey—LMR and LTE

At the end of Day 2, the same five (5) players as in §4.3, representing the fire lines for Alberta, Saskatchewan and Montana, completed an online survey to provide feedback on using the LMR system in combination with the LTE system. The questions of the Day 2 post-experiment survey are contained in Annex H.

Although the sample size is small, this dataset constitutes the majority of participants. Again, these participants are extremely knowledgeable and experienced with respect to the operational tasks that they performed during the experiment. Therefore, the feedback from this group is considered to be significant for the qualitative evaluation of the experiment.

The focus of this survey was to gather feedback on the experience sending and receiving information using a combination of both the LMR (voice only) and LTE (voice and data) technologies.

The replies from the participants indicate that the combination of LMR and LTE technologies was useful for developing an improved understanding of the ongoing emergency response.

Upon completion of the experiment, the replies to the post-experiment survey indicated that the exchange of several types of data would be useful for improving situational awareness including transmitting pictures and videos embedded within emails or as attachments as well as real-time communications enabled through VoIP and video conferences. Feedback from the participants

indicates that sharing geospatial information through the MASAS application improved their situation awareness as did having access to their own email account.

The top three benefits of sharing data during an emergency were identified as follows:

- Allow information to be exchanged with a wider community during the response phase
- Enhance situational awareness and decision making processes within my organization
- Enhance situational awareness and decision making between my organization and other organizations

In general, the feedback indicated that the players found the technology difficult to use when sending or receiving information. This difficulty was related to their lack of familiarity with using the software applications while operating in a remote and mobile environment. It is noteworthy that these responders are accustomed to using voice communications on numerous radio channels to exchange information.

The features and functionalities associated with the software applications such as uploading files, sending and receiving confirmations, attaching videos or pictures, viewing the map display in MASAS required some practice to understand the requirements for completing the information exchange.

The lack of familiarity with the LTE technology and the MASAS software by the players resulted in information that needed to be clarified and repeated/re-sent. For example, players repeated a transmission because they were unsure whether the initial data transmission had been successfully posted to the MASAS site at the JIC.

The feedback indicated that the videoconferencing capability worked successfully between outstations in one instance but was limited to the audio component during another attempt.

There was an indication that the radio signal was weak and players were unable to confirm that the data had been received.

Observations:

When an emergency occurs, particularly when multiple jurisdictions are affected, the frequency of contact and information exchange between responders increases. In these time-critical situations, deployable LTE technology could be used to exchange data from existing (and commonly used) accounts (e.g., email, Skype, Google Hangouts). If responders are required to setup these accounts and establish electronic contact using unfamiliar applications then their ability to exchange information will be hampered. For example, the access features and settings (e.g., URLs, username, password) and functionalities (e.g., contact lists, reply, forward, copy, etc.) are already familiar to the users and do not require training to use them within the context of each specific emergency.

Much of the data that was transmitted was presented in a visual format (e.g., pictures, videos, maps with coordinates, etc.) which was immediately meaningful to responders and did not require any explanation. The provincial response teams observed that visual information provides the most value to responders.

4.5 Situational Awareness Ratings

At the outset of the experiment less than half of the responders had direct experience using a LMR system. Similarly, there was very little experience using broadband LTE technology to transmit data using software applications during the execution of an emergency response. Over the course of the experiment though, participants acquired sufficient knowledge to comment on their levels of situational awareness.

Five (5) players completed a self-assessment of their situational awareness during Day 1 of the experiment and four (4) players during Day 2. The situational awareness questionnaires were provided to the participants on paper and the replies were submitted to their Lead Controller. The questionnaires for Day 1 and Day 2 are found in Annex D.

Because the CAUSE III experiment was intentionally set in a remote area of the Canada–U.S. border that was void of any existing communications infrastructure, the baseline of comparison for the situational awareness ratings was: no communications available to emergency responders and information exchange done person-to-person. The level of situational awareness for both Day 1 (LMR) and Day 2 (LMR+LTE) relative this low level of SA was then assessed. The elements of SA included the understanding of:

- The local fire line perimeter;
- The overall fire line perimeter;
- Movement of the fire line;
- Progress in combatting the fire;
- Road closures;
- Your location relative to fire line, road closures, equipment, resources;
- Personnel/equipment/resources locations and distribution;
- Personnel shift changes;
- Additional personnel/equipment/resource needs;
- Current weather, wind speed and wind direction;
- Projected weather, wind speed, wind direction shifts;
- Missing hunter descriptions.

On Day 1, SA was achieved through the use of push-to-talk voice amongst emergency responders and managers. SA was also increased by using a LMR interoperability gateway that allowed responders and managers from all three jurisdictions to communicate by voice. On Day 2, SA aware was further improved by making data applications such as MASAS, voice and video conferencing, email, video feeds and photos available to all emergency personnel over LTE networks. Also, because each LTE network was connected to the World Wide Web, all emergency personnel from all jurisdiction were fully interoperable.

Situational awareness levels using LMR technology was associated with a wide range of responses. Some respondents rated their awareness as excellent while others indicated their awareness was poor. This range of response was due to the communications faults when exchanging information by voice or by the loss of coverage in the responders' remote locations.

By comparison, there was some indication that the respondents' level of situational awareness was improved when deployable LTE technology was used to augment the LMR capability. It is important to note that one set of ratings was excluded from the analysis on each day because the technological limitations with the LTE resulted in an inability to use the technology reliably during the time period that the responder was available to participate in the experiment. Hence, the data from Day 1 and Day 2 for this participant were excluded.

The replies from the respondents indicate that a higher overall level of situational awareness is achieved when the information exchange was facilitated by the combination of LMR and LTE technology compared to when the information was exchanged using voice only with the LMR system (Figure 27). It is important to note that the number of replies was very limited as a result of the limited number of participants. A larger sampling would be required to strengthen the above observation.

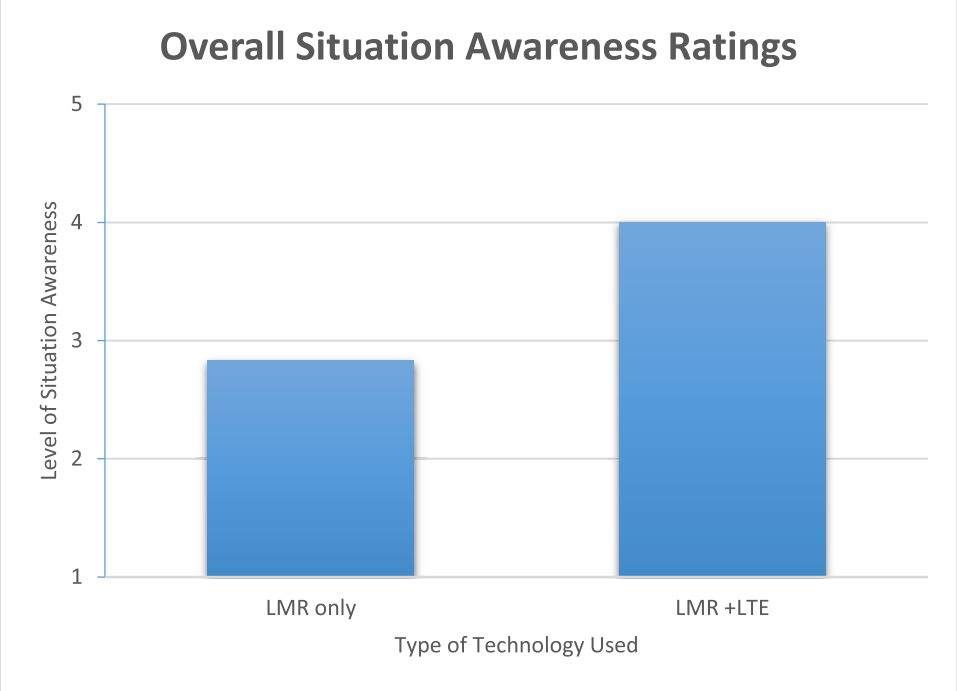

Figure 27: *Overall Level of Situational Awareness by Technology.*

Feedback from the mobile teams indicated that there was value associated with sharing data using software applications. For example, the responders' ability to post and view the MASAS map display provided them with an understanding of the emergency events both within their primary and secondary areas of responsibility as well as in other affected areas.

The use of the video application was a quick method of exchanging information that provided richer details, given the video component, that voice only communications did not possess.

The exchange of pictures, videos and re-supply lists between the Command and mobile units was an effective method of representing the current situation and supporting requests for supplies and resources.

Feedback from the Saskatchewan Logistics Team (see §4.7), also provided several new applications for the sharing of data that would benefit the operational response and have a positive impact of planning coordinated responses (e.g., division of labour to evacuate houses, plan travel routes with all available resources, resources and equipment available through invoking mutual aid).

Observations:

The sharing of data supported the situational awareness of the participants in the JIC. It provided an opportunity for discussion of the emergency response requirements between the command element for each of the provincial and state teams. In a real situation, these discussions would support the decision-making process, and the determination of information that would then be communicated to the mobile units (outstations). Further, the use of video and audio conference capabilities would provide an opportunity for command elements to observe and participate in discussions and to contribute to their understanding of the emergency and the actions that may need to be taken. This information exchange provides the foundation for developing coordinated responses involving affected and collaborating jurisdictions.

4.6 Comparison of Workload Demands—Day 1 and Day 2

The End of Day 1 survey and the Post-Experiment survey each contained a self-assessment section related to workload demands. Respondents completed a self-assessment of six types of workload demands that were placed upon them during the Western experiment. These workload demands included mental, physical, temporal, performance, effort and frustration.

The analysis of the workload data obtained from the end of Day 1 survey indicated that there were minimal demands on the players when using the LMR. There was some indication that the performance dimension was associated with a higher workload for some players.

The analysis of the workload ratings obtained from the Day 2 Post-Experiment survey based on LMR and LTE technology revealed that there were greater demands placed upon the players for all six dimensions (Figure 28). In particular, players experienced higher frustration levels on Day 2. These higher demands could be attributable, at least in part, to the lack of familiarity by the players with LTE technology and with MASAS, though further investigation into this would be required. The use of familiar software applications (e.g., email, VoIP) did not appear to be related to increased frustration levels.

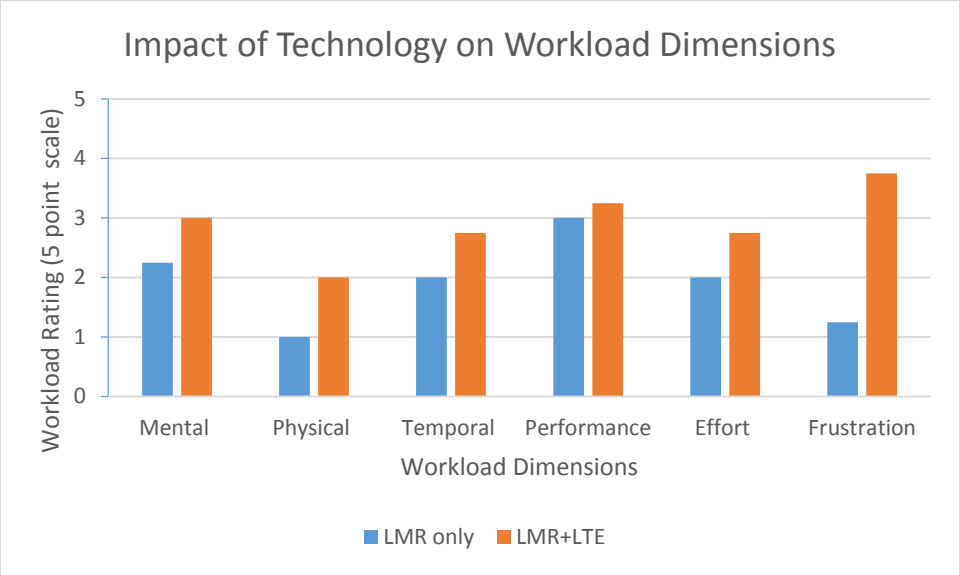

Figure 28: *Workload Ratings Across Six Workload Dimensions.*

4.7 Group Discussion with Logistics Personnel

On Day 2 a group discussion was held with logistics personnel from the Saskatchewan team who were referred to by Saskatchewan EMO officials as 'hot shot first responders'. This team was comprised of experienced first responders who have significant expertise and experience throughout the province of Saskatchewan. These team members are deployed when the emergency events have exhausted the resources of the local first responders in the geographical area that is affected by the emergency. They are the logistics resources for the provincial first responder team.

The purpose of this discussion was to gather information related to the Logistics team's information requirements and operational tasks that are performed at the fire line. This group of responders has experience using a LMR system that has already been implemented within the province of Saskatchewan. The highlights of the group discussion are presented in the following sub-sections:

4.7.1 Situational Awareness

The situational awareness for the responders executing the fire line response is typically focused on their primary and secondary areas. The immediate area in which the responders are located is considered their primary area of interest. Secondary areas of interest are located to the left and right of a responder's primary area and have other responders working in these areas. Responders do not necessarily know the actual location of the responders located in the secondary areas. The primary and secondary areas can be large and remotely located. The terrain in these areas is unfamiliar to the provincial responders and they rely whenever possible on the local responders to provide geographic knowledge during the operation to support their understanding of the local maps. The local maps provide the main geographical features but are limited in terms of how the

first responders should prioritize routing when generating plans (e.g., main and potential detour roads, impassible roads, unsafe bridges for heavy machinery, location of farms, farm and animal owners, water sources, presence and description of coulees or deep and narrow valleys that can be filled with water, or are very long and difficult and/or impossible to cross which can put responder teams in great danger). Despite having access to maps there is significant value to having access to a local expert, as the road conditions may prohibit the vehicles from being able to use them or there may be other routes that would be more effective given the position and anticipated movement of the fire.

4.7.2 Radio Communications

Resource teams are comprised of fire fighters, police and conservation officers who communicate via radio using standard communications protocols. Responders are constantly aware of the radio communications on their selected channel. However, since the tones used on the radios are identical for all responders they only attend to specific information including their own call sign (e.g., call sign 328), the group/team call sign (e.g., Call sign Groupnet Local 15) and their commander's call sign (e.g., Call sign Saskatchewan Lead Control). When a relevant call sign is verbalized over the radio the responders attend to the information being transmitted and respond to information requests. The command centre has a list of individual call signs and their current locations. However, responders often do not know the individual call signs for their team members and would not know the call signs for other response teams. As a result, they do not listen or respond to information that is not directly related to them.

Responders do not want to switch radio channels. If the usability of the radio system becomes laborious and distracting to the conduct of the physical tasks, it is possible that responders will ignore the radio chatter completely and critical information will be lost.

Responders communicate with dispatch to identify any supplies that are needed within their primary areas.

Communications are frequently lost when fighting fires in remote locations. For this reason, it would be useful for individual resources to receive data directly to their hand-held devices. It is likely that they will not refer to these devices and will receive updates from their commander. However, if communications are lost, it would be useful to access the information which may be critical to their own safety and survival. Further, if the type of information that is transmitted to the hand-held devices is relevant to the current status of the fire then the responders would be more likely to actually use the device.

4.7.3 Enhancing Emergency Response

Interoperable technology that allows for effective information exchange and enhances situational awareness can represent a significant benefit to operational response teams which are often in need of additional personnel. Feedback gathered during the group discussion identified certain types of information that can support response planning and execution. These types of information are listed below:

- Direction of the fire;

- Speed of fire movement;
- Impact of wind that is created by the fire;
- If the fire has jumped a river or other body of water;
- Grass fire burning amongst a bush fire;
- Location and configuration of coulees;
- Update on the fire line status;
- Location of any houses, barns or other building structures;
- Presence of any back-burning efforts by the responders;
- Monitor position of your own team members;
- Areas that are impassable due (e.g., washed out culvert);
- Vehicle service status (e.g., maintenance);
- Transfer/availability of resources (e.g., if fire is under control in a particular area then the responder can be moved to assist at another location);
- Areas where the fire has re-started naturally or by humans;
- Show completed evacuations (e.g., structures, disabled people, non-compliant people) within the command area on a map; and
- Availability of additional personnel who can provide operational support.

In addition, the group discussion identified methods through which information could be effectively exchanged among operational response teams. Software applications accessed via a LTE capability and could effectively transmit data to and from responder teams and organizations are identified below:

- Live video of the fire line;
- Satellite images;
- Predictive modeling of the direction and speed of fire given the wind conditions and the presence of coulees (fires burn slowly down a coulees but burn quickly up the opposite side of the coulee);
- Post a url to provide a link to a video that the responders can watch if needed;
- GPS on each hand-held device to track the responders' positions;
- Information transmission via radio and followed up with a posting on a map to confirm location of critical incidents (e.g., road closure location);
- Topographical information sent to the first responders who are fighting the fire to support the planning process (e.g., configuration of coulees);
- Current map depicting fire location;
- Static images taken at the scene and geotagged to a specific spot; and
- Thermal images to identify hotspots.

5 Findings

The findings that are presented and highlighted in gray boxes in this section have been derived by interpreting the results that were obtained from the experiment. Although numerical scores were derived from the results, it is important to note that the evaluation methodology is strictly qualitative. "Data" that was collected is in the form of observations and impressions that were formed by the evaluation team, and subjective replies by responders to surveys.

The reader is advised to not infer any statistical significance between observed differences. This is primarily due to the small data set and the technological difficulties that were encountered by some participants when using the data sharing applications.

5.1 Analysis of LTE-Related Data

Observations were gathered throughout the experiment and the data was subjected to a qualitative evaluation. A set of metrics tailored to the Canadian Communications Interoperability Continuum Model (CCIC) categories (i.e., Governance, Standard Operating Procedures, Technology, Training & Exercises and Usage) was scored on a 5-point scale by the evaluation team. The metrics are contained in Annex E. The set of qualitative metrics was used to evaluate the impact of interoperable technology on information exchange during cross-border response to an emergency incident. The scale reflected the impact of interoperable technology on information exchange and the extent to which situational awareness was enhanced and able to support coordinated responses.

The scoring is as described in §3.3.2 of this report.

5.1.1 Impact of Interoperable Technology on Situational Awareness

An analysis of the data was performed to assess the overall impact of interoperable technology on the emergency response operation performed in the experiment.

The analysis produced an overall score of 3.9, which was within the moderate range on the 5 point scale (i.e., a rating of at least a 3 on the 5-point scale).

This finding supports the hypothesis that the use of interoperable technology can enhance situational awareness leading to improved response efforts.

The improvements in SA support the exchange of information within individual organizations as well as between the two provinces and the US state that were involved in the experiment.

Further examination compared the scores for technologies that were used on each of the two days of the experiment. The score associated with exchanging information using 'voice only' via the LMR systems is 3.8, which is lower than that observed for the exchange of information using both voice and data via the LTE technology with a score of 4.2.

This finding suggests that the level of situation awareness related to the status of the emergency event is improved when voice transmissions are augmented by the transmission of data (e.g., map-based applications, email, static images, video).

A set of information requirements (e.g., evacuated homes and structures, vehicle service status) and the most effective methods for delivering the information (e.g., satellite images, contour maps) to the first responders was identified.

5.1.2 Indicators of a Mature Interoperable Capability

The level of maturity associated with the use of interoperable technology was assessed and is illustrated in Figure 29. The scores for each of the key attributes identified in the CCIC model were compared. The intent of this analysis is to assess the levels of maturity of the interoperable technology that was used to facilitate information exchange in the experiment.

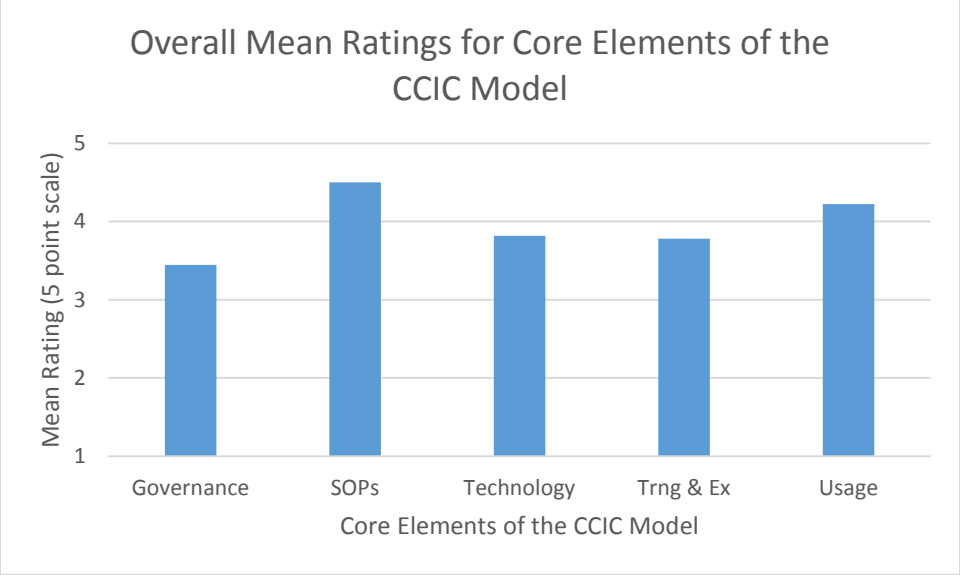

Figure 29: *Scores for Core Elements of CCIC Model.*

The scores for all of the core elements identified in the CCIC model were within the moderate range on the 5 point scale (i.e., a score of at least a 3 on the 5-point scale).

This finding suggests that the interoperable technology facilitated the exchange of information. This exchange was of sufficient quality to enhance the responders' situational awareness throughout the experiment.

The scores were compared against the attributes that are identified in the CCIC Model for each of the core elements. These attributes are intended to provide guidance with respect to the level of maturity enabled through interoperable technology. The current ratings suggest that all of the core elements were associated with moderate levels of maturity. The most advanced levels of maturity were associated with the SOPs and Usage elements.

Further examination of the data compared the scores for the LMR and LTE technologies that were used in the experiment (Figure 30).

In general, the responders' situational awareness was enhanced when information exchange was facilitated by sending and/or receiving data.

An exception to this finding was observed for the element which was concerned with SOPs. The SOPs for radio communications that were executed via the LMR systems are well known and understood by all responders. In contrast, the procedures for requesting, confirming and disseminating transmitted data are less defined.

The existing SOPs which support voice communications will require modification to accommodate the effective sending and receiving of data.

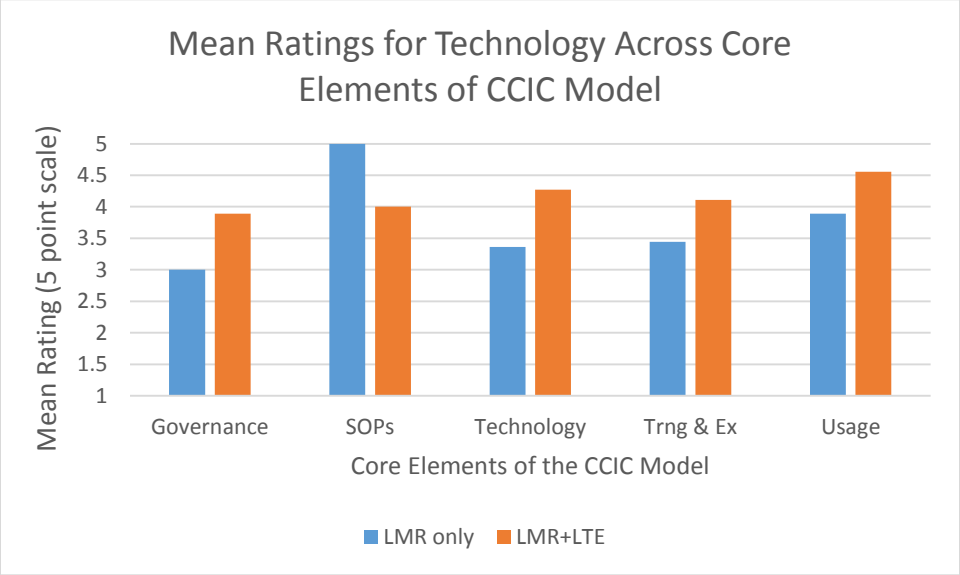

Figure 30: *Scores for Technology across Core Elements of the CCIC Model.*

5.1.3 Opportunities for Improving the Response Capability Through the use of Interoperable Technology

An examination of the metrics data identified the potential capability gaps which, if addressed in future work are likely to enhance the impact of using interoperable technology on multi-agency operational responses (Table 5). The results of this analysis identified individual metrics which have a relatively low score for their dimension category.

The main gaps identified by this analysis are listed below:

- **Governance:**

  The analysis indicates that identifying which mutual aid agreements can be invoked for specific types of assistance would benefit the planning and execution of an emergency response.

  The leading authorities are known in these types of emergencies but the activation and conditions for providing mutual aid are not as visible to the different emergency response organizations. The existence of trusted relationships between these organizations would facilitate providing support whenever and wherever possible but this support could be strengthened through invoking pre-established mutual aid agreements and with a coordinated effort.

- **SOPs:**

  Establishing or modifying SOPs that define the mechanisms, processes, and formats for how the information will be shared and requested would be useful.

  In addition, ensuring that the information sources are self-explanatory will limit the requirement for clarification from the senders.

- **Technology:**

  Interaction with the interoperable technology would improve if responders had the opportunity to develop an understanding of the features and functionalities that are available.

  This would ensure that responders know how to use the technology to support time critical decision-making, planning and operations (e.g., communications plans that support the integration with technology that enables real-time information sharing such as MASAS).

- **Training and Exercises:**

  Operations undergoing testing can be enhanced through information exchanges that are easily understood by the senders/receivers.

  The use of multiple technologies would, if coordinated appropriately (e.g., common terminology, status updates by on-scene responders) support the stated objectives and allow for progress to be monitored.

- **Usage:**

  The delivery of detailed information is optimized through data sharing applications.

  The time and personnel resources that are required to repeat and confirm information could be reduced through the careful delivery of information that is easily confirmed and consumed by the receiver.

Table 5: *Opportunities for Enhancing Capabilities.*

Metrics Code	Metric Statement	Score
Governance		
PSBN-G8	Pre-identified mechanisms (MOUs, MAAs) to request assistance from other cities, counties and levels of government are in place.	2.5
Standard Operating Procedures		
PSBN-S2	Clearly defined and documented mechanisms/processes/formats for sharing information.	3.5
PSBN-S3	Information sources are obvious so that clarification is not required.	4.0
PSBN-S4	Processes for requesting information from other organizations are in place.	4.0
Technology		
PSBN-T3	Disseminate relevant information to other stakeholders in a usable and expected format.	3.5
PSBN-T4	Personnel understand how to use the technology to communicate with other responders.	3.5
PSBN-T7	Technology supports the exchange of useful/actionable information between emergency response organizations.	3.5
PSBN-T8	Terminology is understood by senders and receivers.	3.5
PSBN-T9	Technology enhances the timeliness for information sharing and supports decision making.	3.5
PSBN-11	Communication systems support on-demand, real-time interoperable voice and data communication.	3.5
Training & Exercises		
PSBN-TEx1	Information exchange is enabled through the use of multiple technologies.	3.5
PSBN-TEx2	Evaluate, revise and prioritize tactics to meet incident developments.	3.0
PSBN-TEx7	Communications plans include all relevant data and voice communications that are available for the exercise.	3.5
PSBN-TEx8	Terminology is understood by senders and receivers.	3.5
PSBN-TEx10	Unit with new information provides initial on-scene report to appropriate emergency response organization(s).	4.0

Metrics Code	Metric Statement	Score
Usage		
PSBN-U3	Provide geographical coordinates to communicate status of community, homes and facilities identified as safe or unsafe to re-enter and re-occupy.	4.0
PSBN-U4	Plans address establishing key transportation avenues (e.g., best routes for personnel and equipment to access disaster locations, etc.).	4.0
PSBN-U5	Develop a Common Operating Picture (COP) for ongoing status of recovery operations.	4.0
PSBN-U9	Vertical information exchange requirements can be met	4.0
PSBN-U10	Information bottlenecks created by communications process OR technology can be identified by emergency response organizations	4.0
PSBN-U11	Request for information issued and understood in a single transmission (JIC to outposts and vv.).	3.5

5.2 Technology Innovation

Many innovative LMR technologies were demonstrated during the CAUSE III Western experiment:

- A deployable site on wheels—a trailer mounted radio site designed to augment existing trunked radio network coverage;
- An Interoperability Gateway (IOG) that allowed users on three disparate LMR radio systems to communicate with one another, thereby enabling seamless inter-system interoperability across many jurisdictions.

The LMR capability which connected all responders via the same radio channel was quickly learned and required only a short briefing and a small amount of troubleshooting to effectively use it.

A LMR feature that was available but not tested due to time constraints was

- Blue Channel—a “simplex” VHF channel in place to allow for localized peer-to-peer communications among first responders from separate agencies, jurisdictions or countries in border regions.

Broadband mobile LTE communications were demonstrated and confirmed the high value of having feature-rich applications made available to emergency responders in carrying out their duties.

- Enabled the Multi-Agency Situational Awareness System (MASAS) on multiple devices and operating systems from different vendors
- Identified an issue with access to GPS information on some devices
- Enabled private cloud-hosted audio/video conferencing on different computing platforms connected to the Internet
- Enabled SIP-based packets to traverse different types of firewalls
- Allowed VoIP calls to be made between different network domains
- Significantly reduced LMR-only response times
- Through connectivity to the Internet, enable emergency response teams to communicate with the public safety community globally and quickly obtain valuable information (not demonstrated in this experiment).

Limitations related to training and unfamiliarity with the LTE system appeared to have a negative effect on the extent to which the data could be shared and could have contributed to higher perceptions of workload and frustration by the participants.

The data sharing capabilities that are enabled through the deployment of LTE technology will require more structured training with a practical component for specific and unfamiliar applications such as MASAS.

The area selected for the CAUSE III Western Scenario was a relatively remote location that lacked access to broadband communications infrastructures.

Deployable LTE technology will be an important component of 700 MHz public safety broadband on many fronts. In this case, deployable LTE provided communications as required in remote areas of Canada lacking in broadband communications.

5.3 Interoperability

The magnitude of the challenges related to effective communication interoperability is one of the key findings in the western component of CAUSE III.

Interoperability has many layers and is a very important consideration in communication networks. This became evident during the CAUSE exercise. There are many areas of interoperability that require attention in the very least, and in many cases the development of capability.

- Agency-to-agency LMR interoperability
- Dedicated channel LMR interoperability
- Personnel interoperability
- Intra-network interoperability
- Network-to-network interoperability

- EPC-to-RAN interoperability (multi-vendor)
- EPC component interoperability (multi-vendor) (e.g., Vendor 1 HSS in NE and Vendor 2 MME/SGW/PGW in RSDE)
- Public safety broadband to commercial network interoperability (heterogeneous)
- Deployable to deployable interoperability
- Deployable to permanent infrastructure interoperability
- Application interoperability (e.g., MASAS in Canada, Virtual USA in the US)
- Device interoperability (on the same app, in same network)
- Device interoperability (on multiple apps, in same network)
- Device interoperability (on the same app, on multiple networks)
- Device interoperability (on multiple apps, on multiple networks)
- PSBN to WiFi offloading (heterogeneous)
- Internet Protocol
- Heterogeneous networking (multiple technologies within the same network—Media Independent Handover (MIH))
- Heterogeneous networking (same technologies in multiple networks—Network Independent Handover (NIH))
- Heterogeneous networking (multiple technologies in multiple networks—MIH and NIH)
- Seamless connectivity (added to the above heterogeneous networks where no action/intervention is required to maintain a communication session (session persistence)
- Devices that contain Universal Integrated Circuit Cards (UICC) devices versus non UICC devices (UICC devices let you replace the UICC for multiple network support)
- Single UICC devices versus Multi-UICC devices

Some of the above interoperability solutions were demonstrated during the experiment. In the case of LMR, interoperability was achieved through a Harris Interoperability Gateway [17] that connected the three different systems together. The Interoperability Gateway was then connected by satellite to the Alberta AFRRCS network in Edmonton in order to establish a common talk group on which all emergency responders and managers in all three jurisdiction were then able to talk to each other. Although not tested in this experiment, interoperability can also be achieved by means of a common “blue channel” that permits direct communication between devices from different systems. The blue channel is in the VHF frequency band.

In the case of LTE, interoperability was achieved primarily by providing users with access to the Internet. First responders on three separate networks were able to communicate with one another and share MASAS information via the Internet.

Many time-consuming technical issues were resolved prior to the start of the experiment in order to achieve a rudimentary level of interoperability. Listed below are the more important issues that were uncovered.

1. VoIP SIP agent incompatibilities with some devices.

2. MASAS client application incompatibility with some device operating systems.

3. Inability to tag data captured by some devices with the GPS location.

4. Audio/video conferencing application incompatibility with some Network Address Translation (NAT) functions.

5. Inability to stream video directly from the video server at the base of the aerostat.

A significant amount of time was spent addressing issues that were product-configuration dependent that required the assistance of the implicated vendors to troubleshoot and solve.

A key finding is that it was essential for the communications infrastructure of the CAUSE III experiment to be tested in a laboratory before fielding the system. This step must be planned into any event of this nature.

The execution of the scripts in Day 2 was negatively affected by the adverse weather conditions that delayed the deployment of the aerostat. As the aerostat served as the point of presence for the Internet, its availability was critical to being able to execute the scripts of Day 2.

A key finding is that the ability to evaluate the impact of LTE, and thus the objectives of CAUSE III West was dependent on a critical function (aerostat) whose availability was determined by highly unpredictable events, namely the weather.

On this last finding, where a significant weather event such as high speed gusting winds can potentially limit the use of an aerostat to extend the coverage range of wireless technologies, the rapid emergence of aerial drones and UAVs operating at appropriate elevations (~hundred(s) of meters above ground level) could be used in place of an aerostat. Such a solution is becoming more and more viable as the size and weight of broadband radio equipment is becoming smaller and smaller, and therefore much easier to carry.

6 Conclusion and Recommendations

6.1 Conclusion

This report presents a description and an analysis of the CAUSE III experiment. The experiment was evaluated by examining how emergency responders used actual LMR and LTE communications technologies in the response to a simulated brush fire that covered a wide expanse of territory at the borders of Alberta, Saskatchewan, and Montana.

The objectives of the experiment were focused on enhancing situational awareness by the exchange of information, enabled by technology that supported interoperability. The experiment enabled the comparison of legacy LMR voice systems and a deployable high-speed broadband LTE network capability to facilitate communications interoperability between public safety agencies from different provinces and, indeed from different countries. The experiment represented a realistic response to a brush fire that affected both sides of the Canada–US border. Two Canadian provinces (Alberta and Saskatchewan) and a US state (Montana) exchanged information during the experiment using LMR on Day 1 and LMR augmented by LTE capability on Day 2.

The data collected during the course of this study was obtained by means of qualitative observations and responses to surveys from experienced operational personnel who are generally accustomed to rehearsing emergency procedures on a regular basis and responding to and/or monitoring cross-border events. The feedback is relevant and generalizable to the EM organizations that respond to multi-agency emergency events whether these events occur within a single nation or across the Canada–US border.

Analyses of the data resulted in several findings that are detailed in §5. In general, the findings reveal that situational awareness is increased when the LMR system is used in conjunction with the deployable LTE system. This stems primarily from the capabilities that LTE enables. That is, to be able to use tools and applications that allow incident-critical data to be shared among users in real time. Examples of such tools and applications are map-based applications, VoIP, emails with and without attached images, audio/video conferencing, and live streaming video. This information exchange between Canada and the US provided emergency response organizations with reach back to their tools, maps and other decision-supporting aids. In addition, the MASAS application was used to generate a real-time Common Operating Picture (COP) where all participants had the capability to view the information that was posted to the MASAS hub using the mobile technology application.

The findings also indicate that LTE systems are more complex to implement and more laborious to use, thus allowing for opportunities to address these shortfalls, which are proposed in the following recommendations.

As Canada and the US advance further towards achieving a binational capability that enables the seamless exchange of SA information for the EM community, it is hoped that the results of CAUSE III can be used to inform and achieve this vision.

6.2 Recommendations

6.2.1 Technology

Recommendation #1: Investigate technologies that enable the use-cases of interoperability in accordance with the roadmap of showcase capabilities for CAUSE IV and subsequent experiments.

Recommendation #2: Mitigate the technology risks of the experiments by engaging the vendor community to troubleshoot and solve integration issues. Orient public and government test laboratories towards requirements-setting, system-level test cases, and root cause failure analysis capabilities in order to assist vendors in system-level troubleshooting. Use lessons learned in specification failures to strengthen the systems integration capabilities.

Recommendation #3: US and Canadian agencies should jointly determine interoperability requirements that affect near-border and cross-border operations of their respective LTE systems.

6.2.2 User-Oriented

Recommendation #4: Provide additional training and collaboration opportunities. Additional training needs are needed to prepare and exercise cross-border planning, response, and coordination. In particular, training is needed in the following areas:

- LTE networks including deployable systems
- Broadband wireless applications
- For emergency managers to identify available interoperable communications resources and process the requests for acquiring required resources.

Recommendation #5: In order to improve the ability for sharing information over broadband wireless networks on both sides of the border the first responder community could benefit from the development of an engaged working group and bi-national outreach and training campaign.

6.2.3 Processes and Policies

Recommendation #6: Develop bi-national Concept of Operations for deployable LTE systems.

Recommendation #7: Develop decision workflows for identifying relevant information for decision-making based on predefined information requirements established by emergency managers.

Recommendation #8: Engage the emergency responder community to identify requirements for tools and applications.

Recommendation #9: Use a process or checklist to confirm that all operators are tuned to the correct LMR radio channel. This approach should be implemented when LMR systems are connected to ensure that the radio chatter is flowing as expected, i.e., information is not missed.

Recommendation #10: Modify the existing SOPs, which support voice communications, to accommodate the effective sending and receiving of data.

6.2.4 Design of Experiments

Recommendation #11: Define a roadmap of capabilities to introduce into CAUSE IV and subsequent experiments that would showcase different use-cases of interoperability between Canadian and U.S emergency responders.

Recommendation #12: Mitigate the experiment risks by conducting a formal failure mode risk analysis of the experiments communications infrastructure to identify single points of failure and probability of their occurrence.

Recommendation #13: Given the apparent negative impact that the lack of training had on the participants during this experiment, it would be beneficial to familiarize participants in advance on the use of the applications as a first step. These familiar applications like email/SMS, MS Office tools or government data sites should be used to exchange the type of information needed to develop and maintain situational awareness for coordinated responses.

Recommendation #14: It is expected that experiments of this nature that assess the enhanced resilience resulting from the use of advanced broadband wireless communications will normally have a limited number of participants. However, it would be very beneficial to increase the number of experiment participants and observers that participate in the experiment surveys and group discussions. In doing so, the integrity of the observations resulting from the analysis of survey and discussions data will increase.

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Annex A Day 1 Scenario Scripts

Inject Number	Day	Time	Controller	From
10	1	1000h CST 0900h MST	AB	JIC - AB
Communication Method		**Contact Information**		**To**
LMR				AB1 & AB2

Detailed Information

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

AB1 & AB2 will provide the following information based on each respective location:

AB1 - a
Lat: 48.999558°; Long: -110.217730°
Location of call-in: Hwy 232 and Hwy 41 (Wild Horse Border Crossing)
Line of site to fireline: Fireline is 7km E and 8km ENE from reporting location
Elevation: Flat, no obvious elevation
Water sources: no natural water sources, several houses at border crossing, no infrastructure.

AB2-a
Lat: 49.193633°; Long: -110.004883°
Location: Intersection of Red Coat Trail (Hwy 13/501) and Hwy 31
Line of sight to fireline: Fireline is 15km due S and 16km SW
Elevation: Flat, dry grassland, no rock
Water sources: no obvious natural water sources, No residential dwellings present

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Instructions

AB1 and AB2 vehicles are to travel to reporting location 'a' by 0950h CMT (0850h MST). Once you have arrived at your location, confirm with the lead controller using your LMR.
Wait at your designated location until you are requested by the AB rep in the JIC to provide only your information noted in the 'Content' section. The AB rep will address you by your call sign (AB1 or AB2). Include your Lat and Long when providing your information.

AB1
Once AB1 has provided the respective information, remain in position 'a' to request a fire line update from SK1 (Inject 40 at 1015h CST/ 0915h MST). Once Inject 40 has been completed, AB1 may proceed to your next reporting location 'b'.

AB2 - Once AB2 has provided the respective information, proceed to location 'b'.

Inject Number	Day	Time	Controller	From
20	1	1005h CST 0905h MST	SK	JIC - SK
Communication Method		**Contact Information**		**To**
LMR				SK1 & SK2

Detailed Information

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

SK1 & SK2 provide the following information based on each respective location:

SK1-a
Lat: 49.001000° ; Long: -109.733000°
Location: Willow Creek Border Crossing Hwy 21
Line of sight to fireline: Fireline is 5km W and 6.5km WNW from reporting location
Elevation: Flat, dry grassland, no elevation
Water sources: 3 small water sources at 1km, 2km, and 4km from reporting station
Cattle grazing 2 km WNW of reporting location. No dwellings.

SK2-a
Lat: 49.125586°; Long: -109.879513°
Location: From Willow Creek border crossing, travel north on Hwy 21 approximately 19km. Turn left onto dirt road and travel west for approximately 5.5km.
Line of sight to fireline: Fireline is 5.5km due S, 7km SW and 6.5km SSE from reporting location
Water sources: Natural water source (small river) running from north on the east side of farmland. Could intersect fireline.
Elevation: flat, green grassland, farmland.
No dwellings or livestock in immediate area.

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Instructions

SK1 and SK2 vehicles are to travel to reporting location 'a' by 0955h CST/ 0855h MST. Once you have arrived at your location, confirm with the lead controller using your LMR.

Wait at your designated location until you are requested by the SK rep in the JIC to provide only your information noted in the 'Content' section. The SK rep will address you by your call sign (SK1 or SK2). Include your Lat and Long when providing your information.

SK1
Once SK1 has provided the respective information, remain in position 'a' until you receive a

request from AB1 to report your fire perimeter definition (inject 40 at 1015h CST/ 0915h MST). Once you have relayed your information via LMR to AB1, you may proceed to your next reporting location 'b'.

SK2

Once SK2 has provided the respective information, remain in position 'a' to request a fire line update from MT1 (inject 50 at 1020h CST/ 0920h MST). Once Inject 50 has been completed, SK2 may proceed to your next reporting location 'b'.

Inject Number	Day	Time	Controller	From
30	1	1010h CST 0910h MST	MT	JIC - MT
Communication Method		**Contact Information**		**To**
LMR				MT1 & MT2

Detailed Information

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

MT1 & MT2 provides the following information based on each respective location:

MT1-a
Lat: 48.998000°; Long: -109.732000°
Location: Border Crossing on St. Joe Rd.
Line of sight to fireline: Fireline is 4km due W, 5km NW and 5.5km WSW from reporting location
Elevation: Flat, grass
Water sources: Small resevoirs in immediate area, border crossing building

MT2-a
Lat: 48.922139°; Long: -109.841396°
Location: 9.3 Km south from Border on St. Joe Rd., right on Willow Creek road and travel south for 3.1km. Turn right on dirt road and travel west for 9.6km, right on dirt road for 3.1 km. Turn right and follow road for 2.5km.
Distance and Line of sight to fireline: Fireline is 3.5km due N, 5.5km NW and 6.3km NNE from reporting location
Elevation: Flat, farmland
Water sources: Small resevoirs in the immediate area with commercial farm .7 km south of reporting location

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Instructions

MT1 and MT2 vehicles are to travel to reporting location 'a' by 1000h CST/ 0900 MST. Once you have arrived at your location, confirm with the lead controller using your LMR.
Wait at your designated location until you are requested by the MT rep in the JIC to provide only your information noted in the 'Content' section. The MT rep will address you by your call sign (MT1 or MT2).

Include your Lat and Long when providing your information.

MT1
Once MT1 has provided the respective information, remain in position 'a' until you receive a request from SK2 to report your fire perimeter definition (inject 50 at 1020h CST/ 0920h MST). Once you have relayed your information for inject 50 via LMR to SK2, you may proceed to your next reporting location 'b'.

MT2
Once MT2 has provided the respective information, you may proceed to your next reporting location 'b'.

Inject Number	Day	Time	Controller	From
40	1	1015h CST 0915h MST	AB and SK	AB1
Communication Method		**Contact Information**		**To**
LMR				SK1

Detailed Information

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

AB1 calls SK1 and requests and a fire line perimeter update. SK1 provides the following information based on respective location:

SK1-a

Lat: 49.001000° ; Long: -109.733000°
Location: Willow Creek Border Crossing Hwy 21
Line of sight to fireline: Fireline is 5km W and 6.5km WNW from reporting location
Elevation: Flat, dry grassland, no elevation
Water sources: 3 natural water small water sources at 1km, 2km, and 4km from reporting station
Cattle grazing 2 km WNW of reporting location. No dwellings.

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Instructions

While still at location 'a', AB1 calls SK1 using LMR and requests an update on the fire line perimeter.

Once requested, SK1 will provide the information noted in the 'Content' section. Include your Lat and Long when providing your information.

Once SK1 has relayed the information via LMR to AB1, both vehicles (AB1 & SK1) may proceed to your next reporting location 'b'.

Inject Number	Day	Time	Controller	From
50	1	1020h CST 0920h MST	SK and MT	SK2
Communication Method		**Contact Information**		**To**
LMR				MT1

Detailed Information

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

SK2 calls MT1 and requests a fire line perimeter update. MT1 provides the following information based on location above:

MT1-a
Lat: 48.998000°
Long: -109.732000°
Location: Border Crossing on St. Joe Rd.
Line of sight to fireline: Fireline is 4km due W, 5km NW and 5.5km WSW from reporting location
Elevation: Flat, grass
Water sources: Small resevoirs in immediate area with a border crossing building

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Instructions

While still at location 'a', SK2 calls MT1 using LMR and requests an update on the fire line perimeter.

Once requested, MT1 will provide the information noted in the 'Content' section. Include your Lat and Long when providing your information.

Once MT1 has relayed your information via LMR to SK2, both vehicles (SK2 & MT1) may proceed to your next reporting location 'b'.

Inject Number	Day	Time	Controller	From
60	1	1030h CST 0930h MST	AB	AB2 (Conservation Officer)
Communication Method		**Contact Information**		**To**
LMR				JIC - AB

Detailed Information

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Back Story: The grassfires have consumed portions of Onefour Heritage Rangeland Natural Area, driving much of the wildlife to the northern and north eastern parts of the park.

Message to be relayed: The South Regional Office of Alberta Parks has just received a report from RCMP Redcliff detachment of a missing hunter who was last seen on November 22nd entering Onefour Heritage Rangeland Natural Area near the intersection of Buffalo Trail (Hwy 41) and Hwy 501. Coordinates of last known location are: Lat 49.042626 and Long: 110.509149.

Information from the missing person file is as follows:
Name: Willard Henry Branch
Gender: Male
Date last seen: 2014-11-22
Age at time of disappearance: 43
Height: 180 cm, 5'9"
Weight: 82 kg, 181 lbs
Hair colour: Grey Eye Colour: Brown
Distinguishing features: Tattoos on right forearm, dagger and a heart, left hand shows Love and 4 aces across the fingers, appendectomy scar lower right side, on left foot second toe is deformed at distal end.
Clothing worn at time of disappearance: Red hunting jacket, red baseball cap, blue jeans and work boots

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Instructions

While en route to location 'b' (if not already there), AB2 will contact the AB rep at the JIC via LMR on behalf of the South Regional Office of Alberta Parks. AB2 will convey the message to be relayed portion, along with the missing person details that follow.
If not at location 'b' at the time of this call, note the Lat and Long as this will need to be replicated on Day 2.
Once the information has been conveyed via LMR, proceed to location 'b' if not already there.
Location 'b' is Lat: 49.111123° and Long: -110.121381°

Inject Number	Day	Time	Controller	From
70	1	1040h CST 0940h MST	SK	SK1 (RCMP)
Communication Method		**Contact Information**		**To**
LMR				JIC - SK

Detailed Information

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

SK RCMP Maple Creek detachment reports the following road closure:

Due to the area affected by the Grass Fire in the South District, Maple Creek detachment is reporting a full road closure of Hwy 21 South closed 15km south of the Hwy 13 and Hwy 21 junction. (Lat: 49.101583, Long: 109.813005)

Hwy 21 North is also closed to all traffic from Willow Creek, extending north 13.5 km - (Lat: 49.000715, Long: 109.732531).

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Instructions

While at location 'b', SK1 will call SK rep in the JIC on behalf of RCMP and convey the information via LMR noted in the 'content' section. If SK1 is unable to reach location 'b' in time for this inject, take note of the actual location of this call (i.e. GPS coordinates) as it MUST be replicated on Day 2.

Proceed to location 'b' if not already there for inject 100.

Location ‘b’ is Lat: 49.085846°; Long: -109.815349°.

Inject Number	Day	Time	Controller	From
80	1	1045h CST 0945h MST	AB	AB1 (RCMP)
Communication Method		**Contact Information**		**To**
LMR				JIC - AB

Detailed Information

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

AB RCMP Southern Alberta detachment reports the following road closure:

Bow Island detachment in the Southern Districts reporting full road closure of Hwy 12 East 2.5km East of Hwy 12 and 23 junction to Hwy 20 North (Lat: 49.028116°, Long: -110.183961°).

Hwy 20 is closed in both directions from the Hwy 12 junction to 4km north of Hwy 12 junction (Lat: 49.062829°, Long: -110.139648°)

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Instructions

While at location 'b', AB1 will call AB rep at the JIC and convey the information via LMR noted in 'content' section. If AB1 is unable to reach location 'b' in time for this inject, take note of the actual location of this call (i.e. GPS coordinates) as it MUST be replicated on Day 2.

Proceed to location 'b' if not already there for inject 90.

Location ‘b’ is Lat: 49.028000°; Long: -110.140000°.

Inject Number	Day	Time	Controller	From
90	1	1050h CST 0950h MST	AB	JIC - AB
Communication Method		**Contact Information**		**To**
LMR				AB1 & AB2

Detailed Information

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

AB1 & AB2 provide the following information based on each respective location:

AB1-b
Lat: 49.028000°
Long: -110.140000°
Location: From AB1-a location, north on Hwy 23 for 3.1 Km, right on Hwy 12, travel 5.7 km to intersection of Hwy 12 and Hwy 20
Line of sight to fireline: Fireline is 2km due E and 3km ENE from reporting location
Water sources: Natural water source 2.5 km ENE from reporting location. Small stream coming from the north intersects fireline at 2.8 km at ENE.
Elevation: flat, dry grass,
No dwellings or livestock in immediate area

AB2-b
Lat: 49.111123°
Long: -110.121381°
Location: From AB2-a location, travel SW on Hwy 31 approximately 12.5 km
Line of sight to fireline: Fireline is 7 km due S, 7 km SE and 8km ESE from reporting location
Elevation: Flat, no elevation, dry grassland
Water sources: small lake approximately 5.5 km ESE from reporting location
No dwellings or livestock in immediate area

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Instructions

AB1 and AB2 vehicles are to travel to reporting location 'b' by 1045h CST / 0945h MST. Once you have arrived at your location, confirm with the lead controller using your LMR.
Wait at your designated location until you are requested by the AB rep in the JIC to provide only your information noted in the 'Content' section. The AB rep will address you by your call sign (AB1 or AB2).

Include your Lat and Long when providing your information

AB1

Once AB1 has provided the respective information, you may proceed to your next reporting location 'c'.

AB2

Once AB2 has provided the respective information, remain in position 'b' to receive a request for fire line update from SK2 (Inject 120 at 1105 CST/ 1005 MST). Once Inject 120 has been completed, AB2 may proceed to your next reporting location 'c'.

Inject Number	Day	Time	Controller	From
100	1	1055h CST 0955h MST	SK	JIC - SK
Communication Method		**Contact Information**		**To**
LMR				SK1 & SK2

Detailed Information

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

SK1 & SK2 provide the following information based on each respective location:

SK1-b
Lat: 49.085846°; Long: -109.815349°
Location: From Wild Horse (SK1 location), travel north on Hwy 21 approx 14km
Line of sight to fireline: Fireline is 4km due SSW and 3.5km SW from reporting location
Water sources: Natural water source (small river) running from north (could intersect fireline).
Elevation: flat, dry grass,
Two commercial dwellings or some livestock in immediate area.

SK2-b
Lat: 49.087000° ; Long: -109.924000°
Location: From SK2-a location, travel approximately 14 km north of Willow Creek on Hwy 21, left on dirt road, travel 8 km.
Line of sight to fireline: Fireline is 2km due S, 3km WSW, 3km SE from reporting location
Elevation: Flat, no elevation
Water sources: No water sources
No dwellings or livestock in immediate area.

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Instructions

SK1 and SK2 vehicles are to travel to reporting location 'b' by 1050h CST/ 0950 MST. Once you have arrived at your location, confirm with the lead controller using your LMR. Wait at your designated location until you are requested by the SK rep in the JIC to provide only your information noted in the 'Content' section. The SK rep will address you by your call sign (SK1 or SK2).

Include your Lat and Long when providing your information.

SK1
Once SK1 has provided the respective information, remain in position 'b' to request a fire line update from MT2 (Inject 130 at 1110h CST/ 1010h MST). Once Inject 130 has been completed, SK1 may proceed to your next reporting location 'c'.

SK2
Once SK2 has provided the respective information, remain in position 'b'. SK2 will call AB2 to request a fire perimeter definition (inject 120 at 1105h CST/ 1005h MST)). Once you have recieved the information via LMR from AB2, you may proceed to your next reporting location 'c'.

Inject Number	Day	Time	Controller	From
110	1	1100h CST 1000h MST	MT	JIC - MT
Communication Method		**Contact Information**		**To**
LMR				MT1 & MT2

Detailed Information

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

MT1 & MT2 provide the following information based on each respective location:

MT1-b
Lat: 48.976265°
Long: -109.765180°
Location: From MT1-a location (Border crossing), travel south on St. Joe Rd approximately 2.9 km. Turn right on dirt road and travel west 2.5 km, turn right (or road bends hard right) and travel north .5km.
Line of sight to fireline: Fireline is 2.2km due WNW and 3.8km NW from reporting location
Elevation: flat, grass
Water sources: Creedman Reservoir is .5 km south of reporting location
Creedman Coulee National Wildlife Refuge is directly south of the resevoir

MT2-b
Lat: 48.943000°
Long: -109.929000°
Location: From MT2-a location, travel North for .7 km. Turn left and travel west 6.4 km. Turn right and travel north 1.6 km.
Line of sight to fireline: Fireline is 2.75km due North, and 2.9km NNW, and 3km NNE from reporting location
Elevation: flat farmland
Water sources: small resevoirs in the immediate area
Commercial farm 1.5km east from reporting location

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Instructions

MT1 and MT2 vehicles are to travel to reporting location 'b' by 1055h CST/ 0955h MST. Once you have arrived at your location, confirm with the lead controller using your LMR. Wait at your designated location until you are requested by the MT rep in the JIC to provide only your information noted in the 'Content' section. The MT rep will address you by your call sign (MT1 or MT2).

Include your Lat and Long when providing your information.

MT1
Once MT1 has provided the respective information, you may proceed to your next reporting location 'c'.

MT2
Once MT2 has provided the respective information, remain in position 'b' until you receive a request from SK1 to report your fire perimeter definition (inject 130 at 1110h CST/ 1010 MST). Once you have relayed your information via LMR to SK2, you may proceed to your next reporting location 'c'.

Inject Number	Day	Time	Controller	From
120	1	1105h CST 1005h MST	SK & AB	SK2
Communication Method		**Contact Information**		**To**
LMR				AB2

Detailed Information

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

SK2 calls AB2 and requests a fire line perimeter update. AB2 provides the following information based on respective location:

AB2-b
Lat: 49.111123°
Long: -110.121381°
Location: From AB2-a location, travel SW on Hwy 31 approximately 12.5 km
Line of sight to fireline: Fireline is 7 km due S, 7 km SE and 8km ESE from reporting location
Elevation: Flat, no elevation, dry grassland
Water sources: small lake approximately 5.5 km ESE from reporting location
No dwellings or livestock in immediate area

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Instructions

While still at location 'b', SK2 calls AB2 using LMR and requests an update on the fire line perimeter.

Once requested, AB2 will provide the information noted in the 'Content' section. Include your Lat and Long when providing your information.

Once AB2 has relayed your information via LMR to SK2, both vehicles (AB2 & SK2) may proceed to your next reporting location 'c'.

Inject Number	Day	Time	Controller	From
130	1	1110h CST 1010h MST	SK & MT	SK1
Communication Method		**Contact Information**		**To**
LMR				MT2

Detailed Information

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

SK1 calls MT2 and requests a fire line perimeter update. MT2 provides the following information based on location:

MT2-b
Lat: 48.943000°
Long: -109.929000°
Location: From MT2-a location, travel North for .7 km. Turn left and travel west 6.4 km. Turn right and travel north 1.6 km.
Line of sight to fireline: Fireline is 2.75km due North, and 2.9km NNW, and 3km NNE from reporting location
Elevation: flat farmland
Water sources: small resevoirs in the immediate area
Commercial farm 1.5km east from reporting location

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Instructions

While still at location 'b', SK1 calls MT2 using LMR and requests an update on the fire line perimeter.

Once requested, MT2 will provide the information noted in the 'Content' section. Include your Lat and Long when providing your information.

Once MT2 has relayed the information via LMR to SK1, both vehicles (SK1 & MT2) may proceed to your next reporting location 'c'.

Inject Number	Day	Time	Controller	From
140	1	1120h CST 1020h MST	AB & JIC	JIC - AB
Communication Method		**Contact Information**		**To**
LMR				AB1 & AB2

Detailed Information

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

JIC AB-IC provides a current weather report to all AB stations (AB1, AB2).

Weather Station: ONEFOUR CDA ALBERTA Weather StationID 10725
Sky/weather: Clear, sunny
Max Air Temp: 2°C
Low Temp: -7°C
Current Temp: -3°C
Precipitation since 0600: 0 mm Last hour: 0 mm
Snow accumulation since 0600: 0 cm Last hour: 0 cm
Wind Speed: 15 km/h
Direction: NW 315°
Barometric Pressure: 101.5 kPa (falling)
Minimum Humidity: 40%

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Instructions

AB rep at the JIC will report the information in the 'content' section to all AB outstations via LMR.

AB1 & AB2 to remain at location ‘c’ for next inject.

Inject Number	Day	Time	Controller	From
150	1	1125h CST 1025h MST	SK & JIC	JIC – SK
Communication Method		**Contact Information**		**To**
LMR				SK1 & SK2

Detailed Information

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

JIC SK-IC provides a current weather report to all SK stations (SK1, SK2).

Weather Station: EASTEND CYPRESS (AUT) SASKATCHEWAN Weather StationID 7485
Sky/weather: Part Cloudy
Max Air Temp: 1°C
Low Temp: -8°C
Current Temp: -5°C
Precipitation since 0600: .1 mm Last hour: 0 mm
Snow accumulation since 0600: 1 cm Last hour: 0 cm
Wind Speed: 18 km/h
Direction: WNW 290°
Barometric Pressure: 101.5 kPa
Minimum Humidity: 50%

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Instructions

SK rep at the JIC will report the information in the 'content' section to all SK outstations via LMR.

SK1 & SK2 to remain at location ‘c’ for next inject.

Inject Number	Day	Time	Controller	From
155	1	1130h CST 1035h MST	MT & JIC	JIC - MT
Communication Method		**Contact Information**		**To**
LMR				MT1 & MT2

Detailed Information

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

IC MT-IC provides a current weather report to all MT stations (MT1, MT2).

Weather Station: Havre (KHVR) Montana Weather StationID KHVR
Sky/weather: Part Cloudy
Max Air Temp: 41°F
Low Temp: 21°F
Current Temp: 39°C
Precipitation since 0600: 0.03 in Last hour: 0 in
Snow accumulation since 0600: 0.03 in Last hour: 0 in
Wind Speed: 11.1 mph
Direction: WNW 280°
Barometric Pressure: 99.5 kPa
Minimum Humidity: 48%

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Instructions

MT rep at the JIC (or Havre EOC) will report the information in the 'content' section to all MT outstations via LMR.

Inject Number	Day	Time	Controller	From
180	1	1140h CST 1040h MST	AB	JIC - AB
Communication Method		**Contact Information**		**To**
LMR				AB1 & AB2

Detailed Information

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

AB1 and AB2 provide the following information based on each respective location:

AB1-c
Lat: 49.051000°; Long: -110.140000°
Location: From AB1-b location, travel 2.5 Km north on Hwy 20 from juction of Hwy 12 and Hwy 20 intersection
Line of site to fireline: Fireline is 3 km SE and 3 km ESE from reporting location
Elevation: Flat, dry grassland
Water sources: dried river bed approximately 1km E from reporting location
No residential dwellings present

AB2-c
Lat: 49.086000°; Long: -110.071000°
Location: From AB2-b location, travel east on dirt road and south for approximately 5km.
Line of sight to fireline: Fireline is 4km S, 5km SW, and 5km SSE from reporting location
Elevation: Flat, dry grass,
Water sources: No obvious water sources
No livestock or dwellings

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Instructions

AB1 and AB2 vehicles are to travel to reporting location 'c' by 1135h CST/ 1035 MST. Once you have arrived at your location, confirm with the lead controller using your LMR.
Wait at your designated location until you are requested by the AB rep in the JIC to provide only your information noted in the 'Content' section. The AB rep will address you by your call sign (AB1 or AB2). Include your Lat and Long when providing your information

AB1
Once AB1 has provided the respective information, remain in your position 'c' until 1155h CST/1055h MST for inject 200.
AB2
Once AB2 has provided the respective information, remain in position 'c' until 1155h CST/1055h MST for inject 200.

Inject Number	Day	Time	Controller	From
190	1	1145h CST 1045h MST	SK	JIC - SK
Communication Method		**Contact Information**		**To**
LMR				SK1 & SK2

Detailed Information

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

SK1 & SK2 provide the following information based on each respective location:

SK1-c

Lat: 49.135609°; Long:-109.835661°
Location: From SK1-b location, travel north on Hwy 21 approximately 5.6km. Turn left on dirt road and travel west approximately 1.7 km.
Line of sight to fireline: Fireline is 7km due S and 6.5km SSW reporting location
Water sources: River running south terminating at reporting location. Several small resevoirs in the immediate area.
Elevation: flat, dry grassland
Commercial farm, livestock and dwellings located at reporting area.

SK2-c

Lat: 49.087000°; Long: -110.004000°
Location: From SK1-b location, travel west approximately 14 km.
Line of sight to fireline: Fireline is 3km due S, 4km SSW and 3km SSE from reporting location
Water sources: Small lake .5km SW from reporting location and a second lake 1.5km SE from reporting location.
Elevation: flat, dry grassland
No dwellings or livestock in immediate area

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Instructions

SK1 and SK2 vehicles are to travel to reporting location 'c' by 1140h CST/ 1040h MST. Once you have arrived at your location, confirm with the lead controller using your LMR.
Wait at your designated location until you are requested by the SK rep in the JIC to provide only your information noted in the 'Content' section. The SK rep will address you by your call sign (SK1 or SK2).

Include your Lat and Long when providing your information

SK1

Once SK1 has provided your respective information, remain in your position 'c' until 1200h CST/ 1100h MST for your next inject.

SK2
Once SK2 has provided your respective information, remain in your position 'c' until 1200h CST/ 1100h MST for your next inject.

Inject Number	Day	Time	Controller	From
195	1	1150h CST 1050h MST	MT	JIC - MT
Communication Method		**Contact Information**		**To**
LMR				MT1 & MT2

Detailed Information

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

MT1 & MT2 provide the following information based on each respective location:

MT1-c
Lat: 48.934919°
Long: -109.763355°
Location: From MT1-b location, return to St. Joe Rd. Turn right on St. Joe Rd and travel south for 6.5km.
Line of sight to fireline: Fireline is 9km NW and 9.5km NNW from reporting location
Elevation: flat, grass
Water sources: Creedman Reservoir is 5.5 km NNW of reporting location

MT2-c
Lat: 48.962628°
Long: -109.929559°
Location: From MT2-b location, continue N for 2.2km
Line of sight to fireline: Fireline is .5km due N,.5km NNW and .5km NNE from reporting location
Elevation: flat farmland
Water sources: small resevoirs in the immediate area
No dwellings in immediate area

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Instructions

MT1 and MT2 vehicles are to travel to reporting location 'c' by 1145h CSR/ 1045h MST. Once you have arrived at your location, confirm with the lead controller using your LMR.
Wait at your designated location until you are requested by the MT rep in the JIC to provide only your information noted in the 'Content' section. The MT rep will address you by your call sign (MT1 or MT2).

Include your Lat and Long when providing your information.

Request further instructions from the MT controller.

Inject Number	Day	Time	Controller	From
200	1	1155h CST 1055h MST	AB	JIC - AB
Communication Method		**Contact Information**		**To**
LMR				AB1 & AB2

Detailed Information

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Since sending the weather update at 1120h CST/ 1020h MST, the JIC - AB rep has noted a significant change in wind speed and direction in the respective call-in locations.
The AB rep in the JIC reports the wind shift to all AB outstations based on their last reporting location:

AB1
New wind speed: 18 km/hr
Wind gusts up to 25km/hr
Wind Direction: SW 220°

AB2
New wind speed: 19.5 km/hr
Wind gusts up to 30km/hr
Wind Direction: SW 220°

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Instructions

While at your respective location 'c', the JIC – AB rep will report each respective wind shift via LMR.

Once the information has been reported, outstations can travel to location 'd':

AB1
From your 'c' location, travel north on hwy 20 approximately 4km to junction where 20 turns into 15 (20 bends directly west). Location (Lat: 49.086237°; Long: -110.139731°)

AB2
From your 'c' location, travel approximatley 3.5km east on dirt road toward SK border (Lat: 49.086907°; Long: -110.022783°).

Inject Number	Day	Time	Controller	From
210	1	1200h CST 1100h MST	SK	JIC - SK
Communication Method		**Contact Information**		**To**
LMR				SK1 & SK2

Detailed Information

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Since sending the weather update at 1125h CST/ 1025h MST the JIC - SK rep has noted a significant change in wind speed and direction in the respective call-in locations.

The information in the 'content' section will be communicated to all SK outstations:

SK1
New wind speed: 18 km/hr
Wind gusts up to 32km/hr
Wind Direction: SSW 200°

SK2
New wind speed: 19.5 km/hr
Wind gusts up to 30km/hr
Wind Direction: SSW 210°

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Instructions

While at your respective location 'c', SK rep at JIC will report each respective wind shift via LMR.

Once the information has been reported, outstations can travel to location 'd':

SK1
From your 'c' location, continue traveling West and South for approximately 2.25km (Lat: 49.124069°; Long:-109.858002°)

SK2
From your 'c' location, travel north 6km on dirt road (Lat: 49.141054°°; Long: -110.004602°). You will remain at this location for the duration of the experiment.

Inject Number	Day	Time	Controller	From
220	1	1215h CST 1115h MST	AB	AB1 (RCMP)
Communication Method		**Contact Information**		**To**
LMR				JIC - AB

Detailed Information

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

AB RCMP Southern Alberta detachment updates the following road closures:

Bow Island detachment in the Southern District has extended the full road closure of Hwy 12 between Hwy 23 and Hwy 20 North.

Hwy 20 is closed in both directions from the Hwy 12 junction to 6.5km north of Hwy 12 junction (Lat: 49.086268°, Long: -110.139841°)

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Instructions

While at location 'd', AB1 will call AB rep at the JIC on behalf of the RCMP and convey the road closure update via LMR noted in 'content' section. If AB1 is unable to reach location 'd' in time for this inject, take note of the actual location of this call (i.e. GPS coordinates) as it MUST be replicated on Day 2.

Proceed to location 'd' if not already there for inject 280 at 1245h CST/ 1145h MST.

Inject Number	Day	Time	Controller	From
240	1	1220h CST 1120h MST	AB	AB2 (Conservation Officer)
Communication Method		**Contact Information**		**To**
LMR				JIC - AB

Detailed Information

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

AB Conservation Officer contacts the AB rep in the JIC and provides the following update:

The South Regional Office of Alberta Parks has just received an update from RCMP Redcliff detachment regarding a missing hunter reported today by family members, who was last seen on November 22nd entering Onefour Heritage Rangeland Natural Area. RCMP have confirmed a body matching the description of Willard Branch was located within the boundaries of Onefour Heritage Rangeland at approximately 1120h CST/ 1020 MST (lat: 49.221174°, Long: -110.264503°). Mr. Branch was found inside of his truck believed to have to suffered a heart attack while at the wheel. Family members have been notified. No foul play is suspected. Crews are extracting the body which will be transferred to the Coroner's Office for autopsy.

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Instructions

While at location 'd', AB2 will contact the AB rep at the JIC via LMR on behalf of the South Regional Office of Alberta Parks. AB2 will convey the information noted in the 'content' section.

Once the information has been conveyed via LMR, proceed to location 'e' if not already there.

AB2

From location 'd', travel back to location 'c' and turn left at dirt road. Travel south for .5km (Lat: 49.082202; Long: -110.068928°)°

Inject Number	Day	Time	Controller	From
250	1	1230h CST 1130h MST	SK	SK1 (RCMP)
Communication Method		**Contact Information**		**To**
LMR				JIC - SK

Detailed Information

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

SK RCMP Maple Creek detachment updates the following road closure:

Maple Creek detachment has extended a full road closure of Hwy 21 South closed 10km south of the Hwy 13 and Hwy 21 junction. (Lat: 49.119716°, Long: -109.813317°)

Hwy 21 North continues to be closed to all traffic from Willow Creek, extending north 16 km (Lat: 49.107017°, Long: -109.811865°).

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Instructions

While at location 'd', SK1 will call SK rep at the JIC on behalf of the RCMP and convey the information via LMR noted in 'content' section. If SK1 is unable to reach location 'd' in time for this inject, take note of the actual location of this call (i.e. GPS coordinates) as it MUST be replicated on Day 2.

Once the information has been provided, proceed to location 'e'.

From location ‘d’, continue traveling west for approximately 1 km.

Location ‘e’ is at Lat: 49.124425°; Long: -109.870008°.

Inject Number	Day	Time	Controller	From
270	1	1240h CST 1140h MST	SK	CBSA - Border Crossing Willow Creek
Communication Method		**Contact Information**		**To**
LMR				JIC - SK
Detailed Information				
FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE** Due to the closure of Hwy 21, Canada Border Services Agency has announced the closure of the Willow Creek border crossing. All services, including export declarations and permits from the Highway-Land Border Office will be suspended until further notice. This border crossing will remain unmanned until the reopening of Hwy 21. **FOR EXERCISE ***** FOR EXERCISE ***** FOR EXERCISE**				
Instructions				
SK controller to relay information to SK rep in the JIC (either through LMR or in person). Using LMR, SK rep in the JIC will notify all outstations (AB, MT, and SK) that the border crossing has been closed.				

Inject Number	Day	Time	Controller	From
280	1	1245h CST 1145h MST	AB	AB1
Communication Method		**Contact Information**		**To**
LMR				JIC - AB

Detailed Information

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Back Story: AB1 supplies and equipment are insufficient to contain the spread of the fire traveling in the N and NNW directions and contacts the JIC - AB rep for additional fire suppression equipment. AB1 is currently located 9.6Km north on Hwy 41 and 3.3km ESE (Lat: 49.086237°, Long: -110.139731°). Equipment can be delivered to the staging area at Onefour.

The request consists of the following:
- 50 suction hoses
- 2 wild land fire tenders
- 40 high pressure pumps
- 100 bottles of two cycle oil
- 25 shovels and axes
- 20 first aid kits
- 4 large tents
- 40 ration packets

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Instructions

Once at location 'd', AB1 will contact AB rep at the JIC via LMR and relay the information in the 'content' section.
Once AB1 has provided the information, proceed to location 'e' for final inject. (Lat: 49.069664°; Long: -110.206616°)

From Ab1-d location, travel west 4.8 km and south 1.9km. This will be the last reporting location for the experiment.

Inject Number	Day	Time	Controller	From
290	1	1255h CST 1155h MST	SK	SK1
Communication Method		**Contact Information**		**To**
LMR				AB2

Detailed Information

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Back Story: In an effort to prevent the fire from crossing Hwy 21, SK outstations plan to dig a trench along the highway to contain the spread. SK1 is currently located approximately 20 km north of Willow Creek off of Hwy 21 (Lat: 49.124425° , Long: - 109.870008°)

Equipment can be delivered directly to SK1 location.

The request consists of the following:
- 6 bulldozers
- 3 wildland fire tenders
- 6 500 gallon water tanks

Additional suppression equipment requested includes:
- 20 high pressure pumps
- 50 bottles of two cycle oil
- 25 shovels and axes
- 15 first aid kits

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Instructions

Once SK1 has arrived at location 'e', SK1 is to contact AB2 via LMR and request some fire suppression equipment (see'content').
Both SK1 and AB2 are to remain at location ‘e’ for the duration of the experiment.

Inject Number	Day	Time	Controller	From
300	1	1305h CST 1205h MST	AB	JIC - AB
Communication Method		**Contact Information**		**To**
LMR				AB1 & AB2

Detailed Information

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Back Story: The AB IC is working closely with the Logistics Section to ensure that approved resources are ordered and distributed accordingly based on the current situation. The Planning Section is busy developing maps, assessing damage, and projecting future needs. The logistical officer has requested an update from the Incident Commander on the tactical personnel status from each of the outstations.

When contacted by the JIC – AB rep, provide the information as per below:

AB1
Check in location: From Wild Horse, north on Hwy41 for 10km, east on Hwy 15 approximately 3.3 km (Lat: 49.069664, Long: -110.206616°) - location 'e'
Agency: Alberta ESRD
Supervisor Name: Joe Shoeless
Total # of assigned personnel (# and location): 8 at check-in
Next scheduled Shift change: 1600h
Total # of available (# and staging location): 10 available at staging in Wild Horse
Total # out of service: 2 from fatigue

AB2
Check in location: From Wild Horse, north on Hwy 23 for 3.2km, east on Hwy 12 for approximately 5.7 km, north on hwy 20 for 10.6km, right on dirt road and travel SE for approximately 5km. Turn right on dirt road and travel .5 km south (Lat: 49.082202°, Long: -110.068928°)
Agency: Boulder Mountain Contracting Ltd
Supervisor Name: Billy Bugle
Total # of assigned personnel (# and location): 6 at check-in location
Next scheduled Shift change: 1600h
Total # of available (# and staging location): 8 available at staging area at Hwy 41 and 501 junction
Total # out of service: 2 bulldozers, insufficient personnel to operate machinery

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Instructions

Once at location 'e', both AB1 and AB2 are to confirm their arrival via LMR with the AB rep at the JIC.

The AB rep at the JIC will request a personnel report from both outstations. When requested to do so, read the required information in the 'content' section as it pertains to your call sign.

This is the last reporting location for the experiment. The lead controller will announce to all that the experiment is over for the day and provide any remaining instructions to all players (e.g. complete questionnaire, etc).

Inject Number	Day	Time	Controller	From
310	1	1320h CST 1220h MST	SK	JIC - SK
Communication Method		**Contact Information**		**To**
LMR				SK1 & SK2

Detailed Information

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Back Story: The SK IC is working closely with the Logistics Section to ensure that approved resources are ordered and distributed accordingly based on the current situation. The Planning Section is busy developing maps, assessing damage, and projecting future needs. The logistical officer has requested an update from the Incident Commander on the tactical personnel status from each of the outstations.

When contacted by the JIC – SK rep, provide the information as per below:

SK1
Check in location: From Willow Creek , travel north on Hwy 21 approx 20km, left on dirt road and travel 1.6 km to farm, continue traveling West and South for approximately 3.25km (Lat: 49.124425°, Long:-109.870008°)
Agency: Silviculture Contractors
Supervisor Name: John Black
Total # of assigned personnel (# and location): 8
Next scheduled Shift change: 1500h
Total # of available (# and staging location): 10 available at staging in Govenlock
Total # out of service: 2 from fatigue

SK2
Check in location: From Willow Creek, travel north on Hwy 21 for 13.5 km, travel west approximately 19km. Turn right and travel north for 6km (Lat: 49.141054°, Long:-110.004602°)
Agency: Outland
Supervisor Name: Paul Tortiere
Total # of assigned personnel (# and location): 8 at call in location
Next scheduled Shift change: 1600h
Total # of available (# and staging location): 8 at Gravenlock
Total # out of service: 0

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Instructions

SK1 should be at location 'e' and SK2 should be at location 'd'.
Once at your respective location, both SK1 and SK2 are to confirm their arrival via LMR with the

SK rep at the JIC.
The SK rep at the JIC will request a personnel report from both outstations. When requested to do so, read the required information in the 'content' section as it pertains to your call sign.

This is the last reporting location for the experiment. The lead controller will announce to all that the experiment is over for the day and provide any remaining instructions to all players (e.g. complete questionnaire, etc).

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Annex B Day 2 Scenario Scripts

Inject Number	Day	Time	Controller	From
10	2	1000h CST 0900h MST	AB	JIC - AB
Communication Method		**Contact Information**		**To**
Primary: MASAS Backup: Email w/ attachment				AB1 & AB2

Detailed Information

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

AB1 & AB2 provide the following information based on each respective location:

AB1 - a
Lat: 48.999558°; Long: -110.217730°
Location of call-in: Hwy 232 and Hwy 41 (Wild Horse Border Crossing)
Line of site to fireline: Fireline is 7km E and 8km ENE from reporting location
Elevation: Flat, no obvious elevation
Water sources: no natural water sources, several houses at border crossing, no infrastructure.

AB2-a
Lat: 49.193633°; Long: -110.004883°
Location: Intersection of Red Coat Trail (Hwy 13/501) and Hwy 31
Line of sight to fireline: Fireline is 15km due S and 16km SW
Elevation: Flat, dry grassland, no rock
Water sources: no obvious natural water sources
No residential dwellings present

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Instructions

AB1 and AB2 vehicles are to travel to reporting location 'a' by 0950h CMT/0850h MST. Once you have arrived at your location, confirm with the lead controller using your LMR.
Wait at your designated location until you are requested by the AB rep in the JIC to provide a perimeter update.

The AB rep will address you by your call sign (AB1 or AB2). AB1 and AB2 are to use the LTE application noted below:

LTE: MASAS (Email with attachment as back-up)

MASAS
Using the MASAS application, plot the fire perimeter icon at your respective location on the MASAS map. Take a picture of your respective description in the content section (AB1 or AB2) and attach as a photo within MASAS.

Backup: Email with attachment
In the event that MASAS is not working properly, compose an email using only your information noted in the 'Content' section under your call sign. Do NOT include your Lat and Long in the email. Take a photo of the picture labeled with your respective location and attach it to your email before sending.

AB1
Once AB1 has provided/plotted the respective information, remain in position 'a' to request a fire line update from SK1 (Inject 40 at 1015h CST/ 0915h MST). Once Inject 40 has been completed, AB1 may proceed to your next reporting location 'b'.

AB2
Once AB2 has provided the respective information, you may proceed to your next reporting location 'b'.

Inject Number	Day	Time	Controller	From
20	2	1005h CST 0905h MST	SK	JIC - SK
Communication Method		**Contact Information**		**To**
Primary: MASAS Backup: Email w/ attachment				SK1 & SK2

Detailed Information

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

SK1 & SK2 provide the following information based on each respective location:

SK1-a
Lat: 49.001000° ; Long: -109.733000°
Location: Willow Creek Border Crossing Hwy 21
Line of sight to fireline: Fireline is 5km W and 6.5km WNW from reporting location
Elevation: Flat, dry grassland, no elevation
Water sources: 3 small water sources at 1km, 2km, and 4km from reporting station
Cattle grazing 2 km WNW of reporting location. No dwellings.

SK2-a
Lat: 49.125586°; Long: -109.879513°
Location: From Willow Creek border crossing, travel north on Hwy 21 approximately 19km. Turn left onto dirt road and travel west for approximately 5.5km.
Line of sight to fireline: Fireline is 5.5km due S, 7km SW and 6.5km SSE from reporting location
Water sources: Natural water source (small river) running from north on the east side of farmland (could intersect fireline).
Elevation: flat, green grassland, farmland.
No dwellings or livestock in immediate area.

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Instructions

SK1 and SK2 vehicles are to travel to reporting location 'a' by 0955h CST/ 0855h MST. Once you have arrived at your location, confirm with the lead controller using your LMR.
Wait at your designated location until you are requested by the SK rep in the JIC to provide a perimeter update.

The SK rep will address you by your call sign (SK1 or SK2). SK1 and SK2 are to use the LTE application noted below:

LTE: MASAS (Email with attachment as back-up)

MASAS
Using the MASAS application, plot the fire perimeter icon at your respective location on the MASAS map. Take a picture of your respective description in the content section (SK1 or SK2) and attach as a photo within MASAS.

Backup: Email with attachment
In the event that MASAS is not working properly, compose an email using only your information noted in the 'Content' section under your call sign. Do NOT include your Lat and Long in the email. Take a photo of the picture labeled with your respective location and attach it to your email before sending.

SK1
Once SK1 has provided/ plotted the respective information, remain in position 'a' until you receive a request from AB1 to report your fire perimeter definition (inject 40 at 1015h CST/0915h MST). Once you have relayed your information via email to AB1, you may proceed to your next reporting location 'b'.

SK2
Once SK2 has provided the respective information, remain in position 'a' to request a fire line update from MT1 (Inject 50 at 1020h CST/ 0920h MST). Once Inject 50 has been completed, SK2 may proceed to your next reporting location 'b'.

Inject Number	Day	Time	Controller	From
30	2	1010h CST 0910h MST	MT	JIC - MT
Communication Method		**Contact Information**		**To**
Primary: MASAS Backup: Email				MT1 & MT2

Detailed Information

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

MT1 & MT2 provide the following information based on each respective location:

MT1-a
Lat: 48.998000°; Long: -109.732000°
Location: Border Crossing on St. Joe Rd.
Line of sight to fireline: Fireline is 4km due W, 5km NW and 5.5km WSW from reporting location
Elevation: Flat, grass
Water sources: Small resevoirs in immediate area
Border crossing building

MT2-a
Lat: 48.922139°; Long: -109.841396°
Location: 9.3 Km south from Border on St. Joe Rd., right on Willow Creek road and travel south for 3.1 km. Turn right on dirt road and travel west for 9.6km, right on dirt road for 3.1 km. Turn right and follow road for 2.5km.
Distance and Line of sight to fireline: Fireline is 3.5km due N, 5.5km NW and 6.3km NNE from reporting location
Elevation: Flat, farmland
Water sources: Small resevoirs in the immediate area with commercial farm .7 km south of reporting location

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Instructions

MT1 and MT2 vehicles are to travel to reporting location 'a' by 1000h CST/ 9000h MST. Once you have arrived at your location, confirm with the lead controller using your LMR.
Wait at your designated location until you are requested by the MT rep in the JIC to provide a perimeter update. The MT rep will address you by your call sign (MT1 or MT2). MT1 and MT22 are to use the LTE application noted below:

LTE: MASAS (Email backup)

MASAS
Using the MASAS application, plot the fire perimeter icon at your respective location on the MASAS map. Take a picture of your respective description in the content section (MT1 or MT2) and attach as a photo within MASAS.

Backup: Email
In the event that MASAS is not working properly, compose an email using only your information noted in the 'Content' section under your call sign. Do NOT include your Lat and Long in the email.

MT1
Once MT1 has provided/ plotted the respective information, remain in position 'a' until you receive a request from SK2 to report your fire perimeter definition (inject 50 at 1020h CST/ 0920h MST). Once you have relayed your information from inject 50 via email to SK2, you may proceed to your next reporting location 'b'.

MT2
Once MT2 has provided the respective information, you may proceed to your next reporting location 'b'.

Inject Number	Day	Time	Controller	From
40	2	1015h CST 0915h MST	AB and SK	AB1
Communication Method		**Contact Information**		**To**
Email w/ attachment				SK1

Detailed Information

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

AB1 calls SK1 and requests and a fire line perimeter update. SK1 provides the following information based on respective location:

SK1-a

Lat: 49.001000° ; Long: -109.733000°
Location: Willow Creek Border Crossing Hwy 21
Line of sight to fireline: Fireline is 5km W and 6.5km WNW from reporting location
Elevation: Flat, dry grassland, no elevation
Water sources: 3 natural water small water sources at 1km, 2km, and 4km from reporting station
Cattle grazing 2 km WNW of reporting location. No dwellings.

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Instructions

While still at location 'a', AB1 calls SK1 using LMR and requests an update on the fire line perimeter. Once requested, SK1 will respond via LMR and indicate that you will reply with an update via email.

LTE: Email with attachment

Compose an email using only your information noted in the 'Content' section under your call sign. Do NOT include your Lat and Long in the email. Take a photo of the picture labeled with your respective location and attach it to your email before sending.

Once SK1 has relayed the information via email to AB1, both vehicles (AB1 & SK1) may proceed to your next reporting location 'b'.

Inject Number	Day	Time	Controller	From
50	2	1020h CST 0920h MST	SK and MT	SK2
Communication Method		**Contact Information**		**To**
Email w/ attachment				MT1

Detailed Information

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

SK2 calls MT1 and requests a fire line perimeter update. MT1 provides the following information based on location above:

MT1-a

Lat: 48.998000°; Long: -109.732000°
Location: Border Crossing on St. Joe Rd.
Line of sight to fireline: Fireline is 4km due W, 5km NW and 5.5km WSW from reporting location
Elevation: Flat, grass
Water sources: Small resevoirs in immediate area
Border crossing building

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Instructions

While still at location 'a', SK2 calls MT1 using LMR and requests an update on the fire line perimeter. Once requested, MT1 will respond via LMR and indicate that you will reply with an update via email.

LTE: Email with attachment

Compose an email using only your information noted in the 'Content' section under your call sign. Do NOT include your Lat and Long in the email. Take a photo of the contents of this inject and attach it to the email.

Once MT1 has relayed your information via email to SK2, both vehicles (SK2 & MT1) may proceed to your next reporting location 'b'.

Inject Number	Day	Time	Controller	From
60	2	1030h CST 0930h MST	AB	AB2 (Conservation Officer)
Communication Method		**Contact Information**		**To**
Primary: MASAS Backup: Email w/ attachment				JIC - AB

Detailed Information

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Back Story: The grassfires have consumed portions of Onefour Heritage Rangeland Natural Area, driving much of the wildlife to the northern and north eastern parts of the park.

Message to be relayed:

The South Regional Office of Alberta Parks has just received a report from RCMP Redcliff detachment of a missing hunter who was last seen on November 22nd entering Onefour Heritage Rangeland Natural Area near the intersection of Buffalo Trail (Hwy 41) and Hwy 501. Coordinates of last known location are: Lat 49.042626 and Long: 110.509149.

Information from the missing person file is as follows:
Name: Willard Henry Branch
Gender: Male
Date last seen: 2014-11-22
Age at time of disappearance: 43
Height: 180 cm, 5'9"
Weight: 82 kg, 181 lbs
Hair colour: Grey
Eye Colour: Brown
Distinguishing features: Tattoos on right forearm, dagger and a heart, left hand shows Love and 4 aces across the fingers. appendectomy scar lower right side, onleft foot second toe is deformed at distal end.
Clothing worn at time of disappearance: Red hunting jacket, red baseball cap, blue jeans and work boots

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Instructions

While en route to location 'b' (if not already there), AB2 will contact the AB rep at the JIC via LMR on behalf of the South Regional Office of Alberta Parks. AB2 will notify the JIC of a missing person and use the LTE application noted below:

LTE: MASAS (Email with attachment as back-up)

MASAS
Using the MASAS application, plot the missing person icon at your respective location on the MASAS map. Take a picture of the missing person report and attach as a photo within MASAS.

Backup: Email with attachment
In the event that MASAS is not working properly, compose an email that confirms a missing person report has been filed for Willard Henry Branch. Include the word document as an attachment (file name: 'Missing Person Report').

Do NOT include your Lat and Long in the email.

Once the information has been conveyed via email, confirm if received via LMR, and proceed to location 'b' if not already there.

Location 'b' is Lat: 49.111123° and Long: -110.121381°

Inject Number	Day	Time	Controller	From
70	2	1040h CST 0940h MST	SK	SK1 (RCMP)
Communication Method		**Contact Information**		**To**
Primary: MASAS Backup: Email				JIC - SK

Detailed Information

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

SK RCMP Maple Creek detachment reports the following road closure:

Due to the area affected by the Grass Fire in the South District, Maple Creek detachment is reporting a full road closure of Hwy 21 South closed 15km south of the Hwy 13 and Hwy 21 junction. (Lat: 49.101583, Long: 109.813005)

Hwy 21 North is also closed to all traffic from Willow Creek, extending north 13.5 km. (Lat: 49.000715, Long: 109.732531).

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Instructions

While at location 'b', SK1 will call SK rep in the JIC on behalf of RCMP using LMR and indicate that you have an update on road closures to submit. If this information was not submitted at location 'b' on day 1, ensure that SK1 is in the same location as the previous day. SK1 will use the LTE application noted below:

LTE: MASAS (Email backup)

MASAS
Using the MASAS application, plot the road closure icon at the location noted in the content section.

Backup: Email
In the event that MASAS is not working properly, compose an email containing the information noted in the 'Content' section.

Do NOT include your actual Lat and Long in the email.

Proceed to location 'b' if not already there for inject 100. Location ‘b’ is Lat: 49.085846°; Long: -109.815349°.

Inject Number	Day	Time	Controller	From
80	2	1045h CST 0945h MST	AB	AB1 (RCMP)
Communication Method		**Contact Information**		**To**
Primary: MASAS Backup: Email				JIC - AB

Detailed Information

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

AB RCMP Southern Alberta detachment reports the following road closure:

Bow Island detachment in the Southern Districts reporting full road closure of Hwy 12 East 2.5km East of Hwy 12 and 23 junction to Hwy 20 North (Lat: 49.028116°, Long: -110.183961°).

Hwy 20 is closed in both directions from the Hwy 12 junction to 4km north of Hwy 12 junction (Lat: 49.062829°, Long: -110.139648°)

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Instructions

While at location 'b', AB1 will call AB rep at the JIC on behalf of the RCMP using LMR and indicate that you have an update on road closures to submit. If this information was not submitted at location 'b' on day 1, ensure that AB1 is in the same location as the previous day. AB1 will use the LTE application noted below:

LTE: MASAS (Email backup)

MASAS
Using the MASAS application, plot the road closure icon at the location noted in the content section.

Backup: Email
In the event that MASAS is not working properly, compose an email containing the information noted in the 'Content' section. Do NOT include your actual Lat and Long in the email.

Proceed to location 'b' if not already there for inject 90.

Location 'b' is Lat: 49.028000°; Long: -110.140000°.

Inject Number	Day	Time	Controller	From
90	2	1050h CST 0950h MST	AB	JIC - AB
Communication Method		**Contact Information**		**To**
Primary: MASAS Backup: Email w/ attachment				AB1 & AB2

Detailed Information

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

AB 1 & AB2 provide the following information based on each respective location:

AB1-b
Lat: 49.028000°; Long: -110.140000°
Location: From AB1-a location, north on Hwy 23 for 3.1 Km, right on Hwy 12, travel 5.7 km to intersection of Hwy 12 and Hwy 20
Line of sight to fireline: Fireline is 2km due E and 3km ENE from reporting location
Water sources: Natural water source 2.5 km ENE from reporting location. Small stream coming from the north intersects fireline at 2.8 km at ENE.
Elevation: flat, dry grass,
No dwellings or livestock in immediate area

AB2-b
Lat: 49.111123°; Long: -110.121381°
Location: From AB2-a location, travel SW on Hwy 31 approximately 12.5 km
Line of sight to fireline: Fireline is 7 km due S, 7 km SE and 8km ESE from reporting location
Elevation: Flat, no elevation, dry grassland
Water sources: small lake approximately 5.5 km ESE from reporting location
No dwellings or livestock in immediate area

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Instructions

AB1 and AB2 vehicles are to travel to reporting location 'b' by 1045h/ 0945h MST. Once you have arrived at your location, confirm with the lead controller using your LMR. AB1 and AB2 are to use the LTE application noted below:

LTE: MASAS (Email with attachment as back-up)

MASAS
Using the MASAS application, plot the fire perimeter icon at your respective location on the MASAS map. Take a picture of your respective description in the content section (AB1 or AB2) and attach as a photo within MASAS.

Backup: Email with attachment
In the event that MASAS is not working properly, compose an email using only your information noted in the 'Content' section under your call sign. Do NOT include your Lat and Long in the email. Take a photo of the picture labeled with your respective location and attach it to your email before sending.

AB1
Once AB1 has provided/plotted the respective information, you may proceed to your next reporting location 'c'.

AB2
Once AB2 has provided/plotted the respective information, remain in position 'b' to receive a request for fire line update from SK2 (Inject 120 at 1105h CST/ 1005h MST). Once Inject 120 has been completed, AB2 may proceed to your next reporting location 'c'.

Inject Number	Day	Time	Controller	From
100	2	1055h CST 0955h MST	SK	JIC - SK
Communication Method		**Contact Information**		**To**
Primary: MASAS Backup: Email w/ attachment				SK1 & SK2

Detailed Information

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

SK1 & SK2 provides the following information based on each respective location:

SK1-b
Lat: 49.085846°; Long: -109.815349°
Location: From Wild Horse (SK1 location), travel north on Hwy 21 approx 14km
Line of sight to fireline: Fireline is 4km due SSW and 3.5km SW from reporting location
Water sources: Natural water source (small river) running from north (could intersect fireline).
Elevation: flat, dry grass,
Two commercial dwellings or some livestock in immediate area

SK2-b
Lat: 49.087000° ; Long: -109.924000°
Location: From SK2-a location, travel approximately 14 km north of Willow Creek on Hwy 21, left on dirt road, travel 8 km.
Line of sight to fireline: Fireline is 2km due S, 3km WSW, 3km SE from reporting location
Elevation: Flat, no elevation
Water sources: No water sources
No dwellings or livestock in immediate area

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Instructions

SK1 and SK2 vehicles are to travel to reporting location 'b' by 1050h CST/ 0950h MST. Once you have arrived at your location, confirm with the lead controller using your LMR.
SK1 and SK2 are to use the LTE application noted below:

LTE: MASAS (Email with attachment as back-up)

MASAS
Using the MASAS application, plot the fire perimeter icon at your respective location on the MASAS map. Take a picture of your respective description in the content section (SK1 or SK2) and attach as a photo within MASAS.

Backup: Email with attachment

In the event that MASAS is not working properly, compose an email using only your information noted in the 'Content' section under your call sign. Do NOT include your Lat and Long in the email. Take a photo of the picture labeled with your respective location and attach it to your email before sending.

SK1
Once SK1 has provided the respective information, remain in position 'b' to request a fire line update from MT2 (Inject 130 at 1110h CST/ 1010h MST). Once Inject 130 has been completed, SK1 may proceed to your next reporting location 'c'.

SK2
Once SK2 has provided the respective information, remain in position 'b'. SK2 will call AB2 to request a fire perimeter definition (inject 120 at 1105h CST/ 1005h MST). Once you have recieved the information via LMR from AB2, you may proceed to your next reporting location 'c'.

Inject Number	Day	Time	Controller	From
110	2	1100h CST 1000h MST	MT	JIC - MT
Communication Method		**Contact Information**		**To**
Primary: MASAS Backup: Email				MT1 & MT2

Detailed Information

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

MT1 & MT2 provide the following information based on each respective location:

MT1-b

Lat: 48.976265°; Long: -109.765180°
Location: From MT1-a location (Border crossing), travel south on St. Joe Rd approximately 2.9 km. Turn right on dirt road and travel west 2.5 km, turn right (or road bends hard right) and travel north .5km.
Line of sight to fireline: Fireline is 2.2km due WNW and 3.8km NW from reporting location
Elevation: flat, grass
Water sources: Creedman Reservoir is .5 km south of reporting location
Creedman Coulee National Wildlife Refuge is directly south of the resevoir

MT2-b

Lat: 48.943000°; Long: -109.929000°
Location: From MT2-a location, travel North for .7 km. Turn left and travel west 6.4 km. Turn right and travel north 1.6 km.
Line of sight to fireline: Fireline is 2.75km due North, and 2.9km NNW, and 3km NNE from reporting location
Elevation: flat farmland
Water sources: small resevoirs in the immediate area
Commercial farm 1.5km east from reporting location

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Instructions

MT1 and MT2 vehicles are to travel to reporting location 'b' by 1055h CST/ 0955h MST. Once you have arrived at your location, confirm with the lead controller using your LMR.
MT1 and MT2 are to use the LTE application noted below:

MASAS

Using the MASAS application, plot the fire perimeter icon at your respective location on the MASAS map. Take a picture of your respective description in the content section (MT1 or MT2) and attach as a photo within MASAS.

Backup: Email
In the event that MASAS is not working properly, compose an email using only your information noted in the 'Content' section under your call sign. Do NOT include your Lat and Long in the email.

MT1
Once MT1 has provided the respective information, you may proceed to your next reporting location 'c'.

MT2
Once MT2 has provided the respective information, remain in position 'b' until you receive a request from SK1 to report your fire perimeter definition (inject 130 at 1110h CST/ 1010h MST). Once you have relayed your information via email to SK2, you may proceed to your next reporting location 'c'.

Inject Number	Day	Time	Controller	From
120	2	1105h CST 1005h MST	SK & AB	SK2
Communication Method		**Contact Information**		**To**
Email w/ attachment				AB2

Detailed Information

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

SK2 calls AB2 and requests a fire line perimeter update. AB2 provides the following information based on respective location:

AB2-b
Lat: 49.111123°; Long: -110.121381°
Location: From AB2-a location, travel SW on Hwy 31 approximately 12.5 km
Line of sight to fireline: Fireline is 7 km due S, 7 km SE and 8km ESE from reporting location
Elevation: Flat, no elevation, dry grassland
Water sources: small lake approximately 5.5 km ESE from reporting location
No dwellings or livestock in immediate area

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Instructions

While still at location 'b', SK2 calls AB2 using LMR and requests an update on the fire line perimeter. Once requested, AB2 will respond via LMR and indicate that you will reply with an update via email.

LTE: Email with attachment

Compose an email using only your information noted in the 'Content' section under your call sign. Do NOT include your Lat and Long in the email. Take a photo of the picture labeled with your respective location and attach it to your email before sending.

Once AB2 has relayed your information via email to SK2, both vehicles (AB2 & SK2) may proceed to your next reporting location 'c'.

Inject Number	Day	Time	Controller	From
130	2	1110h CST 1010h MST	SK & MT	SK1
Communication Method		**Contact Information**		**To**
Email w/ attachment				MT2

Detailed Information

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

SK1 calls MT2 and requests a fire line perimeter update. MT2 provides the following information based on location:

MT2-b

Lat: 48.943000°; Long: -109.929000°
Location: From MT2-a location, travel North for .7 km. Turn left and travel west 6.4 km. Turn right and travel north 1.6 km.
Line of sight to fireline: Fireline is 2.75km due North, and 2.9km NNW, and 3km NNE from reporting location
Elevation: flat farmland
Water sources: small resevoirs in the immediate area
Commercial farm 1.5km east from reporting location

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Instructions

While still at location 'b', SK1 calls MT2 using LMR and requests an update on the fire line perimeter. Once requested, MT2 will respond via LMR and indicate that you will reply with an update via email.

LTE: Email with attachment

Compose an email using only your information noted in the 'Content' section under your call sign. Do NOT include your Lat and Long in the email. Take a photo of the contents of this inject and attach it to the email.

Once MT2 has relayed the information via email to SK1, both vehicles (SK1 & MT2) may proceed to your next reporting location 'c'.

Inject Number	Day	Time	Controller	From
140	2	1120h CST 1020h MST	AB & JIC	JIC - AB
Communication Method		**Contact Information**		**To**
Primary: VOIP Backup: Email w/ attachment				AB1 & AB2

Detailed Information

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

JIC AB-IC provides a current weather report to all AB stations (AB1, AB2).

Weather Station: ONEFOUR CDA ALBERTA Weather StationID 10725
Sky/weather: Clear, sunny
Max Air Temp: 2°C
Low Temp: -7°C
Current Temp: -3°C
Precipitation since 0600: 0 mm Last hour: 0 mm
Snow accumulation since 0600: 0 cm Last hour: 0 cm
Wind Speed: 15 km/h
Direction: NW 315°
Barometric Pressure: 101.5 kPa (falling)
Minimum Humidity: 40%

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Instructions

AB rep in the JIC will notify AB1 & AB2 via LMR that a weather report will be communicated using VOIP. AB rep at the JIC will report the information in the 'content' section to all AB outstations:

LTE: VOIP (Email backup)

VOIP
Using VOIP, AB Rep in JIC will relay the weather information to all AB stations.

Backup: Email with attachment
If there are issues with VOIP, compose an email entitled Weather Update #1 and attach the file 'Weather Update 1 - AB'. Request confirmation of receipt from the outstations using email (LMR will be backup).

AB1 & AB2 to remain at location ‘c’ for next inject.

Inject Number	Day	Time	Controller	From
150	2	1125h CST 1025h MST	SK & JIC	JIC - SK
Communication Method		**Contact Information**		**To**
Primary: VOIP Backup: Email				SK1 & SK2

Detailed Information

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

JIC SK-IC provides a current weather report to all SK stations (SK1, SK2).

Weather Station: EASTEND CYPRESS (AUT) SASKATCHEWAN Weather StationID 7485
Sky/weather: Part Cloudy
Max Air Temp: 1°C
Low Temp: -8°C
Current Temp: -5°C
Precipitation since 0600: .1 mm Last hour: 0 mm
Snow accumulation since 0600: 1 cm Last hour: 0 cm
Wind Speed: 18 km/h
Direction: WNW 290°
Barometric Pressure: 101.5 kPa
Minimum Humidity: 50%

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Instructions

SK rep in the JIC will notify SK1 & SK2 via LMR that a weather report will be communicated using VOIP. SK rep at the JIC will report the information in the 'content' section to all SK outstations:

LTE: VOIP (Email backup)

VOIP
Using VOIP, SK Rep in JIC will relay the weather information to all SK stations.

Backup: Email with attachment
If there are issues with VOIP, compose an email entitled Weather Update #1 and attach the file 'Weather Update 1 - SK'. Request confirmation of receipt from the outstations using email (LMR will be backup).

SK1 & SK2 to remain at location ‘c’ for next inject.

Inject Number	Day	Time	Controller	From
155	2	1130h CST 1035h MST	MT & JIC	JIC - MT
Communication Method		**Contact Information**		**To**
Primary: VOIP Backup: Email				MT1 & MT2

Detailed Information

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

JIC - MT provides a current weather report to all MT stations (MT1, MT2).

Weather Station: Havre (KHVR) Montana Weather StationID KHVR
Sky/weather: Part Cloudy
Max Air Temp: 41°F
Low Temp: 21°F
Current Temp: 39°C
Precipitation since 0600: 0.03 in Last hour: 0 in
Snow accumulation since 0600: 0.03 in Last hour: 0 in
Wind Speed: 11.1 mph
Direction: WNW 280°
Barometric Pressure: 99.5 kPa
Minimum Humidity: 48%

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Instructions

MT rep in the JIC will notify MT1 & MT2 via LMR that a weather report will be communicated using VOIP. MT rep at the JIC or Havre EOC will report the information in the 'content' section to all MT outstations:

LTE: VOIP (Email backup)

VOIP
Using VOIP, MT Rep in JIC or Havre EOC will relay the weather information to all MT stations.

Backup: Email
If there are issues with VOIP, compose an email entitled Weather Update #1 and send the contents of this inject. Request confirmation of receipt from the outstations using email (LMR will be backup).

Inject Number	Day	Time	Controller	From
180	2	1140h CST 1040h MST	AB	JIC - AB
Communication Method		**Contact Information**		**To**
Primary: MASAS Backup: Email w/ attachment				AB1 & AB2

Detailed Information

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

AB1 & AB2 provide the following information based on each respective location:

AB1-c
Lat: 49.051000°; Long: -110.140000°
Location: From AB1-b location, travel 2.5 Km north on Hwy 20 from juction of Hwy 12 and Hwy 20 intersection
Line of site to fireline: Fireline is 3 km SE and 3 km ESE from reporting location
Elevation: Flat, dry grassland
Water sources: dried river bed approximately 1km E from reporting location
No residential dwellings present

AB2-c
Lat: 49.086000°; Long: -110.071000°
Location: From AB2-b location, travel east on dirt road and south for approximately 5km.
Line of sight to fireline: Fireline is 4km S, 5km SW, and 5km SSE from reporting location
Elevation: Flat, dry grass,
Water sources: No obvious water sources
No livestock or dwellings

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Instructions

AB1 and AB2 vehicles are to travel to reporting location 'c' by 1135h CST/ 1035h MST. Once you have arrived at your location, confirm with the lead controller using your LMR.
AB1 and AB2 are to use the LTE application noted below:

LTE: MASAS (Email with attachment as back-up)

MASAS
Using the MASAS application, plot the fire perimeter icon at your respective location on the MASAS map. Take a picture of your respective description in the content section (AB1 or AB2) and attach as a photo within MASAS.

Backup: Email with attachment
In the event that MASAS is not working properly, compose an email using only your information noted in the 'Content' section under your call sign. Do NOT include your Lat and Long in the email. Take a photo of the picture labeled with your respective location and attach it to your email before sending.

AB1
Once AB1 has provided the respective information, remain in your position 'c' until 1155h CST/1055h MST for inject 200.

AB2
Once AB2 has provided the respective information, remain in position 'c' until 1155h CST/1055h MST for inject 200.

Inject Number	Day	Time	Controller	From
190	2	1145h CST 1045h MST	SK	JIC - SK
Communication Method		**Contact Information**		**To**
Primary: MASAS Backup: Email w/ attachment				SK1 & SK2

Detailed Information

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

SK1 & SK2 provide the following information based on each respective location:

SK1-c

Lat: 49.135609°; Long:-109.835661°
Location: From SK1-b location, travel north on Hwy 21 approximately 5.6km. Turn left on dirt road and travel west approximately 1.7 km.
Line of sight to fireline: Fireline is 7km due S and 6.5km SSW reporting location
Water sources: River running south terminating at reporting location. Several small resevoirs in the immediate area
Elevation: flat, dry grassland
Commercial farm, livestock and dwellings located at reporting area.

SK2-c

Lat: 49.087000°; Long: -110.004000°
Location: From SK1-b location, travel west approximately 14 km.
Line of sight to fireline: Fireline is 3km due S, 4km SSW and 3km SSE from reporting location
Water sources: Small lake .5km SW from reporting location and a second lake 1.5km SE from reporting location.
Elevation: flat, dry grassland
No dwellings or livestock in immediate area

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Instructions

SK1 and SK2 vehicles are to travel to reporting location 'c' by 1140h CST/ 1040h MST. Once you have arrived at your location, confirm with the lead controller using your LMR.
SK1 & SK2 are to use the LTE application noted below:

LTE: MASAS (Email with attachment as back-up)

MASAS

Using the MASAS application, plot the fire perimeter icon at your respective location on the MASAS map. Take a picture of your respective description in the content section (SK1 or SK2) and attach as a photo within MASAS.

Backup: Email with attachment
In the event that MASAS is not working properly, compose an email using only your information noted in the 'Content' section under your call sign. Do NOT include your Lat and Long in the email. Take a photo of the picture labeled with your respective location and attach it to your email before sending.

SK1
Once SK1 has provided/plotted your respective information, remain in your position 'c' until 1200h CST/ 1100h MST for your next inject.

SK2
Once SK2 has provided/plotted your respective information, remain in your position 'c' until 1200h CST/ 1100h MST for your next inject.

Inject Number	Day	Time	Controller	From
195	2	1150h CST 1050h MST	MT	JIC-MT
Communication Method		**Contact Information**		**To**
Primary: MASAS Backup: Email				MT1 & MT2

Detailed Information

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

MT1 & MT2 provide the following information based on each respective location:

MT1-c
Lat: 48.934919°; Long: -109.763355°
Location: From MT1-b location, return to St. Joe Rd. Turn right on St. Joe Rd and travel south for 6.5km.
Line of sight to fireline: Fireline is 9km NW and 9.5km NNW from reporting location
Elevation: flat, grass
Water sources: Creedman Reservoir is 5.5 km NNW of reporting location

MT2-c
Lat: 48.962628°; Long: -109.929559°
Location: From MT2-b location, continue N for 2.2km
Line of sight to fireline: Fireline is .5km due N,.5km NNW and .5km NNE from reporting location
Elevation: flat farmland
Water sources: small resevoirs in the immediate area
No dwellings in immediate area

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Instructions

MT1 and MT2 vehicles are to travel to reporting location 'c' by 1145h CSR/ 1045h MST. Once you have arrived at your location, confirm with the lead controller using your LMR.
MT1 and MT2 are to use the LTE application noted below:

LTE: MASAS (Email backup)

MASAS
Using the MASAS application, plot the fire perimeter icon at your respective location on the MASAS map. Take a picture of your respective description in the content section (MT1 or MT2) and attach as a photo within MASAS.

Backup: Email

In the event that MASAS is not working properly, compose an email using only your information noted in the 'Content' section under your call sign. Do NOT include your Lat and Long in the email.

Request further instructions from the MT controller.

Inject Number	Day	Time	Controller	From
200	2	1155h CST 1055h MST	AB	JIC AB
Communication Method		**Contact Information**		**To**
Primary: VOIP Backup: Email				AB1 & AB2

Detailed Information

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Since sending the weather update at 1120h CST/ 1020h MST, the JIC - AB rep has noted a significant change in wind speed and direction in the respective call-in locations.
The AB rep in the JIC reports the wind shift to all AB outstations based on their last reporting location:

AB1
New wind speed: 18 km/hr
Wind gusts up to 25km/hr
Wind Direction: SW 220°

AB2
New wind speed: 19.5 km/hr
Wind gusts up to 30km/hr
Wind Direction: SW 220°

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Instructions

The JIC – AB rep will notify AB1 & AB2 via LMR that a significant wind shift will be communicated using VOIP. The information in the 'content' section will be communicated to all AB outstations:

LTE: VOIP (Email backup)

VOIP
Using VOIP, the JIC – AB rep will relay the weather information to all AB stations.

Backup: Email
If there are issues with VOIP, compose an email entitled Weather Update #1 and send the contents of the inject. Request confirmation of receipt from the outstations using email (LMR will be backup).

Once the information has been reported, outstations can travel to location 'd':

AB1
From your 'c' location, travel north on hwy 20 approximately 4km to junction where 20 turns into 15 (20 bends directly west). Location (Lat: 49.086237°; Long: -110.139731°)

AB2
From your 'c' location, travel approximatley 3.5km east on dirt road toward SK border (Lat: 49.086907°; Long: -110.022783°).

Inject Number	Day	Time	Controller	From
210	2	1200h CST 1100h MST	SK	JIC SK
Communication Method		**Contact Information**		**To**
Primary: VOIP Backup: Email				SK1 & SK2

Detailed Information

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Since sending the weather update at 1125h CST/ 1025h MST the JIC - SK rep has noted a significant change in wind speed and direction in the respective call-in locations.
The information in the 'content' section will be communicated to all SK outstations:

SK1
New wind speed: 18 km/hr
Wind gusts up to 32km/hr
Wind Direction: SSW 200°

SK2
New wind speed: 19.5 km/hr
Wind gusts up to 30km/hr
Wind Direction: SSW 210°

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Instructions

The JIC – SK rep will notify SK1 & SK2 via LMR that a significant wind shift will be communicated using VOIP. The information in the 'content' section will be communicated to all SK outstations:

LTE: VOIP (Email backup)

VOIP
Using VOIP, the JIC – SK rep will relay the weather information to all SK stations.

Backup: Email
If there are issues with VOIP, compose an email entitled Weather Update #1 and send the contents of the inject. Request confirmation of receipt from the outstations using email (LMR will be backup).

Once the information has been reported, outstations can travel to location 'd':

SK1
From your 'c' location, continue traveling West and South for approximately 2.25km (Lat: 49.124069°; Long:-109.858002°)

SK2
From your 'c' location, travel north 6km on dirt road (Lat: 49.141054°°; Long: -110.004602°). You will remain at this location for the duration of the experiment.

Inject Number	Day	Time	Controller	From
220	2	1215h CST 1115h MST	AB	AB1 (RCMP)
Communication Method		**Contact Information**		**To**
Primary: MASAS Backup: Email				JIC - AB IC

Detailed Information

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

AB RCMP Southern Alberta detachment updates the following road closures:

Bow Island detachment in the Southern District has extended the full road closure of Hwy 12 between Hwy 23 and Hwy 20 North.

Hwy 20 is closed in both directions from the Hwy 12 junction to 6.5km north of Hwy 12 junction (Lat: 49.086268°, Long: -110.139841°)

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Instructions

While at location 'd', AB1 will call AB rep at the JIC on behalf of the RCMP using LMR and indicate that you have an update on road closures to submit. If this information was not submitted at location 'd' on day 1, ensure that AB1 is in the same location as the previous day. AB1 will use the LTE application noted below:

LTE: MASAS (Email backup)

MASAS
Using the MASAS application, plot the road closure icon at the location noted in the content section.

Backup: Email
In the event that MASAS is not working properly, compose an email containing the information noted in the 'Content' section. Do NOT include your actual Lat and Long in the email.

Proceed to location 'd' if not already there for inject 280 at 1245h CST/ 1145h MST.

Inject Number	Day	Time	Controller	From
240	2	1220h CST 1120h MST	AB	AB2 (Conservation Officer)
Communication Method		**Contact Information**		**To**
Primary: MASAS Backup: Email w/ attachment				JIC - AB

Detailed Information

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

AB Conservation Officer contacts the AB rep in the JIC and provides the following update:

The South Regional Office of Alberta Parks has just received an update from RCMP Redcliff detachment regarding a missing hunter reported today by family members, who was last seen on November 22nd entering Onefour Heritage Rangeland Natural Area. RCMP have confirmed a body matching the description of Willard Branch was located within the boundaries of Onefour Heritage Rangeland at approximately 1120h CST/ 1020h MST (lat: 49.221174°, Long: -110.264503°).

Mr. Branch was found inside of his truck believed to have to suffered a heart attack while at the wheel. Family members have been notified. No foul play is suspected. Crews are extracting the body which will be transferred to the Coroner's Office for autopsy.

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Instructions

AB2 will contact the AB rep at the JIC via LMR on behalf of the South Regional Office of Alberta Parks. AB2 will notify the JIC of an update on the missing person using the LTE application noted below:

LTE: MASAS (Email with attachment as back-up)

MASAS
Using the MASAS application, plot the missing person icon update at your respective location on the MASAS map. Take a picture of the missing person report update and attach as a photo within MASAS.

Backup: Email with attachment
In the event that MASAS is not working properly, compose an email that confirms that the missing person has been found. Include the word document as an attachment (file name: 'Update Missing Person Report'.

Do NOT include your Lat and Long in the email.

Once the information has been conveyed via email, confirm if received via LMR, and proceed to location 'e' if not already there.

Location 'e' is Lat:49.082202° and Long: -110.068928°. AB2 to travel WNW 3.5km back to 'c' location. Turn left on dirt road and travel south .5 km.

Inject Number	Day	Time	Controller	From
250	2	1230h CST 1130h MST	SK	SK1 (RCMP)
Communication Method		**Contact Information**		**To**
Primary: MASAS Backup: Email				JIC - SK

Detailed Information

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

SK RCMP Maple Creek detachment updates the following road closure:

Maple Creek detachment has extended a full road closure of Hwy 21 South closed 10km south of the Hwy 13 and Hwy 21 junction. (Lat: 49.119716°, Long: -109.813317°).

Hwy 21 North continues to be closed to all traffic from Willow Creek, extending north 16 km (Lat: 49.107017°, Long: -109.811865°).

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Instructions

While at location 'd', SK1 will call SK rep at the JIC on behalf of the RCMP using LMR and indicate that you have an update on road closures to submit. If this information was not submitted at location 'd' on day 1, ensure that SK1 is in the same location as the previous day. SK1 will use the LTE application noted below:

LTE: MASAS (Email backup)

MASAS
Using the MASAS application, plot the road closure icon at the location noted in the content section.

Backup: Email
In the event that MASAS is not working properly, compose an email containing the information noted in the 'Content' section. Do NOT include your actual Lat and Long in the email.

Proceed to location 'e' if not already there for inject 290. From location ‘d’, continue traveling west for approximately 1 km.

Location ‘e’ is at Lat: 49.124425°; Long: -109.870008°.

Inject Number	Day	Time	Controller	From
270	2	1240h CST 1140h MST	SK	CBSA - Border Crossing Willow Creek
Communication Method		**Contact Information**		**To**
Primary: VOIP Backup: Email				JIC - SK

Detailed Information

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Due to the closure of Hwy 21, Canada Border Services Agency has announced the closure of the Willow Creek border crossing. All services, including export declarations and permits from the Highway-Land Border Office will be suspended until further notice. This border crossing will remain unmanned until the reopening of Hwy 21.

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Instructions

SK controller to relay information to SK rep in the JIC (either through LMR or in person).
SK rep in the JIC will notify all outstations (AB, MT, and SK) that the border crossing has been closed.

LTE: VOIP (Email backup)

VOIP
Using VOIP, SK Rep in JIC will relay the border closure to all stations.

Backup: Email
If there are issues with VOIP, compose an email that relays the information in the content section. Request confirmation of receipt from the outstations using email (LMR will be backup).

Inject Number	Day	Time	Controller	From
280	2	1245h CST 1145h MST	AB	AB1
Communication Method		**Contact Information**		**To**
Email				JIC - AB

Detailed Information

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Back Story: AB1 supplies and equipment are insufficient to contain the spread of the fire traveling in the N and NNW directions and contacts the JIC - AB rep for additional fire suppression equipment. AB1 is currently located 9.6Km north on Hwy 41 and 3.3km ESE (Lat: 49.086237°, Long: -110.139731°).

Equipment can be delivered to the staging area at Onefour.

The request consists of the following:
- 50 suction hoses
- 2 wild land fire tenders
- 40 high pressure pumps
- 100 bottles of two cycle oil
- 25 shovels and axes
- 20 first aid kits
- 4 large tents
- 40 ration packets

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Instructions

Once at location 'd', AB1 will contact AB rep at the JIC via LMR and note that they are sending a log req for additional fire suppression equipment in the form of an email.

LTE: Email
Compose an email using only your information noted in the 'Content' section . Do NOT include your actual Lat and Long in the email.

Once AB1 has provided the information, proceed to location 'e' for final inject. (Lat: 49.069664°; Long: -110.206616°)

From AB1-d location, travel west 4.8 km and south 1.9km. This will be the last reporting location for the experiment.

Inject Number	Day	Time	Controller	From
290	2	1255h CST 1155h MST	SK	SK1
Communication Method		**Contact Information**		**To**
Email				AB2

Detailed Information

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Back Story: In an effort to prevent the fire from crossing Hwy 21, SK outstations plan to dig a trench along the highway to contain the spread. SK1 is currently located approximately 20 km north of Willow Creek off of Hwy 21 (Lat: 49.124425° , Long: - 109.870008°)

The request consists of the following:
- 6 bulldozers
- 3 wildland fire tenders
- 6 500 gallon water tanks

Additional suppression equipment requested includes:
- 20 high pressure pumps
- 50 bottles of two cycle oil
- 25 shovels and axes
- 15 first aid kits

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Instructions

Once SK1 has arrived at location 'e', SK1 is to contact AB2 via LMR and notifiy them of an incoming request for some fire suppression equipment to come via email.

LTE: Email
Compose an email using only your information noted in the 'Content' section . Do NOT include your actual Lat and Long in the email.

Both SK1 and AB2 are to remain at location ‘e’ for the duration of the experiment.

Inject Number	Day	Time	Controller	From
300	2	1305h CST 1205h MST	AB	JIC AB
Communication Method		**Contact Information**		**To**
Email				AB1 & AB2

Detailed Information

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Back Story: The AB IC is working closely with the Logistics Section to ensure that approved resources are ordered and distributed accordingly based on the current situation. The Planning Section is busy developing maps, assessing damage, and projecting future needs. The logistical officer has requested an update from the Incident Commander on the tactical personnel status from each of the outstations.

When contacted by the JIC - AB rep, provide the information as per below:

AB1
Check in location: From Wild Horse, north on Hwy41 for 10km, east on Hwy 15 approximately 3.3 km (Lat: 49.069664, Long: -110.206616°) - location 'e'
Agency: Alberta ESRD
Supervisor Name: Joe Shoeless
Total # of assigned personnel (# and location): 8 at check-in
Next scheduled Shift change: 1600h
Total # of available (# and staging location): 10 available at staging in Wild Horse
Total # out of service: 2 from fatigue

AB2
Check in location: From Wild Horse, north on Hwy 23 for 3.2km, east on Hwy 12 for approximately 5.7 km, north on hwy 20 for 10.6km, right on dirt road and travel SE for approximately 5km. Turn right on dirt road and travel .5 km south (Lat: 49.082202°, Long: -110.068928°)
Agency: Boulder Mountain Contracting Ltd
Supervisor Name: Billy Bugle
Total # of assigned personnel (# and location): 6 at check-in location
Next scheduled Shift change: 1600h
Total # of available (# and staging location): 8 available at staging area at Hwy 41 and 501 junction
Total # out of service: 2 bulldozers, insufficient personnel to operate machinery

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Instructions

Once at location 'e', both AB1 and AB2 are to confirm their arrival via LMR with the AB rep at the JIC. The AB rep at the JIC will request a personnel report from both outstations. When requested to do so, confirm that you will send an email with the required information.

LTE: Email
Compose an email using only your information noted in the 'Content' section . Do NOT include your actual Lat and Long in the email. Request a confirmation of receipt using LMR or email.

This is the last reporting location for the experiment. The lead controller will announce to all that the experiment is over for the day and provide any remaining instructions to all players (e.g. complete questionnaire, etc).

Inject Number	Day	Time	Controller	From
310	2	1320h CST 1220h MST	SK	JIC SK
Communication Method		**Contact Information**		**To**
Email				SK1 & SK2

Detailed Information

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Back Story: The SK IC is working closely with the Logistics Section to ensure that approved resources are ordered and distributed accordingly based on the current situation. The Planning Section is busy developing maps, assessing damage, and projecting future needs. The logistical officer has requested an update from the Incident Commander on the tactical personnel status from each of the outstations.

When contacted by the JIC - SK rep, provide the information as per below:

SK1
Check in location: From Willow Creek , travel north on Hwy 21 approx 20km, left on dirt road and travel 1.6 km to farm, continue traveling West and South for approximately 3.25km (Lat: 49.124425°, Long:-109.870008°)
Agency: Silviculture Contractors
Supervisor Name: John Black
Total # of assigned personnel (# and location): 8
Next scheduled Shift change: 1500h
Total # of available (# and staging location): 10 available at staging in Govenlock
Total # out of service: 2 from fatigue

SK2
Check in location: From Willow Creek, travel north on Hwy 21 for 13.5 km, travel west approximately 19km. Turn right and travel north for 6km (Lat: 49.141054°, Long:-110.004602°)
Agency: Outland
Supervisor Name: Paul Tortiere
Total # of assigned personnel (# and location): 8 at call in location
Next scheduled Shift change: 1600h
Total # of available (# and staging location): 8 at Gravenlock
Total # out of service: 0

FOR EXERCISE *** FOR EXERCISE ***** FOR EXERCISE**

Instructions

SK1 should be at location 'e' and SK2 should be at location 'd'.
Once at your respective location, both SK1 and SK2 are to confirm their arrival via LMR with the

SK rep at the JIC. The SK rep at the JIC will request a personnel report from both outstations. When requested to do so, confirm that you will send an email with the required information.

LTE: Email
Compose an email using only your information noted in the 'Content' section . Do NOT include your actual Lat and Long in the email. Request a confirmation of receipt using LMR or email.

This is the last reporting location for the experiment. The lead controller will announce to all that the experiment is over for the day and provide any remaining instructions to all players (e.g. complete questionnaire, etc).

Annex C Call-In Locations

C.1 Alberta

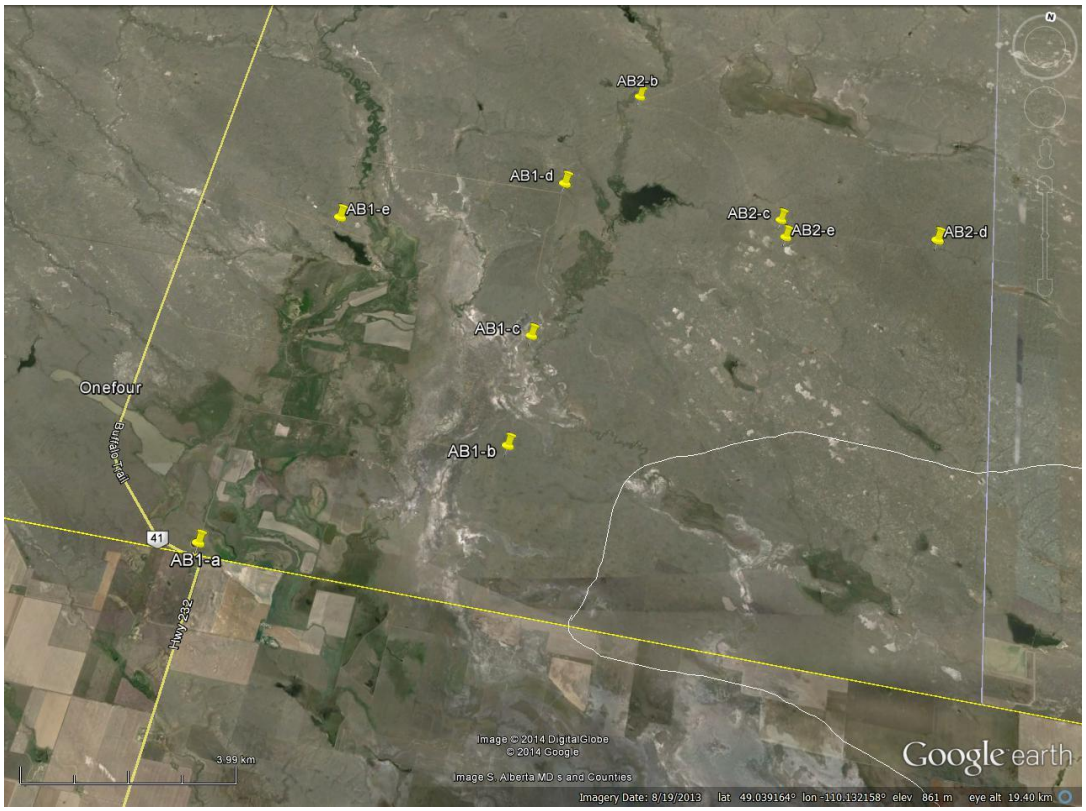

Figure C.1: *Map of AB Call-In Locations.*

Table C.1: *AB GPS Call-In Coordinates.*

Alberta Reporting Locations		
Location	**Lat**	**Long**
AB1-a	48.999558°	-110.217730°
AB2-a	49.193633°	-110.004883°
AB1-b	49.028000°	-110.140000°
AB2-b	49.111123°	-110.121381°
AB1-c	49.051000°	-110.140000°
AB2-c	49.086000°	-110.071000°
AB1-d	49.086237°	-110.139731°
AB2-d	49.086907°	-110.022783°
AB1-e	49.069664°	-110.206616°
AB2-e	49.082202°	-110.068928°

C.2 Saskatchewan

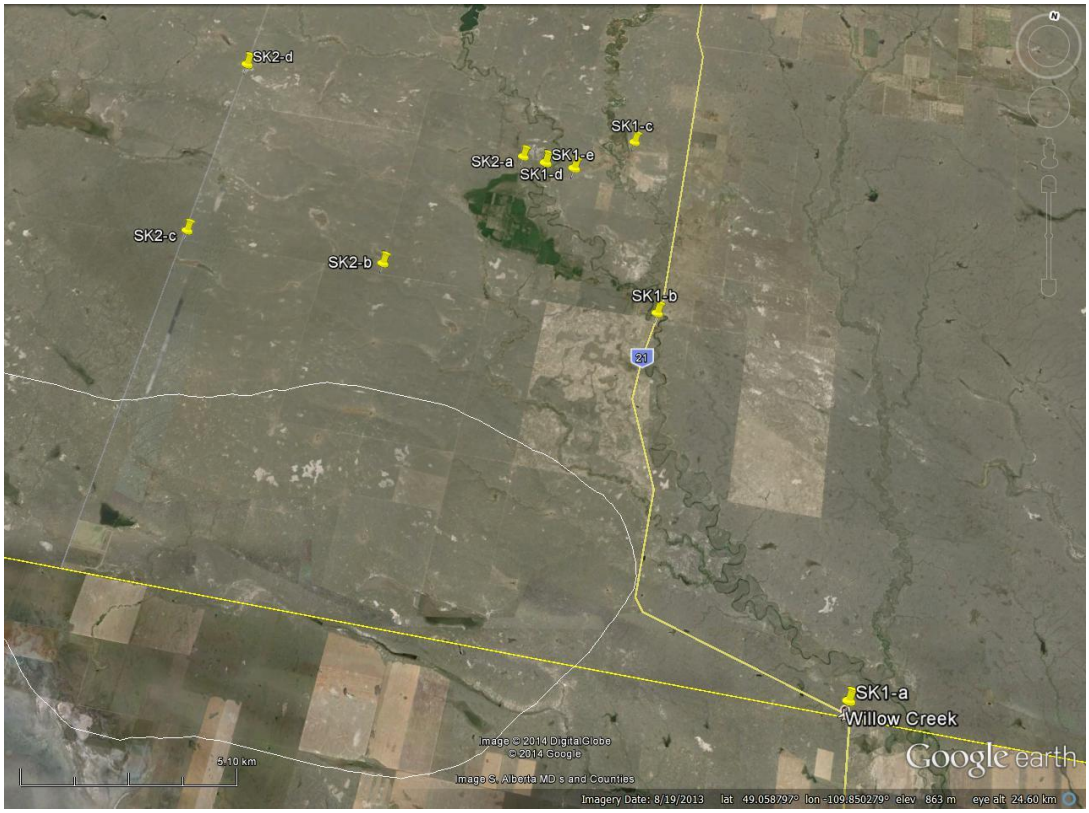

Figure C.2: *Map of SK Call-In Locations.*

Table C.2: *SK GPS Call-In Coordinates.*

Saskatchewan Reporting Locations		
Location	**Lat**	**Long**
SK1-a	49.001000°	-109.733000°
SK2-a	49.125586°	-109.879513°
SK1-b	49.085846°	-109.815349°
SK2-b	49.087000°	-109.924000°
SK1-c	49.135609°	-109.835661°
SK2-c	49.087000°	-110.004000°
SK1-d	49.124069°	-109.858002°
SK2-d	49.141054°	-110.004602°
SK1-e	49.124425°	-109.870008°
SK2-e	N/A	N/A

C.3 Montana

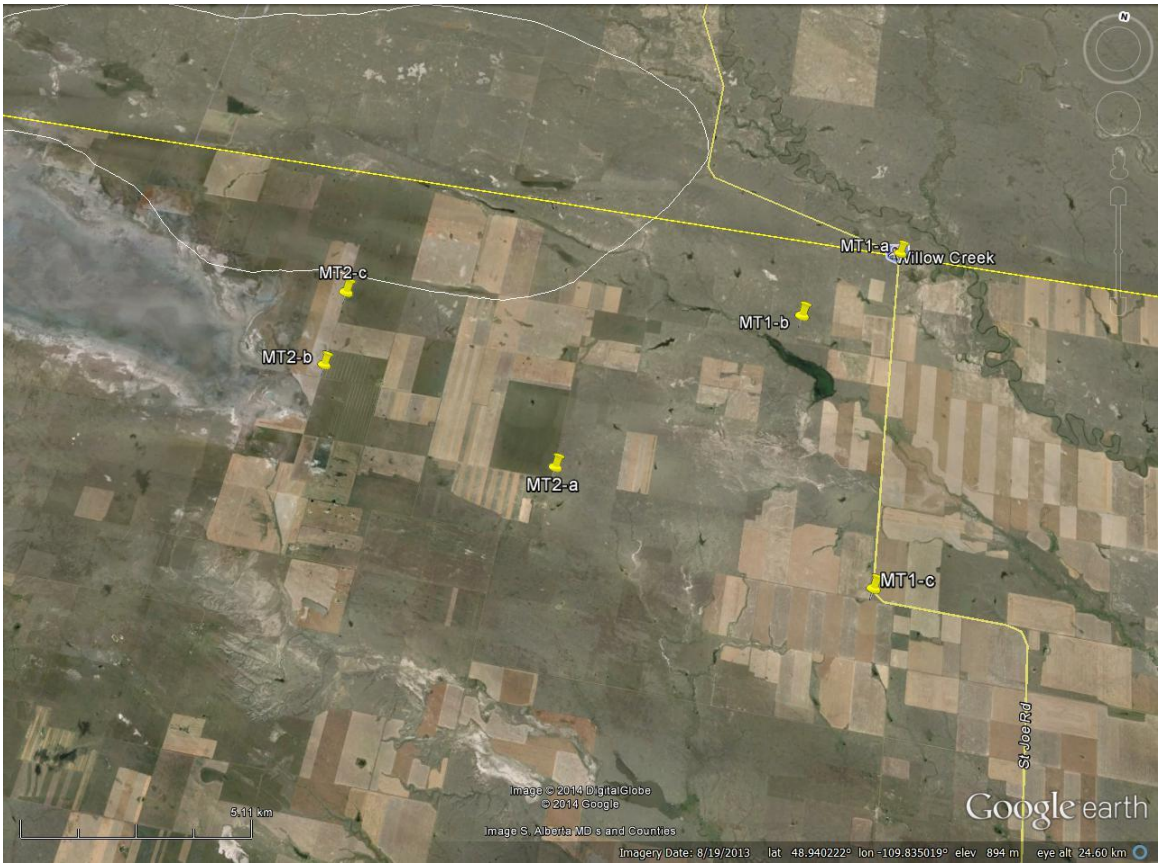

Figure C.3: *Map of MT Call-In Locations.*

Table C.3: *MT GPS Call-In Coordinates.*

Montana Reporting Locations		
Location	**Lat**	**Long**
MT1-a	48.998000°	-109.732000°
MT2-a	48.922139°	-109.841396°
MT1-b	48.976265°	-109.765180°
MT2-b	48.943000°	-109.929000°
MT1-c	48.934919°	-109.763355°
MT2-c	48.962628°	-109.929559°

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Annex D Situational Awareness Evaluation

Background

The table below will be used to record your situation awareness of events that are occurring during today's experiment.

Directions

After the first Situation Report is provided by the Joint Incident Command (JIC) please use the following scale to indicate your level of situation awareness for each statement below.

Write any notes that will help you remember the reason for your ratings.

Table D.1: *Situational Awareness Rating—LMR.*

Day 1 LMR **Circle below:** **JIC:** AB SK MT **Outstation:** AB1 AB2 SK1 SK2 MT1 MT2		**Read each statement**	**Please rate your situation awareness for each of the following statements by narking an 'X' in the box below.** **1=No SA** **2=Low SA** **3=Some SA** **4=Good SA** **5=High SA**				
No.	**Vignette**		**1**	**2**	**3**	**4**	**5**
1	Perimeter definition	Your understanding of the fire line perimeter in your own location.					
		Your understanding of the position of the overall fire line perimeter relative to outstations in the other affected regions.					
		Your expectation for how the fire line is likely to move based on the available information.					
		Your expectation for needing to request information to improve your situation awareness.					
2	Logistics request	Your understanding of how much progress has been made suppressing the fire line in your location.					
		Your understanding that additional fire suppression efforts will be needed to contain the fire.					

		Your expectation of whether the additional firefighting support will control the movement of the fire line.					
3	Lost hunter	Your understanding of the missing hunter's description?					
		Your present location relative to the area that the missing hunter was last seen?					
		Your expectation of the missing hunter's position to the overall fire line?					
4	Road closure	Your location relative to the road closure(s) that have been reported?					
		Your understanding of how the traffic in both directions will be affected in the areas with closed roads.					
		Your expectation that the road closure will affect your position.					
5	Weather Update	Your understanding of the current weather that is occurring in your location.					
		Your understanding of how the wind shift has shifted in SK and AB based on reports.					
		Your expectation for how the wind shift will affect your current position.					
6	Personnel Status	Your understanding of when the next shift change will occur at the outstations on either side of your location.					
		Your understanding of the distribution of personnel across the affected regions.					
		Your expectation for additional personnel will be needed in your location.					

Table D.2: *Situational Awareness Rating—LMR and LTE.*

Day 2 LMR+LTE **Circle below:** **JIC:** AB SK MT **Outstation:** AB1 AB2 SK1 SK2 MT1 MT2		**Read each statement**	**Please rate your situation awareness for each of the following statements by narking an 'X' in the box below.** **1=No SA** **2=Low SA** **3=Some SA** **4=Good SA** **5=High SA**				
No.	**Vignette**		**1**	**2**	**3**	**4**	**5**
1	Perimeter definition	Your understanding of the fire line perimeter in your own location.					
		Your understanding of the position of the overall fire line perimeter relative to outstations in the other affected regions.					
		Your expectation for how the fire line is likely to move based on the available information.					
		Your expectation for needing to request information to improve your situation awareness.					
2	Logistics request	Your understanding of how much progress has been made suppressing the fire line in your location.					
		Your understanding that additional fire suppression efforts will be needed to contain the fire.					
		Your expectation of whether the additional firefighting support will control the movement of the fire line.					
3	Lost hunter	Your understanding of the missing hunter's description?					
		Your present location relative to the area that the missing hunter was last seen?					
		Your expectation of the missing hunter's position to the overall fire line?					
4	Road closure	Your location relative to the road closure(s) that have been reported?					

		Your understanding of how the traffic in both directions will be affected in the areas with closed roads.					
		Your expectation that the road closure will affect your position.					
5	Weather Update	Your understanding of the current weather that is occurring in your location.					
		Your understanding of how the wind shift has shifted in SK and AB based on reports.					
		Your expectation for how the wind shift will affect your current position.					
6	Personnel Status	Your understanding of when the next shift change will occur at the outstations on either side of your location.					
		Your understanding of the distribution of personnel across the affected regions.					
		Your expectation for additional personnel will be needed in your location.					

Annex E Broadband LTE Metrics

The following set of qualitative metrics will be used to evaluate the impact of interoperable technology on information exchange during cross-border response to an emergency incident.

Table E.1: *LTE Impact on Interoperability Continuum Pillars.*

Item	Resiliency Indicator
Governance	
PSBN-G1	Critical information is shared between multiple stakeholder organizations (including cross provincial and national borders).
PSBN-G2	Leadership is accessible and can exchange information from multiple points via technology to exchange information.
PSBN-G3	Assessment and prioritization of response needs is performed and the output is shared.
PSBN-G4	Activate leadership support at relevant government levels.
PSBN-G5	All relevant Points of Contact to be included in the information sharing framework have been identified.
PSBN-G6	Provide feedback from information-gathering entities to the authorities to support decision-making.
PSBN-G7	Develop and communicate baseline indicators and warnings (suspicious information, community-based need) from information-gathering entities to the authorities.
PSBN-G8	Pre-identified mechanisms (MOUs, MAAs) to request assistance from other cities, counties and levels of government are in place.
PSBN-G9	Stakeholders can report indicators/warnings and information to lead emergency organization.
Standard Operating Procedures (SOPs)	
PSBN-S1	Clearly defined and documented mechanisms/processes/formats for sharing information
PSBN-S2	Steps required to transmit and receive information via technology are known and can be described by operators.
PSBN-S3	Information sources are obvious so that clarification is not required.
PSBN-S4	Processes for requesting information from other organizations are in place
PSBN-S5	Requests for additional resources and assets can be communicated with technology.

PSBN-S6	Communication protocols can be accommodated via technology
PSBN-S7	Technology permits multiple stakeholders to contribute information to status reports.
PSBN-S8	Processes or procedures can be used to disseminate information and products between emergency response organizations.
PSBN-S9	Establish and maintain communications with all responder organizations.
PSBN-S10	Establishment of Command is communicated to all emergency response organizations.
Technology	
PSBN-T1	Feedback and/or follow-up on information can be provided through the use of tools.
PSBN-T2	Information reflected the current status of the emergency.
PSBN-T3	Disseminate relevant information to other stakeholders in a usable and expected format.
PSBN-T4	Personnel understand how to use the technology to communicate with other responders.
PSBN-T5	Responders are able to send and receive data need to satisfy information requirements.
PSBN-T6	Amount of information sharing between emergency response organizations can be adjusted to accommodate dynamic response and recovery efforts.
PSBN-T7	Technology supports the exchange of useful/actionable information between emergency response organizations.
PSBN-T8	Technology supports the enhancement of situation awareness for responding units.
PSBN-T9	Technology enhances the timeliness for information sharing and supports decision making.
PSBN-T10	Mobile communications and data coverage is provided in rural areas affected by emergency event.
PSBN-T11	Communication systems support on-demand, real-time interoperable voice and data communication.
Training & Exercises	
PSBN-TEx1	Information exchange is enabled through the use of multiple technologies.
PSBN-TEx2	Evaluate, revise and prioritize tactics to meet incident developments

PSBN-TEx3	Information exchange reflects the time critical nature of emergency (i.e., bush fire)
PSBN-TEx4	Existing technology is interoperable with emerging technology
PSBN-TEx5	Processes for exchanging information are tested and refined.
PSBN-TEx6	Effectiveness of information exchange is augmented by the overlay of LTE on LMR.
PSBN-TEx7	Communications plans include all relevant data and voice communications that are available for the exercise.
PSBN-TEx8	Terminology is understood by senders and receivers
PSBN-TEx9	Information exchanges enhance ability to quickly detect changes in success of the response.
PSBN-TEx10	Unit with new information provides initial on-scene report to appropriate emergency response organization(s).
Usage	
PSBN-U1	Receipt of information is acknowledged using the same technology through which the information was received.
PSBN-U2	Situation awareness for key officials is enhanced through the overlay of LTE on LMR.
PSBN-U3	Provide geo-coded status report of community, homes and facilities identified as safe or unsafe to re-enter and re-occupy.
PSBN-U4	Plans address establishing key transportation avenues (e.g. best routes for personnel and equipment to access disaster locations, etc.).
PSBN-U5	Develop a common operating picture (COP) for ongoing status of recovery operations.
PSBN-U6	Deploy and transport resources to appropriate, pre-determined locations.
PSBN-U7	Issue corrective messages when errors are recognized in previous public announcements.
PSBN-U8	Horizontal information exchange requirements can be met.
PSBN-U9	Vertical information exchange requirements can be met.
PSBN-U10	Information bottlenecks created by communications process OR technology can be identified by emergency response organizations
PSBN-U11	Request for information issued and understood in a single transmission (JIC to outposts and vv.)

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Annex F Pre-Experiment Questionnaire

Background

This questionnaire will gather feedback related to your knowledge and experience using Land Mobile Radio (LMR) and the 4G Communications Protocol Long Term Evolution (LTE) of the Universal Mobile Telecommunications System (UMTS). We are particularly interested in the use of these technologies within the context of emergency response operations. This information will be used to support the conduct of the experiment.

This Questionnaire

Questionnaire will be available on 23 November, 2014.

The estimated time for completion is approximately 15 minutes. There is a status bar located at the top of the questionnaire which displays the percentage of questions that have been completed. You may complete the questionnaire in one or multiple sessions. Click on 'Exit and come back later' and you will return to the last page on which you entered data.

You can go back to previous pages in the questionnaire and update existing responses until you click 'Done' at the end of the questionnaire or until the questionnaire is closed. After the questionnaire is finished, you will not be able to re-enter it.

All data gathered will be treated anonymously in the final summary report.

Part One: Experience with Emergency Management

1. What is name of your organization? _____
2. What is your role within your organization? _____
3. What is your role within the PSBN experiment?
    a. Player (go to Q4)
    b. Exercise Design Team member or Controller (go to Q6)
    c. Observer (go to Q6)

4. What role has been assigned to you today?
    a. Joint Incident Command
    b. Alberta Fire Line Outstation
    c. Saskatchewan Fire Line Outstation

d. Montana Fire Line Outstation

5. In this role, what type of organization do you represent?
    a. Municipal
    b. Provincial/State
    c. Federal government
    d. Private industry

6. Does your organization respond to cross-border emergency events?
    a. Yes
    b. No
    c. Don't know

Part Two: Experience with Emergency Response

7. Does your organization typically rehearse multi-agency emergency responses?
    a. Yes
    b. No
    c. Don't know

8. Have you participated in a real or simulated emergency response to a bush fire?
    a. Yes
    b. No
    c. Don't know

9. What types of tools (hardware and software) would you likely use during an emergency response? (Select all that apply.)

Item	Tools	Mark an "X" if you would likely use this tool
1	Radios connected to a standalone radio system What frequency? _____	
2	Radios connected to an LMR system	

3	Telephone (1:1)	
4	Audio Teleconference	
5	Cell phone/ Blackberry	
6	Tablet	
7	Email/Text message	
8	Fax	
9	Video Teleconference	
10	Webcast/Webinar (e.g., Webex)	
11	Streaming Video (e.g., webcams)	
12	Web Portal (e.g., Sharepoint)	
13	Web-based EM software Name: _____	
14	Web-based incident management system Name: _____	
14	Office tools (MS Office)	
15	Government data sites (e.g., weather, maps)	
16	Social Networking sites (e.g., twitter, facebook, youtube, flickr, etc.)	
17	Other:_____	

10. What information would you likely need to send and/or receive during an emergency response? (Select all that apply.)

Item	Information Requirements	Mark an "X" if you would likely need to send and/or receive information
1	Location based data related to the affected area	
2	Maps with details about the emergency	

3	Sit Reps, briefings, field observations	
4	Confirmation of information that is sent and received	
5	Resources/Personnel Shift Changes	
6	Equipment requirements and location	
7	Shelters and refreshment locations	
8	Status of other emergency responders organizations	
9	Redundant communication systems	
10	Alerts and Notifications □Major fires □HAZMAT incidents □Severe weather □Criminal incidents with location □Major traffic accidents □Bridge/road closures □Flood locations □Shelters	
11	Resource deployment monitoring and tracking	
12	Hazard specific software applications	
13	Automated communications log	
14	Task tracking and after action reporting	
15	Mutual aid agreements	
16	Other:_____	

Part Three: Experience with Radio Usage

11. Have you used a stand-alone radio system during an emergency response prior to this experiment? A stand-alone radio system connects the members of one response organization to each other but not to other response organizations.

    a. Yes

    b. No

    c. Don't know

12. Have you used an LMR system for any reason prior to this experiment? An LMR system connects multiple response organizations to each other at the same time on a single radio channel.

    a. Yes

    b. No

    c. Don't Know

13. If you had the ability to talk to multiple response organizations on a single radio channel would this improve your situation awareness during an emergency response operation?

    a. Yes (Go to Q14)

    b. No (Go to Q15)

    c. Don't know (Go to Q15)

14. Would your improved situation awareness help you to perform your specific tasks during the response operation more effectively?

    a. Yes

    b. No

    c. Don't Know

15. If your radio system allowed you to talk to any response organization which organizations would you be likely to communicate with during an emergency response operation? (Select all that apply.)

    a. Only my own team members

    b. Teams within the affected area

    c. Teams within the affected province/state

    d. Teams between neighbouring provinces (e.g., Alberta and Saskatchewan) and states (Montana)

    e. Cross-border emergency response organizations (e.g., Wild Horse/Willow Creek, Havre)

    f. Other: _____

Part Four: Experience with LTE Usage

16. Have you used LTE technology to send or receive data (e.g., maps. equipment lists, locations, pictures) during an emergency response?

    a. Yes

    b. No

    c. Don't Know

17. What type of data would be useful to share via LTE during an emergency response organization? (Select all that apply.)

    a. Picture files

    b. Video files

    c. Streaming videos

    d. Emails

    e. Voice over IP (VOIP) such as Skype

    f. Teleconference

    g. Videoconference

    h. Other: _____

Part Five: Situation Awareness

18. Each statement below is related to the impact of sharing data on situation awareness and response co-ordination.

    The items in the table below complete the following statement: "Data sharing during an emergency response operation could…"

    Please read each item and select a rating that reflects how much you agree or disagree with each statement.

		5-Point Rating Scale				
#	**Statement** **Sharing data through LTE-enabled devices**	1	2	3	4	5
1	…could allow information to be exchanged with a wider community during the response phase.					
2	…could enhance situation awareness and decision making processes **within** my organization.					
3	... could enhance situation awareness and decision making **between** my organization and other organizations.					

4	… could enhance situation awareness and decision making between Canadian and American volunteer and disaster response organizations.					
5	… could reduce the time required to make decisions during the recovery operations.					
6	… could help describe the roles and responsibilities of each organization involved in the recovery phase.					
7	… could improve response co-ordination between organizations.					
8	… could enhance my understanding of the **initial** efforts to recover from the disaster.					
9	... could enhance my understanding of the **on-going** efforts to recover over time.					
10	… could improve the coordination of emergency response operations between organizations.					
11	… could reduce my workload during the emergency response operation.					
12	… could help my organization to manage risks related to planning and executing the response operations.					
13	… could help responders understand the Mutual Aid Assistance options that are available during an emergency.					

END OF QUESTIONS

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Annex G Post-Experiment Questionnaire Day 1

Background

This questionnaire will gather feedback related to your experience using Land Mobile Radio (LMR) at the end of Day 1 of the PSBN experiment. We are particularly interested in the type of information that you sent or received using LMR, during this day of the experiment and any information requirements that were not met.

This Questionnaire

The questionnaire will be available 24 November, 2014.

Estimated time for completion is approximately 20 minutes. There is a status bar located at the top of the questionnaire which displays the percentage of questions that have been completed. You may complete the questionnaire in one or multiple sessions. Click on 'Exit and come back later' and you will return to the last page on which you entered data.

You can go back to previous pages in the questionnaire and update existing responses until you click 'Done' at the end of the questionnaire or until the questionnaire is closed. After the questionnaire is finished, you will not be able to re-enter it.

All data gathered will be treated anonymously in the final summary report.

1. Where were you located during the PSBN experiment today?
    a. Joint Information Centre (JIC)
    b. Alberta Fire Line Outstation
    c. Saskatchewan Fire Line Outstation
    d. Montana Fire Line Outstation

2. What was your role in the experiment today?
    a. Player with a specific assigned role during the experiment (go to Q3)
    b. Team member who assisted in the design and execution of the experiment (go to Q3)
    c. Observer (go to Q14)

3. Did you use any communications protocols (e.g., Incident Command System – ICS) for sending or receiving information over your radio today?
    a. Yes (go to Q4)

b. No (go to Q5)

c. Don't know (go to Q5)

4. Please list the communications protocol you used.

   _____

5. What type of information did you send or receive today?

   a. Geographical coordinates (e.g., latitude, longitude)

   b. Local weather conditions (e.g., temp, precip, wind speed, wind direction)

   c. Local area description (e.g., terrain, buildings, residences, farms, animals, water sources, other natural resources)

   d. Fire line description

   e. Missing person description

   f. Road closure details

   g. Status updates and/or briefings

   h. Personnel updates (e.g., requests, locations, shift change, crew size)

   i. Equipment updates (e.g., requests, locations)

   j. Alerts and notifications

   k. Other: _____

6. How easy or difficult was it to send or receive the information?

   a. Extremely Difficult

   b. Difficult

   c. Neutral

   d. Easy

   e. Extremely Easy

7. Did you need to CLARIFY your understanding of any details?

   a. Yes (go to Q8)

   b. No (go to Q9)

   c. Don't know (go to Q9)

8. Please list the type of information that needed to be CLARIFIED.

_____

9. Did any of the information needed to be REPEATED/RE-SENT so that the person receiving the message got all the information.

   a. Yes (go to Q10)

   b. No (go to Q11)

   c. Don't know (go to Q11)

10. Please list the type of information that needed to be REPEATED so that the receiver was able to get all the details.

    _____

11. Was there any information that you NEEDED but could not get OR that was difficult to get?

    a. Yes (go to Q12)

    b. No (go to Q13)

    c. Don't know (go to Q13)

12. Please list the type of information that you NEEDED but could not get OR was difficult to get.

    _____

13. The study team is interested in gathering your feedback on the "workload" you experienced during the experiment. There are 6 workload dimensions for this experiment.

    Please read each statement click on the button that reflects your rating for each workload dimension. A rating of '1' reflects a low demand and a rating of '5' reflects a high demand for the dimension. A rating of '3' reflects a moderate level of demand.

		5-Point Rating Scale				
#	**Workload Dimension**	1	2	3	4	5
1	**Mental Demand:** How much mental and perceptual activity was required (e.g., thinking, deciding, calculating, remembering, looking, searching, etc.) for the task (easy or demanding, simple or complex, exacting or forgiving)?					
2	**Physical Demand:** How much physical activity was required (e.g., pushing, pulling, turning, controlling, activating, etc.) for the task (easy or demanding, slow or brisk, slack or strenuous, restful or laborious)?					
3	**Temporal Demand:** How much time pressure did you feel due to the rate or pace at					

	which the tasks occurred (pace was slow and leisurely or rapid and frantic)?					
4	**Performance Demand:** How successful do you think you were in accomplishing the goals of the tasks assigned to you?					
5	**Effort Demand:** How hard did you have to work (mentally and physically) to accomplish your level of performance?					
6	**Frustration Demand:** How insecure, discouraged, irritated, stressed and annoyed versus secure, gratified, content, relaxed and complacent did you feel during the task?					

14. How effective do you think the LMR system was for sending or receiving information during today's experiment?

    a. Extremely Effective

    b. Very Effective

    c. Neutral

    d. Slightly Effective

    e. Not at all Effective

15. How would your rate your overall situation awareness based on the information that was sent or received during today's experiment?

    a. Excellent

    b. Very Good

    c. Satisfactory

    d. Poor

    e. Very Poor

END OF QUESTIONS

Annex H Post-Experiment Questionnaire Day 2

Background

This questionnaire will gather feedback related to participating in the PSBN experiment and the use of Land Mobile Radio (LMR) and Long Term Evolution (LTE) of the Universal Mobile Telecommunications System (UMTS) to support emergency response operations related to a bush fire.

This Questionnaire

The questionnaire will be available on 25 November, 2014.

The estimated time for completion is approximately 20 minutes. There is a status bar located at the top of the questionnaire which displays the percentage of questions that have been completed. You may complete the questionnaire in one or multiple sessions. Click on 'Exit and come back later' and you will return to the last page on which you entered data.

You can go back to previous pages in the questionnaire and update existing responses until you click 'Done' at the end of the questionnaire or until the questionnaire is closed. After the questionnaire is finished, you will not be able to re-enter it.

All data gathered will be treated anonymously in the final summary report.

Part One: Experience during the Experiment

1. Where were you located during the experiment today?
    a. Joint Information Centre (JIC)
    b. Alberta Fire Line Outstation
    c. Saskatchewan Fire Line Outstation
    d. Montana Fire Line Outstation

2. What was your role in the experiment today?
    a. Player (go to Q3)
    b. Exercise Design Team member or Controller (go to Q3)
    c. Observer (go to Q20)

3. Did you use any communications protocols (e.g., Incident Command System – ICS) for sending or receiving information over your devices today?

a. Yes (go to Q4)

b. No (go to Q5)

c. Don't know (go to Q5)

4. Please list the communications protocol you used.

   _____

5. Which of the following technologies did you use?

   a. LMR only (Go to Q6)

   b. Both LMR and LTE (Go to Q8)

6. How effective do you think the LMR system is for sending or receiving information during an emergency response to a bush fire?

   a. Extremely Effective

   b. Very Effective

   c. Neutral

   d. Slightly Effective

   e. Not at all Effective

7. What type of information did you send or receive today? (Go to Q10)

   a. Geographical coordinates (e.g., latitude, longitude)

   b. Local weather conditions (e.g., temp, precip, wind speed, wind direction)

   c. Local area description (e.g., terrain, buildings, residences, farms, animals, water sources, other natural resources)

   d. Fire line description

   e. Missing person description

   f. Road closure details

   g. Status updates and/or briefings

   h. Personnel updates (e.g., requests, locations, shift change, crew size)

   i. Equipment updates (e.g., requests, locations)

   j. Alerts and notifications

   k. Other: _____

8. How effective do you think the combination of the LMR and LTE systems are for improving your understanding of an emergency response?

    a. Extremely Effective

    b. Very Effective

    c. Neutral

    d. Slightly Effective

    e. Not at all Effective

9. What type of information did you exchange today? (Go to Q10)

    a. Geographical coordinates (e.g., latitude, longitude)

    b. Local weather conditions (e.g., temp, precip, wind speed, wind direction)

    c. Local area description (e.g., terrain, buildings, residences, farms, animals, water sources, other natural resources)

    d. Fire line description

    e. Missing person description

    f. Road closure details

    g. Status updates and/or briefings

    h. Personnel updates (e.g., requests, locations, shift change, crew size)

    i. Equipment updates (e.g., requests, locations)

    j. Alerts and notifications

    k. Maps with details about the emergency

    l. Emails with status updates

    m. Emails with attachments

    n. Picture files

    o. Video files

    p. Information via VOIP (e.g. Skype)

    q. Information via videoconference

    r. Other: _____

10. How easy or difficult was it to send or receive the information?

    a. Extremely Difficult

b. Difficult

c. Neutral

d. Easy

e. Extremely Easy

11. Did you need to CLARIFY your understanding of any details when using the LTE?

    a. Yes (go to Q13)

    b. No (go to Q14)

    c. Don't know (go to Q14)

12. Please list the type of information that needed to be CLARIFIED.

    _____

13. Did any of the information need to be REPEATED/RE-SENT when using LTE?

    a. Yes (go to Q15)

    b. No (go to Q16)

    c. Don't know (go to Q16)

14. Please list the type of information that needed to be REPEATED when using LTE.

    _____

15. Was there any information that you NEEDED but could not get OR that was difficult to get?

    a. Yes (go to Q17)

    b. No (go to Q18)

    c. Don't know (go to Q18)

16. Please list the type of information that you NEEDED.

    _____

17. Was your situation awareness sufficient during the event today?

    a. Yes (go to Q20)

    b. No (go to Q19)

    c. Don't know (go to Q20)

18. Please indicate how your situation awareness could be improved?

    _____

Part Two: LMR and LTE Usage

19. To what extent did the sharing of data enhance situation awareness compared to voice only capability?

    a. Not at all Enhanced

    b. Slightly Enhanced

    c. Neutral

    d. Greatly Enhanced

    e. Extremely Enhanced

20. What was the most USEFUL way to send or receive information during today's experiment?

    a. Voice only

    b. Data only

    c. Both voice and data

21. To what extent were the LMR and/or LTE devices easy or difficult to use?

    a. Extremely Difficult

    b. Difficult

    c. Neutral

    d. Easy

    e. Extremely Easy

22. The study team is interested in gathering your feedback on the "workload" you experienced during the experiment. There are 6 workload dimensions for this experiment.

    Please read each statement and click on the button that reflects your rating for each workload dimension.

    A rating of '1' reflects a low demand and a rating of '5' reflects a high demand for the dimension. A rating of '3' reflects a moderate level of demand.

#	Workload Dimension	5-Point Rating Scale				
		1	2	3	4	5
1	**Mental Demand:** How much mental and perceptual activity was required??					
2	**Physical Demand:** How much physical activity was required?					
3	**Temporal Demand:** How much time pressure did you feel?					
4	**Performance Demand:** How successful do you think you were in accomplishing your tasks?					
5	**Effort Demand:** How hard did you have to work (mentally and physically)?					
6	**Frustration Demand:** How stressed/annoyed versus relaxed/calm did you feel during the task?					

Part Three: Situation Awareness

23. Compared to using only the LMR system please indicate the extent to which sharing information through the Multi-Agency Situation Awareness System (MASAS) improved your situation awareness during the experiment.

    a. Greatly improved

    b. Very Improved

    c. Neutral

    d. Slightly improved

    e. Not at all improved

24. Please indicate the extent to which having access to your OWN email account improved your ability to share information during the experiment.

    a. Greatly improved

    b. Very Improved

    c. Neutral

    d. Slightly improved

    e. Not at all improved

25. Please indicate the extent to which having access to each of the following improved (or would improve) your situation awareness during the experiment.

    A rating of '1' indicates 'Completely Disagree' and a rating of '5' indicates 'Completely Agree'. A rating of '3' reflects a 'Neutral' response.

		5-Point Rating Scale				
#	**Statement**	1	2	3	4	5
1	Picture files					
2	Video files					
3	Streaming videos					
4	Your own email account					
5	Emails with embedded images					
6	Emails with attachments					
7	Voice over IP (VOIP) such as skype					
8	Teleconference					
9	Videoconference					

26. Each statement below is related to the impact of sharing data on situation awareness and response co-ordination. Please use the 5-point rating scale to indicate the extent to which you agree or disagree with each statement.

    A rating of '1' indicates 'Completely Disagree' and a rating of '5' indicates 'Completely Agree'. A rating of '3' reflects a 'Neutral' response.

		5-Point Rating Scale				
#	**Statement** **Compared to using LMR only, sharing data through the LTE**	1	2	3	4	5
1	…allowed information to be exchanged with a wider community during the response phase.					
2	…enhanced situation awareness and decision making processes **within** my organization.					
3	...enhanced situation awareness and decision making **between** my organization and other organizations.					
4	…enhanced situation awareness and decision making between Canadian and American volunteer and disaster response organizations.					
5	…reduced the time required to make decisions during the recovery operations.					
6	…helped describe the roles and responsibilities of each organization involved in the recovery phase.					
7	…improved response co-ordination between organizations.					
8	…enhanced my understanding of the **initial** efforts to recover from the disaster.					
9	...enhanced my understanding of the **on-going** efforts to recover over time.					
10	…improved the coordination of emergency response operations between organizations.					

11	…reduced my workload during the emergency response operation.					
12	…helped my organization to manage risks related to planning and executing the response operations.					

27. Did the experiment meet your expectations for investigating the use of interoperable technology during an emergency response to a bush fire?

    a. Yes

    b. No

    c. Don't know

28. Do you have any suggestions for improvements that could be made in future experiments?

    a. Yes

    b. No

    c. Don't know

END OF QUESTIONS

List of Symbols/Abbreviations/Acronyms/Initialisms

AFRRCS	Alberta First Responder Radio Communications System
BTB	Beyond the Border
CANUS	Canada–US
CAP	Common Alerting Protocol
CAUSE	Canada–US Enhanced Resiliency
CIWG	Communications Interoperability Working Group
COG	Common Alerting Group
ConOps	Concept of Operation
COP	Common Operating Picture
CSS	Centre for Security Science
DHS	Department of Homeland Security
DHS S&T	Department of Homeland Security Science & Technology
DRDC	Defence Research and Development Canada
EEI	Essential Elements of Information
EM	Emergency Management
EMA	Emergency Management Agency
EMAC	Emergency Management Assistance Compact
EOC	Emergency Operations Centre
EOS	EMAC Operating System
FEMA	Federal Emergency Management Agency
FRG	First Responders Group
GOC	Government Operations Centre
IOG	Interoperability Gateway
MASAS	Multi-Agency Situational Awareness System
MASS	Mutual Aid Support System
MRPs	Mission Ready Packages
MSRS	Montana Statewide Radio System
NASA TLX	National Aeronautics and Space Administration Task Load Index
NEMA	National Emergency Management Association
NGOs	Non-Governmental Organizations

NH	New Hampshire
NIMS	National Incident Management System
P/T	Provincial/Territorial
PPSTN	Provincial Public Safety Telecommunications Network
PSAF	Public Safety Architecture Framework
PSBN	Public Safety Broadband Network
PSC	Public Safety Canada
S&T	Science and Technology
SA	Situational Awareness
SMS	Short Message Service
SOPs	Standard Operating Procedures
SoS	System-of-Systems
SoW	System-on-Wheels
SQL	Structured Query Language
US	United States
VoIP	Voice over IP
VOST	Virtual Operations Support Team
vUSA	Virtual USA

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On December 7, 2011, President Obama and Prime Minister Harper released the Beyond the Border (BTB) Action Plan, which set out joint priorities and specific initiatives for cross-border collaboration. A common goal within this partnership focused on enhancing the coordination of responses during binational disasters. Specifically, the plan states that Canada and the United States will *"focus on cross-border interoperability as a means of harmonizing cross-border emergency communications efforts."*

The Canada–US Enhanced Resiliency (CAUSE) experiment series addresses this binational goal and hypothesizes that technologically enhanced multi-agency and cross-border Situational Awareness (SA) measurably improves regional resilience.

The third experiment in this series, CAUSE III was jointly sponsored by the US Department of Homeland Security (DHS) Science and Technology Directorate (S&T) First Responders Group (FRG), the Defence Research and Development Canada (DRDC) Centre for Security Science (CSS), and Public Safety Canada (PS Canada). This cross-border initiative consisted of two experiments, performed in November 2014 based on two disaster scenarios—the first a Northeast hurricane, and the second a rangeland brush fire in the Western Plains, affecting Alberta, Saskatchewan and Montana.

In the case of the Western scenario, which is the focus of this report, emergency management agencies in Saskatchewan, Alberta and Montana worked together to assess the effectiveness of Land Mobile Radio (LMR) and Long Term Evolution (LTE) broadband wireless technologies for emergency communications. The scenario first focused on assessing the ability to interconnect Saskatchewan and Alberta's provincial LMR radio systems with the Montana statewide radio system across jurisdictions in response to a simulated remote brush fire spanning both sides of the border. In order to further enhance communications, the operational efficiency of using deployable LTE networks to provide interoperable communications and introduce many feature rich applications was also evaluated.

The interoperable technology enhanced situational awareness of the multi-jurisdictional response organizations by allowing all response organizations to exchange information in real-time. The report describes the impact of the interoperable technologies on emergency operations, provides guidance related to the types of information that are most useful during a remote bush fire emergency and identifies benefits and challenges with introducing complex data sharing applications to emergency responders.

This document reports on the design, execution and findings of the two-day experiment concerned with the Western scenario. Recommendations, at the end of the report, are derived from the findings and propose actions to further push the envelope of communications interoperability between Canada and the US.

Le 7 décembre 2011, le président Obama et le premier ministre Harper ont rendu public le Plan d'action « Par-delà la frontière », qui énonce les priorités communes et les initiatives

particulières de collaboration transfrontalière. L'un des objectifs communs qui sous-tendent ce partenariat est d'améliorer la coordination des interventions lors de catastrophes binationales. Plus précisément, le plan indique que le Canada et les États-Unis doivent « *mettre l'accent sur l'interopérabilité transfrontalière comme moyen d'harmoniser les efforts de communication en situation d'urgence.* »

L'Expérience canado-américaine de renforcement de la résilience (CAUSE) vise cet objectif binational et pose l'hypothèse selon laquelle une meilleure connaissance de la situation interorganisationnelle et transfrontalière, à l'aide d'outils technologiques, accroîtrait sensiblement la résilience régionale.

La troisième expérience de cette série, CAUSE III, a été parrainée par le Groupe des premiers intervenants de la Direction de la science et technologie du département de la Sécurité intérieure des É.-U., le Centre des sciences pour la sécurité de Recherche et développement pour la défense Canada (RDDC CSS) et Sécurité publique Canada. Cette initiative transfrontalière comportait deux expériences, effectuées en novembre 2014, sur deux scénarios de catastrophe – un ouragan dans le nord-est et un feu de broussailles dans les pâturages des plaines de l'Ouest touchant l'Alberta, la Saskatchewan et le Montana.

Dans le cas du scénario dans l'Ouest, sur lequel est fondé le présent rapport, les organismes de gestion des urgences de la Saskatchewan, de l'Alberta et du Montana ont collaboré afin d'évaluer l'efficacité des technologies sans fil à large bande d'évolution à long terme (LTE) et de la radio mobile terrestre (RMT) dans le cadre des communications d'urgence. Le scénario était d'abord axé sur l'évaluation de la capacité d'interconnecter les systèmes RMT provinciaux de la Saskatchewan et de l'Alberta avec le système radio du Montana entre les administrations en vue d'intervenir dans le cas d'un feu de broussailles fictif en région éloignée qui s'étend des deux côtés de la frontière. Afin d'améliorer davantage les communications, on a également évalué l'efficacité opérationnelle des réseaux LTE déployables pour assurer l'interopérabilité des communications et intégrer plusieurs applications riches en fonctionnalités.

On a pu accroître la connaissance de la situation des forces intergouvernementales d'intervention au moyen de la technologie interopérable en permettant à l'ensemble des forces d'intervention de partager des renseignements en temps réel. Le rapport décrit l'incidence des technologies interopérables sur les opérations d'urgence, fournit des directives concernant les types de renseignements les plus utile lors d'un feu de broussailles en région éloignée et énonce les avantages et les défis relatifs à l'intégration d'applications complexes de partage des données au sein des forces d'intervention en cas d'urgence.

Ce document traite de la conception, de l'exécution et des résultats de l'expérience de deux jours portant sur le scénario dans l'Ouest. À la fin du rapport, on énumère des recommandations découlant des résultats et on propose des mesures pour repousser les limites de l'interopérabilité des communications entre le Canada et les États-Unis.

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Wireless; broadband; experiment; Long Term Evolution (LTE); Land Mobile Radio (LMR)