Mobile Digital Systems, Inc.

Intelligent Surveillance Solutions

Mobile Digital Systems, Inc.

WHITE PAPER

First Responders Systems: Why Wireless and Which to Use

July 20, 2007

Mobile Digital Systems, Inc.
Annapolis, MD 21401
O: (301) 576-1866
Toll Free: (800) 303-1152
F: (410) 982-6604
www.mobiledigitalsecurity.com
command@mobiledigitalsecurity.com

Introduction

The objective of this White Paper is to present information on the use of wireless technologies by First Responders, applications, limitations, and how systems by Mobile Digital Systems, Inc. implement wireless technologies to provide First Responders with tools to help perform their mission: to protect our communities and to protect our First Responders.

Several issues affect First Responders' use of technologies, including wireless, in performing their mission of protecting our communities. These issues include: timely information for decision and action, complexity, mobility, and cost.

Various technologies have been implemented by First Responders to improve response times, increase safety of personnel, increase accuracy of destination locations, and facilitate information sharing among jurisdictions.

Background

First Responders have used wireless systems for many years. Wireless technologies have assisted First Responders in determining the location of problems and dangerous situations including crime and fires.

Agencies recognized the need for Wireless systems in order to communicate with mobile personnel in patrol cars and fire fighting equipment.

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Radio

During the 1920s, police departments across the country began experimenting with radio as a crime-fighting tool. As criminals were making greater use of automobiles, the police looked at technology to help keep pace. Beginning in 1928, various Police Departments in the nation used an AM radio frequency to communicate with radios in police cars. Dispatch systems in the police dispatch center used AM 1712 kilocycles **o**n May 1, 1931. In one example, officers driving swift moving automobiles took an average of only two minutes forty seconds to respond to any call in the city

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In the 1930s, radios were provided to Fire Departments to assist in dispatch of Fire Companies to fires.

Digital trunking scanners have been used by Police and Fire Departments. These are computers that encode a voice transmission into streams of data and the receiver decodes it so that an audible voice can be heard. These promote some privacy since only those people who have decoders are able to hear the transmission.

Vehicle Computers and Terminals

Mobile Data Terminal - MDT

Beginning in the 1980s, larger agencies began to introduce Mobile Digital Terminals in vehicles. These early Mobile Data Terminals (MDT) or Mobile Dumb Terminals provided the officer with access, from the vehicle and through their agency, to motor vehicle information, some wanted persons databases, such as the National Crime Information Center (NCIC), and local stolen vehicle information. The first computer terminals were “dumb” because they were simple gateways to whatever mainframe computer an agency was using. Unlike the desk top PC, laptop or other computers currently used in vehicles, MDTs could not perform simple computing tasks like word processing or even act as a calculator. There were several challenges in using the early MDTs. For instance, through the 1990s, installation of new electronic equipment was done on an ad-hoc basis. Because new technology was being added into the vehicle as an after thought, it was spliced into existing systems. Splicing could create personnel safety problems. Police or Fire personnel would get their feet caught in wires protruding from under the dashboard of the vehicle. Splicing also exacerbated maintenance problems because more connections meant more failure points and more places to check to locate failure points. Moreover, previous ad hoc installations tended to over-tax the vehicle battery.

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In todays mobile office the police or fire vehicle is pre-wired to accept the technology. By the late 1990s, the installation of computers, radios and high-end light systems have been accomplished by a specially designed wiring harness. The advent of the wiring harness was a significant improvement. It simplified after-market installation and maintenance by greatly reducing the number of electrical connections and thus potential failure points. It also greatly enhanced the communications platform. By having defined paths for all the wires, signal interference was reduced. Previously, if the vehicle passed underneath electrical transmission lines there would be interference. Before the use of wiring harnesses and specially adapted cables, power for lights and sirens were often run along side cables, cords and wires used for the radio, and there was interference. This type of serious adaptation of electronic equipment to the vehicles is generally referred to as ruggedization. Ruggedization is the design and installation of equipment that can withstand the rigors of police and firefighting work.

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Laptop Computers

Agencies began to install Laptop computers in vehicles in the early 1990s. The increased demand for power on the vehicle prompted agencies to add additional or larger batteries. To communicate to an agency base computer, agencies in the United States utilized wireless technologies such as CDPD and CDMA.

Personnel have operated various applications on these computers to more effectively perform their work, including Computer Aided Dispatch, GPS or other location technologies, license plate search, suspect image and information search, and most currently, video capture and streaming.

Wireless Technologies

While there have been and currently are available numerous wireless technologies, First Responders have mostly used CDPD and CDMA cellular technologies to enable vehicles to communicate with base computers.

This has increased access to the base computer, and also directly to other computers via the Internet.

However, CDPD and CDMA have posed challenges for agencies. These technologies have not allowed for 100% access from the vehicle to the base computers, and have not been very well supported by their vendors. Since these technologies have required a “line of site” for successful operation, buildings, trees, hills, and mountains have interrupted operation of functions on vehicle computers. While additional technology could have mitigated these challenges, the vendors decided to end their support for these wireless technologies.

Faced with this turn of events, agencies looked to an ownership model for providing their vehicles with functionality. Agencies and their respective communities have invested in their own wireless infrastructures including 802.11b and g, or **Wi-Fi,** and in mesh network configurations. This has increased access to the base computer, and also directly to other computers via the Internet.

This has also enabled the use of additional technologies, including GPS, or Global Navigation Satellite System (GNSS). Utilizing a constellation of at least 24 medium Earth orbit satellites that transmit precise microwave signals, the system enables a GPS receiver in a vehicle to determine its location, speed and direction.

Configured in an appropriate Mesh Network, this technology ensures access from a moving vehicle, and ensures access.

Wi-Fi is embedded technology of wireless local area networks (WLAN) based on the IEEE 802.11 standard. As of 2007 common use of the term Wi-Fi has broadened to describe the generic wireless interface of mobile computing devices, such as laptops in LANs. The region covered by one or several access points is called a hotspot. Hotspots can range from a single room to many square miles of overlapping hotspots. Wi-Fi can also be used to create a mesh network. Both architectures are used in community networks. Power consumption is fairly high compared to some other low-bandwidth, standards, such as Zigbee and Bluetooth, making battery life a concern. Wi-Fi networks have limited range. A typical Wi-Fi router using 802.11b or 802.11g with a stock antenna might have a range of 150 ft indoors and 300ft outdoors. Range also varies with frequency band. Wi-Fi in the 2.4 GHz frequency block has slightly better range than Wi-Fi in the 5 GHz frequency block. Outdoor range with improved antennas and repeaters or extenders can be several miles or more with line-of-sight. Configured in an appropriate Mesh Network, this technology ensures access from a moving vehicle, and ensures access. Repeaters or extenders can be strategically placed to elongate a signal area or allow for the signal area to reach around barriers.

There are challenges also with this technology. Wi-Fi is very popular with the average consumer. Wi-Fi pollution, or an excessive number of access points in the area, especially on the same or neighboring channel, can prevent access and interfere with the use of other access points by others, caused by overlapping channels in the 802.11g/b spectrum, as well as with decreased signal-to-noise ratio (SNR) between access points.

Measures to deter unauthorized users include suppressing the AP's service set identifier (SSID) broadcast, allowing only computers with known MAC addresses to join the network, and various encryption standards as WEP, WPA, WPA-2, or other.

In areas without pre-existing physical cable or telephone networks, WiMAX may be a viable alternative for broadband access that has been economically unavailable.

WiMAX, the Worldwide Interoperability for Microwave Access, is a telecommunications technology based on the 802.16 standard, and is aimed at providing wireless data over long distances in a variety of ways, from point-to-point links to full mobile cellular type access. In areas without pre-existing physical cable or telephone networks, WiMAX may be a viable alternative for broadband access that has been economically unavailable. WiMAX is a long range system, and may deliver 70 Mbit/s, over 30 miles The nature of wireless communications dictates that the antenna design will have a substantial impact on what is achievable. Typically, Fixed WiMAX networks have a higher-gain directional antenna installed externally at the customer's premises which results in greatly increased range and throughput.

4.9Ghz and Other Wireless Technologies

In 2002, the Federal Communications Commission designated the 4.9Ghz band for exclusive use of First Responders.

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4.9Ghz, or Long-range Wi- Fi is used for low-cost, unregulated point-to-point connections, as an alternative to cellular networks, microwave or satellite links. Products for this technology are available today. Some boast of 48Mbs with a range of 50 miles.

Other wireless technologies are available, and manufacturers are providing products for them. There are challenges posed by these technologies, including:

1. If the newer technologies are not backward compatible, or interoperable with order technologies, adoption may be slow. Some communities have already invested significant funds in current or older technologies. They would have to reinvest in the newer technologies.
2. Proprietary technologies are numerous. They may not have the sanction of the IEEE group- a standards adoption group for wireless technology. While these technologies may be tempting to purchase, the customer must consider total system operation. If the proprietary technology doesn't interface with the total system, it wont matter how fast or long range the new technology is.
3. Cost and bandwidth. Satellite communications is most accessible. However the cost of using satellite communications is costly both in equipment investment, and in constant usage. Also, satellite communications does not easily support some computer applications as streaming video because of the bandwidth required.

Why Wireless Systems- Mobility and Quick Response

Regardless of the wireless technology selected, wireless technologies enable communication to Mobile users.

Users do not have to stay in one location and rely on a phone or computing device which is wired.
Users do not have to stay in one location and rely on a phone or computing device which is wired. Users can move about, on foot and in vehicles and communicate, generally, with whomever has a similar wireless device. Also, used with GPS technology, wireless users are able to provide location information to their desired receivers.

Personal Systems such as cell phones and PDAs have increased communication ability and productivity of everyone using them.
This has been especially critical in countries where new installation of communications cabling infrastructure would involve a economic crippling amount of investment.
Vehicle Systems have enabled First Responders and the average citizen to travel and respond quickly.
Incident Site Systems, especially interoperable systems, have enabled First Responders to provide information to peers and base stations for quick evaluation and decision on critical situations.

Which Wireless

A systemic view

The decision on which wireless technology to use rests on the most functional for legacy and planned new systems, and its cost effectiveness for any agency, including cost of ownership.

First Responders have a variety of wireless technologies to choose from. Cost of purchase and ownership has been a major consideration. Numerous First Responders purchased CDPD and CDMA technologies, only to be disappointed by inconsistent service and then discontinuance of service and support. First Responders and their respective communities have begun investing in W-Fi, also known as 802.11x, infrastructures including mesh networks installed throughout their communities.

802.11x delivers fair bandwidth for various types of data including text, images, and video, but has a range of 200-300 feet. Additionally, line of site is important for its successful use, so trees, buildings, hills, and mountains pose interruptions in the communications. With the use of strategically placed repeaters or extenders, the range can be extended over several miles.

WiMAX, or 802.16 technology is currently being tested in several jurisdictions. WiMAX has a larger bandwidth of 70mps, a longer range, around the 30 mile mark, and the cost of the infrastructure is becoming more affordable.

The decision on which wireless technology to use rests on the most functional for legacy and planned new systems, and its cost effectiveness for any community including cost of ownership. One approach is to choose the wireless technology in unison with planned new systems, especially those systems which accommodate any wireless technology.

MDS Systems Use Any Wireless

Systems developed by Mobile Digital Systems, Inc. operate with Any Wireless technology.

MDS has developed its Comprehensive Software to operate successfully and reliably on COTS (commercial off the shelf) hardware, and Any Wireless technology, to provide our customers with the most flexible and effective systems possible. MDS systems are IP capable, enable access to the internet, and support peer to peer, and peer to base networking. This ensures successful operation and protects the community's long-term investment. MDS systems include:

Systems developed by Mobile Digital Systems, Inc. operate with Any Wireless technology.

MV-R: MobileVideo-Ruggedized: a Wireless In-Vehicle Video, Audio, and Sensor Surveillance System which operates with Any Wireless technology. MV-R is ruggedized to withstand harsh environments, meeting SAE standards. MV-R's Comprehensive Software includes In-Vehicle capture, record, and transmit as well as a compete "backend".

MDS is able to assist agencies with your choice of wireless and systems.

ISS: Intelligent Surveillance System: a Wireless Fixed Site Surveillance system, providing immediate, real-time Analytics on data from Video and Sensors. ISS operates with Any wireless technology and is ruggedized to meet SAE standards.

MDS products may be purchased from GSAAdvantage.Gov GSA Schedule 70: GS-35F-0665M.

MDS is a proud recipient of the 2006 MIPS Award.
MDS is a Maryland Certified DBE/ S/ WBE Company.

MDS is able to assist agencies with your choice of wireless and systems. For more information, Contact us at:
Command@mobiledigitalsecurity.com
Toll Free: (800) 303-1152

Grants for Purchase of Technologies

Since 1968, purchase of technologies has been facilitated through grants from federal government agencies, including the Department of Justice/ National Institute of Justice and Office of Justice Programs.

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Several programs are funded by NIJ and OJP and can be found at the following websites.

http://www.ojp.usdoj.gov/nij/funding.htm
http://www.ojp.usdoj.gov/