Radio Over Wireless Broadband Pilot

Project Report

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Office for Interoperability and Compatibility

Command, Control and Interoperability Division

Science and Technology Directorate

U.S. Department of Homeland Security

1 Introduction

OIC Background

The U.S. Department of Homeland Security (DHS) established the Office for Interoperability and Compatibility (OIC) in 2004 to strengthen and integrate interoperability and compatibility efforts to improve local, tribal, state, and Federal emergency response and preparedness. Housed within the Command, Control and Interoperability Division, OIC helps coordinate interoperability efforts across DHS. OIC programs and initiatives address critical interoperability and compatibility issues. Priority areas include communications, equipment, and training.

Defining the Problem

Emergency responders—police officers, fire personnel, and emergency medical services—need to share vital voice and data information across disciplines and jurisdictions to successfully respond to day-to-day incidents and large-scale emergencies. Unfortunately, for decades, inadequate and unreliable communications have compromised their ability to perform mission-critical duties. Responders often have difficulty communicating when adjacent agencies are assigned to different radio bands, use incompatible proprietary systems and infrastructure, or lack adequate standard operating procedures and effective multi-jurisdictional, multi-disciplinary governance structures.

In today's environment, emergency responders typically use hand-held or vehicle-mounted land mobile radios (LMRs) to exchange data and voice communications across disciplines and jurisdictions. But as emergency responders gain access to wireless broadband connections, they are increasingly using commercial cell phone networks to communicate as well.

Because LMR and broadband systems serve specific and different needs, they were not designed to communicate with each other. The lack of interoperability between these systems can compromise emergency response operations when emergency responders using a broadband system are unable to communicate with responders employing an LMR system.

To address the capability gap between LMR and broadband systems, OIC launched the Radio Over Wireless Broadband (ROW-B) pilot project in early 2007. The pilot project served to test new products and technologies in the field for possible use by emergency responders to improve interoperability.

2 Project Overview

2.1.1 Application

Based upon needs identified by the emergency response community, the following application functionalities were considered critical components of a new technology solution:

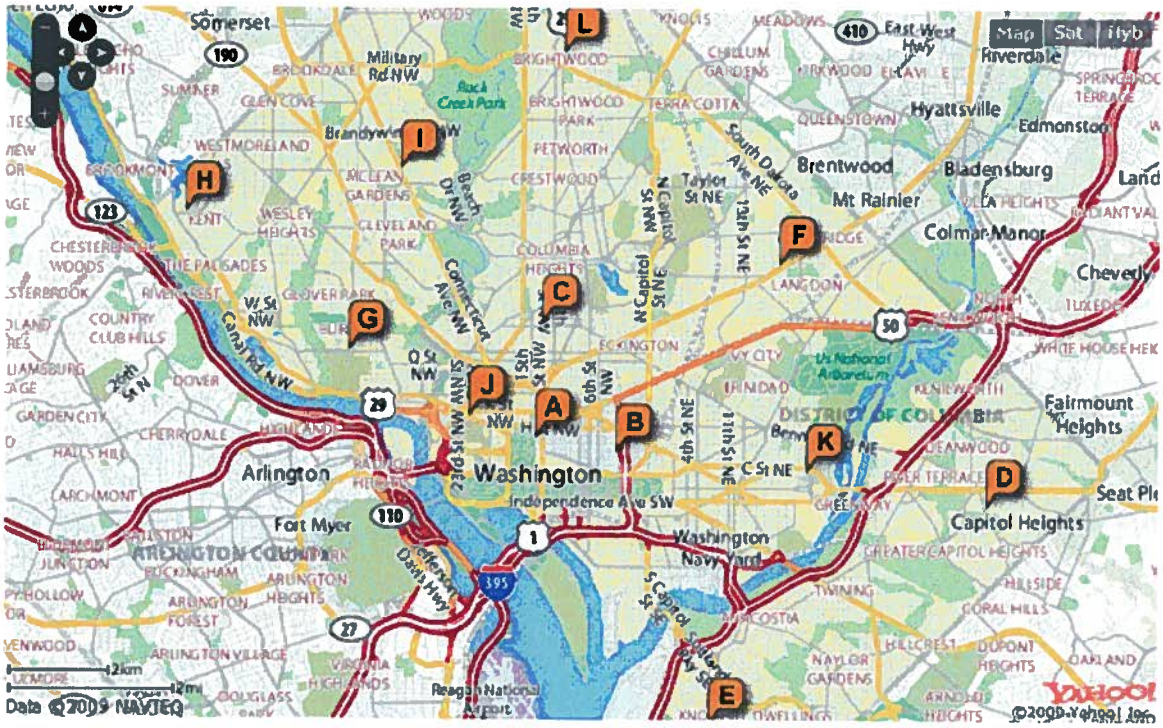
- Support Push-to-Talk (PTT) over Cellular
- Provide online presence indication
- Provide geographic information system location
- Work over wireless broadband technology (cellular-, Wi-Fi- or WiMAX-based)

The ROW-B team's research concluded that a technology solution demonstrated by Clarity Communications Systems, Inc. would meet these requirements. Their location-based software offered a visual interface allowing PTT users to communicate directly with each other and see the presence of other users on the network, while allowing for the interoperability of LMRs and broadband equipment.

2.1.2 Location and Spectrum

The ROW-B team opted to use the existing Washington, D.C. public safety broadband network for the pilot as it provided the only operational 700 MHz broadband network at the time. The network had 12 sites throughout the District of Columbia (see figure 1) and was based upon Evolution-Data Optimized (EVDO) technology. The FCC granted a temporary license to use the upper 700 MHz band for one EVDO channel that was not being commercially used. This provided an opportunity to examine the performance of the 700 MHz spectrum band and how well it met the requirements of responders.

Figure 1 – 700 MHz EVDO Site Locations



3 Technical Overview

3.1 ROW-B Deployment

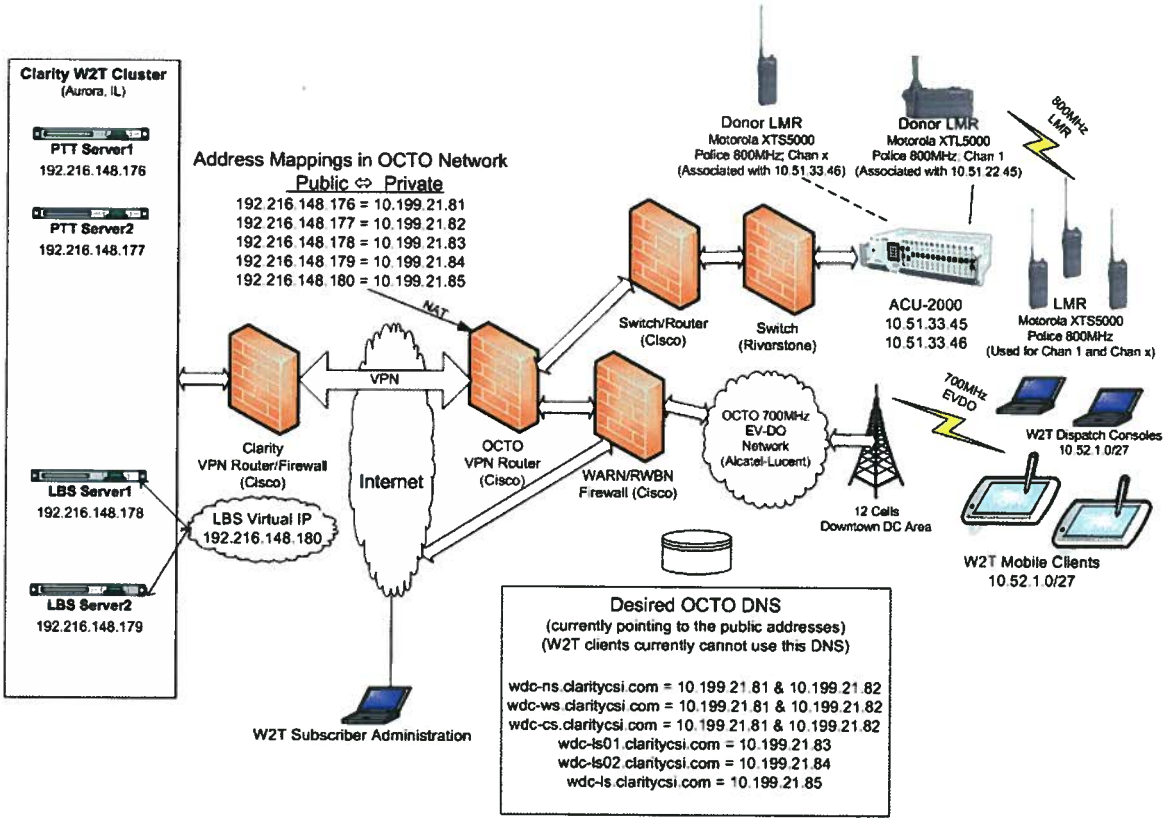
The ROW-B network can be deployed in one of two ways.

1. Hosted Solution: The servers for the Clarity Where2Talk, comprised of PTT and location-based services, are located remotely in a hosting facility. The clients access them via the Internet from remote locations.

2. Local Solution: The Clarity Where2Talk servers are physically located in the same network or facility as the LMR and/or broadband network.

The Clarity servers were physically hosted in Clarity's Aurora, Illinois, facility. Figure 3 shows how within the District of Columbia's Office of the Chief Technology Officer (OCTO) Internet Protocol (IP) network, the ROW-B team had to map the public IP addresses and domain name system (DNS) names of the servers to an OCTO private IP address. On each Windows XP client, the ROW-B team had to edit the "/etc/hosts" file and create a route for any traffic from the registered DNS name to the OCTO private IP address. In a hosted situation, this is the most viable solution to ensure secure communications across emergency response networks.

Figure 2 – Detailed System Diagram



A key feature of ROW-B is its application layer software, which allows for very fast call setup times and excellent in-call performance. This improved functionality can be partially attributed to the various signaling, call processing, and voice packets that are spread across several dedicated ports. This setup creates a much better user experience and robust network by reducing network congestion and collisions.

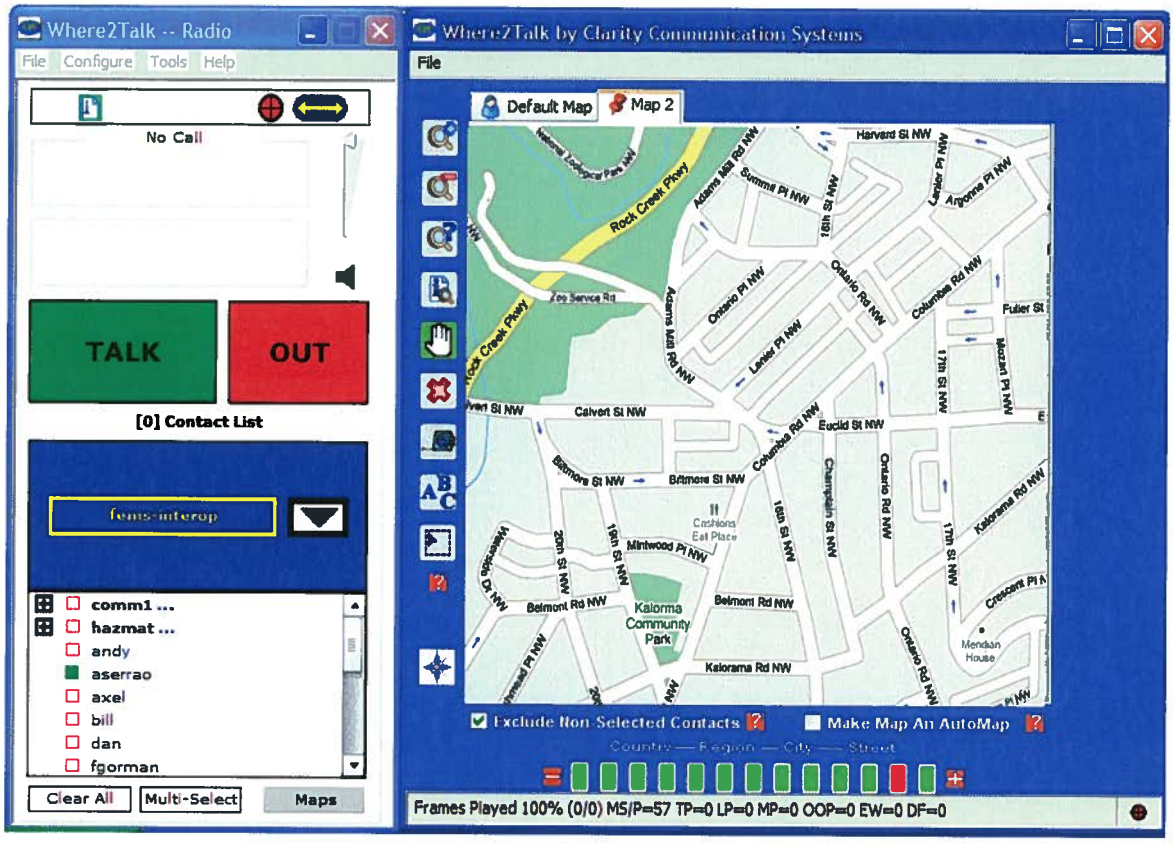
3.2 User Interface

The ROW-B team was approached by Clarity for assistance with the design of a commercial-grade graphical user interface (GUI) for Windows platforms. The user interface design implemented several key features:

- Status indicators for global positioning system (GPS) and server connection
- Large PTT buttons for use by thumb or finger
- A contact list showing the online presence indication of users
- Differentiation of LMR talk groups and broadband chat groups
- Simple map navigation

Figure 5 shows the end result of the GUI development for the Ultra Mobile Personal Computer platform.

Figure 3 - ROW-B User Interface



4 Demonstrations

The ROW-B team demonstrated ROW-B as a technology platform at several conferences, including the DHS Science and Technology Directorate's Stakeholders East Conference and the Association of Public-

Safety Communications Officials (APCO) 2008 convention. These demonstrations illustrated the technology's portability and ability to communicate in poor coverage areas.

The ROW-B technology was also demonstrated at a press event on Capitol Hill in Washington, D.C. OIC, along with Washington, D.C. fire and emergency medical services and Clarity, presented the technology through a panel discussion and demonstration. The event demonstrated the integration of the District's 700 MHz and LMR networks.

These multiple demonstrations illustrated the strong performance of the technology. Unlike other technology solutions, ROW-B transmits LMR traffic over the Internet. This is a paradigm shift in the way voice communications are typically handled for municipalities. Because of these demonstrations, other agencies had the opportunity to view ROW-B capabilities and possible benefits for their community.

5 Lessons Learned Summary

The following points summarize the lessons learned from the ROW-B project:

- Access Technology—The 700 MHz spectrum is the best broadband spectrum available to the emergency response community due to its superior propagation characteristics and available bandwidth. The Washington, D.C. 700 MHz network showed good in-building penetration but the lack of sites for the given coverage area did not provide an "apples-to-apples" comparison with commercial cellular networks. The network was very robust and the ROW-B team learned how existing public safety sites and infrastructure could be used for a broadband system. The team observed the necessity to train city radio and information technology operations personnel to operate a broadband network as these personnel had to be outsourced, even in the large-city government of Washington, D.C. From this experience, the team learned that when choosing a municipality with which to partner, it is important to pursue an extensive due-diligence process to find out the coverage and capabilities of their systems.
- Subscriber Units—Having only a single source for the EVDO subscriber equipment was difficult when problems arose because other vendors were not available to spur competition and problem solving. With less than 400 devices in existence, any changes to the software or hardware were nearly impossible. Identification of several different compatible subscriber units is imperative in a project such as this.
- Testing QoS—The ability to test Quality of Service (QoS) and priority features was initially a goal of the ROW-B team. However, later in the project the team realized that the subscriber units and Packet Data Serving Nodes were not capable of supporting this testing. As emergency response agencies deploy their own networks, it will become very important to understand how these end-to-end features interwork with all the nodes of the network. The team has an understanding now of the difficulty in deploying QoS in a mobile broadband network.
- Location Tracking—Typical cellular systems use network assisted positioning known as Assisted GPS (AGPS). The Washington, D.C. network was a packet-data only network and AGPS had not been deployed. Additionally, the supplied wireless cards did not support AGPS. These problems required greater engineering efforts to use standalone GPS and caused the project to use specific GPS-enabled devices.

6 Conclusion

As an early deployment of cutting-edge technologies, ROW-B can provide emergency responders and the Federal agencies working on interoperability matters with an accurate assessment of new products' functionality. By demonstrating interoperability between broadband technologies and an existing LMR network, ROW-B equips localities with needed information to integrate new technologies with existing emergency response communications systems. The ROW-B technology has been successfully piloted in the Washington, D.C. area. OIC is currently investigating other possible pilot locations to test the solution's viability in various environments.