



Statewide Needs Assessment and Plan for the Improvement of Public Safety Radio Communications Systems in Wisconsin

Phase 1 – Assessment

Prepared by:

Federal Engineering, Inc.
10600 Arrowhead Dr.
Fairfax, VA 22030
703 359-8200



1. Executive Summary

Events over the past few years have demonstrated time and again the importance of public safety radio systems interoperability on a local, regional, and statewide basis. Recognizing this need, Wisconsin released RFP-3101 in July 31, 2003 for a *Statewide Needs Assessment and Plan for the Improvement of Public Safety Radio Communications Systems in Wisconsin*. Federal Engineering, Inc. of Fairfax, Virginia was awarded the contract for this important project.

The overall intent of this project is to develop an understanding of the interoperability capabilities of the existing public safety mobile radio systems as a prerequisite to the generation of a strategic plan for improving these capabilities. This report covers the results of this first phase, the assessment process, of the overall effort to develop a strategic plan and architecture to meet the interoperability needs of the state and local agencies into the future.

Threat levels are now part of our every day life, and it seems that terrorism is never far from the front pages of our newspapers. "Be observant. Know where you are and who's around you. Be vigilant; Welcome to my world," one member of Wisconsin's public safety community said in an interview, "I've lived it every day for seventeen years."

Radio Communications Interoperability is what you want and need at the scene of any major disaster, whether natural or man-made. When police, fire, and EMS arrive on the scene from different counties, experience tells us that there is great difficulty in achieving communications across the involved agencies. During the assessment of Wisconsin's public safety mobile radio environment, **FE** has documented many of the reasons.

The primary source of information for this first phase was the comprehensive Wisconsin Division of Emergency Management Public Safety Communications Survey administered in 2003. This was supplemented by information gathered in twenty-eight structured interviews, conducted by **FE** in February/March 2004 with public safety stakeholders. The Office of Justice Assistance, which is responsible for managing the Homeland Security grant process in Wisconsin, through its staff, coordinated the interview process.

To get a sense of the scope of this project, and the factors that will affect the final outcome, consider that the Wisconsin Public Safety Mobile Radio environment can be characterized by the following:

- There are **38,205** radios in the public safety community across the state.
- There are **924** distinct frequencies in three different frequency bands used by these radios



- **62%** of the Counties' frequencies and **54%** of the State Agencies' frequencies are being used in **analog mode**.

Clearly this is a complex problem that requires a good deal of analysis.

The information that was gathered and analyzed by **FE** in this phase will form the basis by which the final two phases of the project will be completed. Knowing the present state of Wisconsin's public safety radio environment brings certain realities to the forefront of evaluation process. For example, although analog is the predominant technology in Wisconsin, it is not the technology of choice in today's modern public safety radio systems nor is it the choice in today's cellular industry. Digital systems make more efficient use of the frequencies, provide clear and more reliable connections, and allow the introduction of advanced features at minimal costs.

Obstacles to public safety mobile radio interoperability in Wisconsin discovered in the Phase I assessment included:

- Radio frequency incompatibility
- Frequency interference
- Incompatibility of embedded systems
- Mutual aid channels being limited in capacity
- Outdated equipment
- Lack of standards,
- Lack of funding, and
- Availability of radios

Since a seamless process for interoperability does not exist, **FE** found that the public safety radio system operators have found alternate ways to be able to communicate, although the ways are cumbersome and unreliable. These include:

- Sharing frequencies
- Swapping radios
- Using mutual aid channels
- Keeping a supply of spare radios to give out at incidents
- Making inter-system cross patches at the dispatch center
- Using cellular phones with and without "direct connect" features

Sixty-eight of seventy-two Counties and twenty-two State entities responded to the WEM Survey. Of those only four Counties and seven State entities indicated that they had no interoperability problems. The message of the participants is loud and clear.

The State has been attempting to address some of these issues. For example, the Wisconsin State Patrol piloted a VHF trunked radio system to make more efficient use of frequencies and evaluate other advanced features. Wisconsin



Division of Emergency Management purchased two computer controlled radio switches that link disparate frequency groups and bands. These efforts, while limited in scope and too early to be judged, provide experiences to be built upon.

There are major changes coming to public safety radio communications. To address a historic and real shortage of radio frequencies, the Federal Communications Commission has ordered "narrowbanding" of radio frequencies below 512 MHz. This includes frequencies in the low, VHF, and UHF bands. On a timetable, the size or width of a frequency channel will reduce by half, and later it will be halved again. This plan will yield four channels from one of today's channels.

Systems will need major changes, and radios will have to be replaced. In fact, one of Wisconsin's County Sheriff's departments indicated that their investment was over \$450,000 this year to make the change to comply with narrowbanding.

The first step has been rightly taken by the State of Wisconsin; to plan for radio communications interoperability in an inclusive manner that encompasses all public safety disciplines and all levels of jurisdictions.



2. Introduction

One of the major obstacles to public safety responders at the World Trade Center and Pentagon tragedies of September 11, 2001 was radio communications interoperability. Police, Fire, EMS, and other public safety personnel could not communicate effectively with each other nor could these groups communicate with state and Federal authorities.

Similar failures of radio communications faced public safety providers responding after the bombing of the federal building in Oklahoma City, and during the Columbine shootings. The advent of terrorism on our soil sparked a national focus on the urgent need for interoperable communications when multiple first responders come together at an incident. In Wisconsin, on a daily basis, public safety service providers face interoperability challenges between disciplines (e.g. Law enforcement, Fire, EMS, Emergency Management, etc) and jurisdictions (e.g. town, city, county, state, Federal).

Wisconsin, being a "home-rule" state, instills an independence of decision-making. In many cases, this leads to radio equipment purchases that focus on narrow technical requirements and/or the needs of direct system users. The ability to interact with a potentially wider user base and the inherent greater costs is given lower priority when it comes to spending scarce funds. Wisconsin is not unique in this situation. Challenges in radio communication interoperability are a catalyst to action in many states including Montana, Nebraska, North Dakota, and Wyoming. Significant planning efforts on a statewide level are underway in these states.

Since the mid-1990's, national efforts have been underway to develop standards and encourage radio communications interoperability. The Association of Public Safety Communications Officials (APCO) was instrumental in developing a set of standards to be used for interoperability. The most well known of these standards is known as Project 25 (P25). The Public Safety Wireless Network program (PSWN) has also been a forum in this arena. Membership was open to end-users and the vendor community. The program has been a source of information on interoperability for all jurisdictions. The PSWN program moved into the Department of Homeland Security, and was reorganized as SafeCom. The future mission of SafeCom is unclear at this time as they attempt to define their roles in the Federal, state, and municipal segments.

Today in Wisconsin, the Office of Justice Assistance (OJA) is providing focus and energy to the efforts to improve radio communications interoperability across the state. OJA has established a dialog with radio communications users across the state, in order to address user needs in the planning process. Wisconsin, as other states and jurisdictions, must consider ways to address:



1. Radio frequency incompatibility
2. Incompatibility of embedded systems
3. Availability of funding
4. Cost impacts of improved interoperability
5. Build upon existing systems for solutions
6. Planning and training for incidents using radio communications interoperability.



3 Study Background

Interoperability is the ability of public safety service and support providers - law enforcement, fire, EMS, emergency management, the public utilities, transportation, and others - to communicate with staff from other responding agencies and to exchange voice and/or data communications on demand and in real time. It is a term that describes how radio communications systems should operate between agencies and jurisdictions that respond to a common emergency or incident. Different agencies and jurisdictions commonly use incompatible radio equipment operating on different frequencies, resulting in an inability to communicate with each other.

Throughout the State of Wisconsin, emergency responders face this situation quite often. However, this situation occurred through evolution rather than intent. As in most states, local planning efforts were done on a jurisdictional basis, with each community/county planning for the best possible systems for their needs. Many of these gave only limited consideration to the need/ability to interoperate with surrounding jurisdictions and statewide entities. Further, the technology of decades ago (which is the vintage of many of the existing radio systems in Wisconsin) did not enable the rich features available today that can provide a high degree of interoperability.

The Department of Homeland Security, through grants from the Office of Domestic Preparedness (ODP), has focused on improving interoperability at the state and local levels. The Wisconsin Division of Emergency Management (WEM) administered the ODP grant process in Wisconsin until last year. WEM, in a policy and guidance memo (01-03-2003), placed certain restrictions on equipment purchases. All base, mobile, and handheld radio purchases had to include the installation and/or capacity to install a defined set of mutual aid frequencies. WEM stated, "In an effort to ensure that future radio interoperability needs and goals are attained as radios are purchased across all responding disciplines..."

The Wisconsin Division of Emergency Management, also in 2003, conducted the Wisconsin Public Safety Communications Survey (WEM Survey) for all municipal, County and State agencies. Results of the survey were published providing information on systems and planning in the various jurisdictions. Sixty-eight of seventy-two counties and twenty-two state agencies responded to the survey.

In 2003, the grant administration responsibility was assigned to the Office of Justice Assistance (OJA). OJA also recognized that there were significant on-going purchases of radio equipment. Equipment that was being purchased up until 2003 was not being centrally coordinated for high levels of interoperability and clearly this situation required adjustment. For 2004, the funds available to



Wisconsin from the Office of Domestic Preparedness are more than \$51,000,000. This level of funding provides an unprecedented opportunity to improve interoperability within the State if proper planning is performed.

The Office of Justice Assistance realized that there was the need for planning and cooperation to develop a statewide strategy for radio communications interoperability. OJA formed an Advisory Communications Interoperability Steering Committee/Working Group from local and state jurisdictions and public safety disciplines. To aid in its mission, the Office of Justice Assistance sought an independent professional consulting firm with experience in assessing and planning public safety radio systems. *Federal Engineering* was engaged, after a competitive procurement process, by OJA for the State of Wisconsin to:

- Assess the public safety mobile radio infrastructure
- Determine interoperability requirements
- Provide a communications mechanism regarding public safety communication issues
- Develop a set of architectural, governance, and funding recommendations to guide the State's future efforts in creating statewide interoperable public safety communications compatibility.

This report is the result of the first phase of that effort; assessing the current interoperability readiness of the existing infrastructure.



4 Overall Project Approach

4.1 Project Plan

An event-based milestone plan was created to manage the project. The plan detailed tasks, steps, chronology, and dependencies for the events, and was used and updated throughout all three phases of the project.

4.2 Project Coordination

To ensure that the State Project manager was kept informed, the **FE** Project Manager set in place a regular weekly schedule of conference calls. As a first level of communications, the calls provided an interactive structure for the timely management of the project. Although a weekly schedule was the baseline, the calls were scheduled on a demand basis by both the State and **FE** Project managers. The calls were supplemented by regular e-mail contact between the project managers.

4.3 Interviews

The State's Project Manager arranged for twenty-eight stakeholders and interested people to be interviewed by the **FE** Project Manager. Interviews took place over four trips spanning nine days. **FE** developed an interview questionnaire, which made the interview process more efficient. Locations for the interviews were Madison, Milwaukee, and Wisconsin Rapids. These interviews provided a fresh look at conditions across Wisconsin. Details regarding the interviews are included in Section 7.

4.4 Document Gathering

Documents, reports, and survey results were collected that showed different views of Wisconsin's public safety communications interoperability capability. Among the documents gathered was the Wisconsin Emergency Management Public Safety Communications Survey (WEM Survey). The WEM Survey has the most current detailed information available, and it has been used as the primary document for assessment.

4.5 Analysis of Documents

Analysis performed on the WEM Survey revealed very useful information describing the public safety mobile radio (PSMR) environment, including:

- Frequency distribution
- Mutual aid channel access



- Types of systems
- Voice radio interoperability
- Size of systems
- Training exercises for interoperability
- Mobile data system usage

The information extracted from the remaining documents (included in Table 2 below) provided validation and cross-reference for the WEM Survey analysis, as well as planning and designs for future system changes, and system costing. The results from this activity were also used in the subsequent phases of the project.

4.6 Analysis of Interview Responses

The results of the interviews were summarized, grouped, and analyzed by **FE**. Stakeholders provided additional ad hoc comments during the course of the interviews, which were recorded for the added depth of insight. Information culled from the interviews delivered alternative views of the details contained in the WEM Survey.

4.7 PSMR Information Resource Guide

The State's RFP required the development of recommendations for "*methods to keep public safety managers informed and up-to-date on latest trends and significant developments in public safety wireless communications.*"

FE developed a guide for Wisconsin's public safety communications managers and staff to stay informed on technologies and issues in public safety mobile radio. It will enable managers to access a wealth of material from a wide variety of sources that can be used to provide a common base of knowledge across all personnel working in the PSMR environment within the state. Further information describing this guide is included in Section 6.

4.8 Skills & Leadership Survey

FE developed a web-based tool to facilitate an online survey of public safety managers and technical staff leaders. This survey gathered information regarding skills, experience, and supervisory background, as well as the respondents' views of how much of a technology leadership role they are taking in the PSMR environment. The results will be used in forming recommendations for future systems support structures.



4.9 Interoperability Matrix

An interoperability matrix was developed by **FE** based upon detailed information from the WEM Survey. It is a snapshot of public safety radio communications interoperability in Wisconsin. There is a separate matrix for Counties and one for State Agencies.

4.10 Phase I – Assessment Report

This Assessment Report is a project deliverable that documents activities, discoveries, and critical information gathered regarding radio communications interoperability in Wisconsin. Analyses and assessments from Phase I will be used as a basis for Phases II and III.



5 Project Communications Plan

The purpose of the Project Communications Plan is to define the communication mechanisms to be used throughout the Wisconsin Public Safety Mobile Radio Interoperability project. In particular, the plan serves as the mechanism for providing project managers and stakeholders with information regarding roles, responsibilities, and frequency and types of information to be routinely communicated during the evolution of the project. More specifically, the Project Communications Plan identifies the items to be communicated, the individual responsible for generating each item, the frequency of each item, the medium through which each item is to be communicated, the project representative responsible for reporting each item to stakeholders, and the audience for each item. Table 1 below indicates the various methodologies envisioned for this effort.

Table 1 – Project Communications Plan

Item	Originator	Method	Frequency
Activity Report	<i>FE</i> Project Manager	Conference call	Weekly
Project Status	<i>FE</i> Project Manager	Conference call	Bi-weekly
Project Update	<i>FE</i> Project Manager	Onsite meeting	Monthly
Draft Deliverables	<i>FE</i> Project Manager	Electronic and/or printed copy	Milestone dates
Comments on Deliverables	State Project Manager	Electronic and/or printed copy	Milestone dates
Phase Reports	<i>FE</i> Project Manager	Electronic and/or printed copy	Milestone dates
Draft Final Report	<i>FE</i> Project Manager	Electronic and/or printed copy	Milestone dates
Comments on Draft Final Report	State Project Manager	Electronic and/or printed copy	Milestone dates
Project Final Report	<i>FE</i> Project Manager & Program Manager	Electronic and printed copy	July, 2004



6 PSMR INFORMATION RESOURCE GUIDE

FE developed a methodology that will enable the managers of Wisconsin's public safety community to stay current with public safety mobile radio issues, technology, and best practices. Keeping in mind that these individuals operate under time constraints, the methodology allows managers to customize the program to their specific needs.

The *Guide* details sources of information regarding:

- Public Safety Resources:
 - Organizations
 - Publications
 - Federal Government and Regulatory
 - State Governments
- Public Safety Issues:
 - Project 25 standards
 - FCC policies, practices, and regulations
 - 700 MHz band
 - 4.9 GHz band
 - National Consensus Plan
- Vendor Products
 - Source information for major product suppliers, especially those with an embedded base in the State
- Current Best Practices in Public Safety Mobile Radio
 - Listing of successful projects in other government jurisdictions; useful for ideas and as a yardstick for comparison.
- Seminars
 - Listing of training/informational seminars or conferences.
- Selected Readings

A draft of the Public Safety Mobile Radio Information Resource Guide was presented at the March meeting of the Communications Interoperability Steering Committee. The final version included stakeholder feedback from various State reviewers. The PSMR Information Resource Guide was made available for distribution through the Office of Justice Assistance (see Appendix A).



7 Sources of Information

To assess the radio communications interoperability compatibility, the State provided **FE** with surveys, reports, and grant proposals to review and analyze, as shown in Table 2:

Table 2 - Documents Collected for Analysis

Source	Document Name	Comment
Wisconsin Emergency Management	Wisconsin Public Safety Communications Survey	Comprehensive survey of public safety communications
Wisconsin Emergency Management	Wisconsin Public Safety Mutual Aid Survey	Survey of Wisconsin counties ability to provide mutual aid
Wisconsin Emergency Management	Wisconsin Agency Use of Incident Command Structure	Limited survey of Incident Command Structure in Wisconsin
Wisconsin Emergency Management	Volunteer Emergency Communications Support Plan	Plan for use of amateur radio during emergencies
Office of Justice Assistance	2003 Homeland Security Assessment and Strategy	Excerpt of Goal 5, Communications Interoperability
Office of Justice Assistance	Concept Paper: A justice gateway in Wisconsin	Planning document for criminal justice information infrastructure
Office of Justice Assistance	2004 Wisconsin Law Enforcement Technology Survey form	Survey of technology in place for justice information infrastructure
Office of Justice Assistance	State of Wisconsin Justice Information Sharing Initiative	Information sharing in an integrated justice environment
Department of Health & Family Services	Wisconsin Emergency Medical Services Communications Plan	Plan for EMS and pre-hospital service provider communications
Department of Natural Resources	MDCN-DSP-DNR Systems Merger Proposal	Integrate DSP-DNR radio infrastructure with DNR digital upgrade
Division of State Patrol	WICORTS VHF Trunking Pilot Report	Summary of experiences and outcomes
Dane County	911 Public Safety Communications Center Strategic Plan	Comprehensive plan for communications in county



Source	Document Name	Comment
Brown County	Public Safety Communications System Evaluation Study	Study of communications in county
Vilas County	Public Safety Radio Communications Evaluation	County communication evaluation
City of Milwaukee	2003 Homeland Security Grant Proposal	Request for funding
Pierce County	2003 Homeland Security Grant Proposal	Request for funding
Waushara County Sheriff's Department	2003 Homeland Security Grant Proposal	Request for funding

These documents provided a wealth of information and served as a good foundation for **FE** to begin its analysis efforts.



8 Wisconsin Emergency Management Public Safety Communications Survey

The survey provided extensive operational information and detailed systems level information. According to WEM, the purpose of the survey was to gather pertinent, factual information as to public safety communications interoperability. The survey was responded to by 68 counties and 22 state entities.

The WEM Survey was distributed in December, 2002. Completed forms were accepted until June 30, 2003. Results became available in the fall of 2003. Completed surveys were required of any entity submitting a grant request to purchase radio equipment. WEM administered the grant program at that time.

8.1 OJA Grant Proposals

Supplemental information that provided additional entity-specific details was found in several 2003 grant proposals for the purchase of radio equipment. These grant proposals were supplied by the Office of Justice Assistance.

Examples of supplemental information include:

- Brown County's proposal included a "Radio Communication Systems Study." The study provided details on systems throughout the County. A primary recommendation to improve inter-jurisdictional interoperability was an expanded 800MHz trunked system with a VHF overlay for paging and system support until migration to 800 MHz is complete.
- Milwaukee Police Department's proposal is to build an interoperable 800 MHz trunking system. The system would include setting the interfaces in place for a four-county regional interoperable public safety radio system. Milwaukee Police Department has funding at present to build an 800 MHz mobile data network. Their proposal is requesting the additional funds to add voice communications.
- Pierce County's grant proposal highlighted the current interoperability limitations of their local systems. Pierce County supports the building of a statewide radio communications system. Pierce County proposes being the hub of a regional deployment of the statewide system. The County has built a consensus of regional support for its proposal.
- Vilas County provided a proposal to upgrade the radio system for law enforcement over a multiyear timeline. Vilas County would add additional towers, VHF radio equipment, and microwave radio links as well as create a pilot for data communications. Vilas County identified limitations in coverage area and systems capacity. The County desires to upgrade to a more reliable portable radio system to deal with systemic issues and inadequate operational performance.



- Waushara County Sheriff's Department proposal is to replace and upgrade their system to an APCO P25 reverse compatible radio system. The new system will operate in a VHF conventional mode. Their plan is for a timed six-year installation.

A summary of these systems is provided in Table 3 below.

Table 3 – Summary of Grant Proposals

Jurisdiction	Frequency Band	Interoperable	Regional
Brown County	800MHz	Yes	Yes
Milwaukee	800 MHz	Yes	Yes
Pierce County	VHF	Yes	Yes
Vilas County	VHF	No	No
Waushara County	VHF	No	No

8.2 Interoperability Matrices

FE analyzed the Wisconsin Emergency Management Public Safety Communications Survey, looking at the dimensions that are most likely to serve as an indicator as to the ability of the respondents' systems to interoperate amongst themselves and with the State. Also included in the development of the matrices were supplemental sources of information gathered in the assessment phase as described in this Section.

Two versions of an Interoperability Matrix were developed from this information and are shown in Appendix C: one depicts county-level interoperability, and one shows state-level interoperability.

The questions and responses to the WEM survey were examined for their relationship to interoperability. Criteria were selected by **FE** and validated by the State Project Manager that would show interoperability, compatibility or desire to improve compatibility, actual voice communications interoperability, and mobile data systems. Information was categorized based upon technical and operational means of achieving interoperability. Plans for system improvements were used as indicators for future system capabilities. The levels of problems with existing interoperability are indicative of the challenges to be addressed.

Using the *Interoperability Matrices* is straightforward. If you read the information horizontally, you will see if the individual counties or state agencies meet the criteria. Conversely, reading the *Interoperability Matrices* vertically, you will see how many counties or state agencies meet the individual categories.

The categories from the WEM survey that were used as the primary source of information on interoperability are shown in Table 4 below:



Table 4 – Responses Included in Interoperability Matrix Logic

Criteria	Logic
Training for interoperability and use of mutual aid channels	Demonstrates operational commitment to interoperability
WISPERN Transmit	Actual interoperability capability
Desire WISPERN Base Desire WISPERN Base if funded	Shows level of commitment to achieving interoperability
MARC Transmit	Actual interoperability capability
Desire MARC Base Desire MARC Base if funded	Shows level of commitment to achieving interoperability
Mobile Data System	Potential to be used for sharing Information System resources
Communication with state agency by mobile radio	Actual interoperability capability
Communications interoperability problems	Shows extent of interoperability challenges
Communications system planning	Shows desire to improve or upgrade to overcome system problems

8.3 Stakeholder Interviews

FE conducted stakeholder interviews as part of Phase I of the project, based on a comprehensive interview questionnaire that focused on interoperability. The questionnaire was designed to supplement and validate the findings of the WEM survey documents. The interviews provided current information from stakeholders.

The Office of Justice Assistance reviewed and approved the survey and arranged the logistics for the interviews. The process took place during four trips that spanned nine days in February and March. Interviews were conducted in Madison, Milwaukee, Wisconsin Rapids, and by telephone. Twenty-eight stakeholders participated in the process, as indicated in Table 5:

Table 5 - List of Stakeholders Interviewed

STAKEHOLDER	TITLE	REPRESENTING
Geoffrey Anderson	Captain of Administration	Winnebago County Sheriff's Office
Karen Carlson	Management Information Coordinator	FoxCom
John Corbin	State Traffic Engineer	Bureau of Highway



STAKEHOLDER	TITLE	REPRESENTING
		Operations – Division of Infrastructure Development
Richard “Duke” Ellingson	Director	Dane County, Public Safety Communications
David Hewitt	Director	Bureau of Communications, Division of State Patrol
Dave Hinrichs	Assistant Administrator	Division of Enterprise Technology
Ed Kassing	Assistant Fire Chief	Eau Claire
David Kiesner	Lieutenant	Law Enforcement Services Division, Outagamie County Sheriff’s Dept.
Jeff Kirkey	Emergency Management Director	Trempealeau County
Gregory Leck	Chief of Police	Village of McFarland
Mark Meyer	Police Commander	Technical Services Bureau, Milwaukee Police Dept.
Jim Nickel	Communications Manager	Office of Emergency Management, Brown County
Cullen Peltier	Director	Office of Emergency Management, Brown County
Brent Standaert	Investigator	St. Croix Sheriff’s Dept.
Samuel Steffan	Communications Manager	Milwaukee Police Department
Carl Stenbol	Director of Emergency Management	Milwaukee County
John Verhyen	Chief Engineer	Bureau of Communications, Division of State Patrol
William Wentlandt	Chief	Milwaukee Fire Dept.
Donald Wilmot	Emergency Management Director	Winnebago County
Paul Wittkamp	State EMS Communications	Bureau of EMS & Injury Prevention, Department of Public Health
Alan Wohlferd	Communications and Warning Officer	Wisconsin Emergency Management
Paul France	Homeland Security Compliance & Enforcement Manager	Office of Justice Assistance
Michael Jordan	Homeland Security Program And Planning Analyst	Office of Justice Assistance
Michael Kunesh	Homeland Security Program Director	Office of Justice Assistance



STAKEHOLDER	TITLE	REPRESENTING
Bonnie Locke	Director of Planning and Development	Office of Justice Assistance
Alison Poe	Deputy Executive Director	Office of Justice Assistance
Gale Sorum	Homeland Security Interoperability Consultant	Office of Justice Assistance
David Steingraber	Executive Director	Office of Justice Assistance

The stakeholders were very candid and forthcoming in their responses. They expressed support for the planning process. Altogether the stakeholders were most sincere and enthusiastic about improving public safety radio interoperability in Wisconsin.

The major areas covered in the interviews included:

- What is their ability to establish radio communications within their entity and with others?
- What changes have there been in their need to interoperate with other public safety agencies over the last five years?
- To what degree do they have mutual aid agreements with neighboring jurisdictions for mutually defined calls for service and for disasters?
- Does their agency have at least one channel designated for mutual aid?
- What obstacles to interoperability do they see for their agency?
- How do they assess their radio system relative to the current state of technology?
- How do they assess their agency's capability to interoperate?
- How do they achieve interoperability in today's environment?
- Does their agency participate in joint training exercises that involve the actual use of radio communications?
- What serious operational conditions could affect their agency's radio system?
- What plans do they have to replace or upgrade their radio system in the next five years.
- Has the lack of radio communications interoperability hampered their agency in responding to a call.

The survey Instrument and responses are included at Appendix B.



9 Findings

FE's analysis included WEM Survey data for 68 counties and 22 state entities, using the results from the stakeholder interviews as corroboration where possible. As a marker for the magnitude of effort that Wisconsin is addressing, a detailed look into the WEM Survey produced the amount of existing radios, 38,205, which make use of 924 distinct frequencies in three different frequency bands. Clearly a simple solution does not immediately present itself in this situation.

9.1 Use of Analog and Digital Technologies

The first issue to emerge from the detailed data analysis of the WEM Survey was that 62% of County frequencies and 54% of State Agency frequencies are analog.

During the stakeholder interviews, the respondents indicated that the mix of analog and digital radio systems was a significant (3.8 on a scale of 5) problem to achieving interoperability. It was no surprise that there is such a heavy use of analog technology, particularly at the local level. These systems are quite old, and most were purchased prior to the widespread deployment of digital technologies. Most entities have not upgraded their systems using P25-compatible equipment due to the high cost relative to conventional subscriber devices.

Given the widespread use of analog technologies, and the emphasis that the industry and Federal Government are putting on digital technologies, this is a formidable issue to deal with in planning. Building interoperability solutions based upon these existing systems is not practical or cost effective. As with many of the discussions that *FE* has participated in, there was not a strong consensus on the use of P25-compatible technologies to resolve this issue due to the perceived high cost of those radios.

9.2 Use of Frequency Bands

A second serious obstacle to interoperability is posed by the distribution of radios operating in different frequency bands. There is a wide disparity of frequency bands in use at both the State and local levels, as shown in Fig.1:



USE OF FREQUENCIES

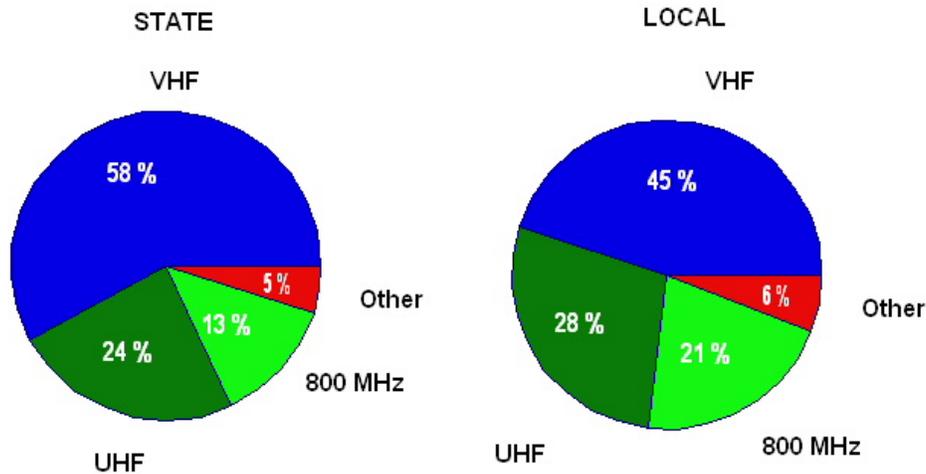


Figure 1 – Use of Frequency Bands

The stakeholder interviews confirmed this as a major issue – the use of different bands was rated at 3.9 on a scale of 1 to 5 by stakeholder interviews.

9.3 Mutual Aid Channels

The use of statewide mutual aid channels is a critical factor in the ability of agencies and municipalities to interoperate today. The WEM survey provided the following responses about the percentage of radios accessing the mutual aid channels by band.

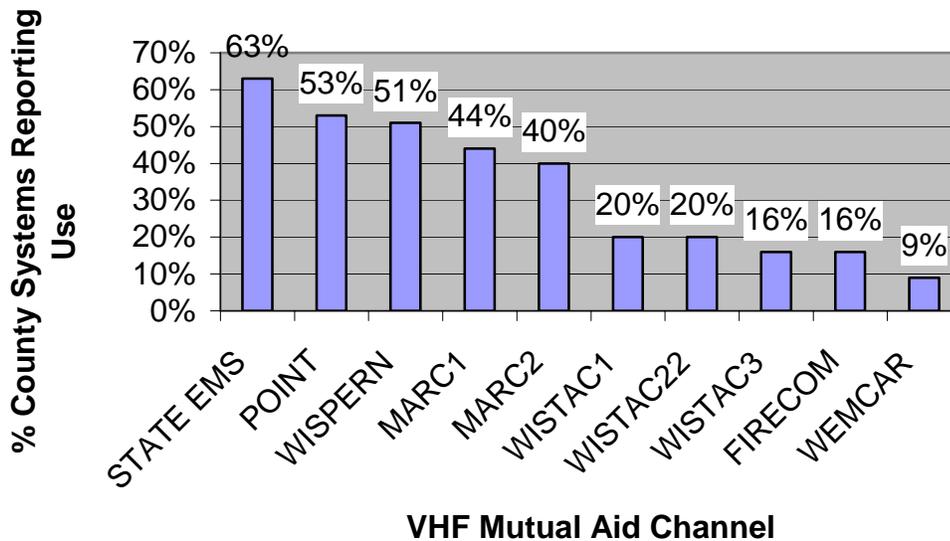
Listed below are the systems that are available in Wisconsin for mutual aid. Most of these channels have been in use for many years:

- WISPERN - Wisconsin State Patrol Emergency Radio Network - a statewide mutual aid channel for law enforcement (VHF & UHF).
- MARC – Mutual Aid Radio Communications – a statewide mutual aid channel (VHF & UHF).
- WISTAC – Wisconsin Tactical Communications - a statewide mutual aid channel (VHF).
- FIRECOM – Fire Communications- a statewide mutual aid channel for the Fire services (VHF).

- Point to Point – a channel between communications centers (VHF).
- ICALL- a statewide mutual aid channel (800 MHz).
- ITAC – a statewide mutual aid channel, but must be activated by controlling communications center (800 MHz).

The data portrayed below in Figures 2-5 is from the WEM study and show the total number of radio systems reported by all of the responding Counties and agencies. Most entities reported multiple systems for each of police, fire, EMS, buses, local departments of transportation, etc. A consolidated view of each entity and “mission” (police, fire, etc.) was not available. So using the ‘total systems’ view tends to show a conservative view of the actual interoperability capabilities because many of the systems reported do not need full interoperability on every channel.

Figure 2 - % of County Systems using VHF Mutual Aid Frequencies



This shows a wide variation of the use of the available VHF mutual aid channels.



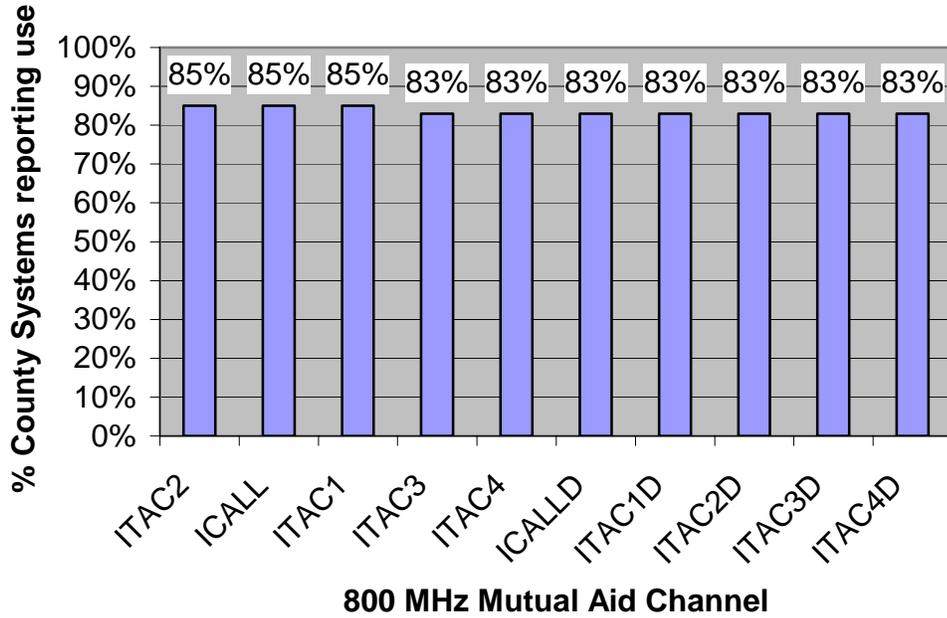


Figure 3 - % of County Systems using 800 MHz Mutual Aid Frequencies

At the County level, the 800 MHz frequency band has the highest percentage of access to mutual aid channels. However, there are fewer users on these systems. This causes the percentage to be high, but the absolute number is still low. These systems tend to be the newest and have sufficient capacity to enable the complete set of mutual aid channels. Limited capacity to add frequencies was prevalent in the other bands.

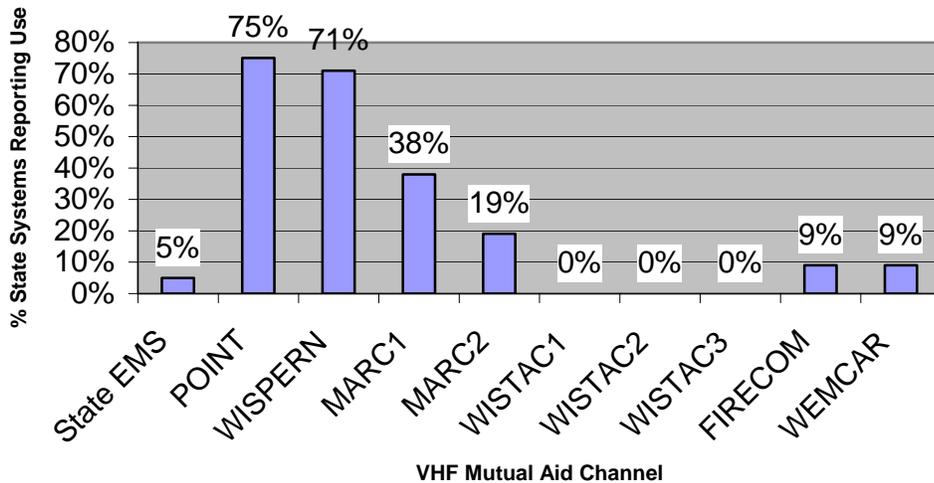


Figure 4 - % of State Systems using VHF Mutual Aid Frequencies



This shows the POINT and WISPERN as clearly the most utilized channels.

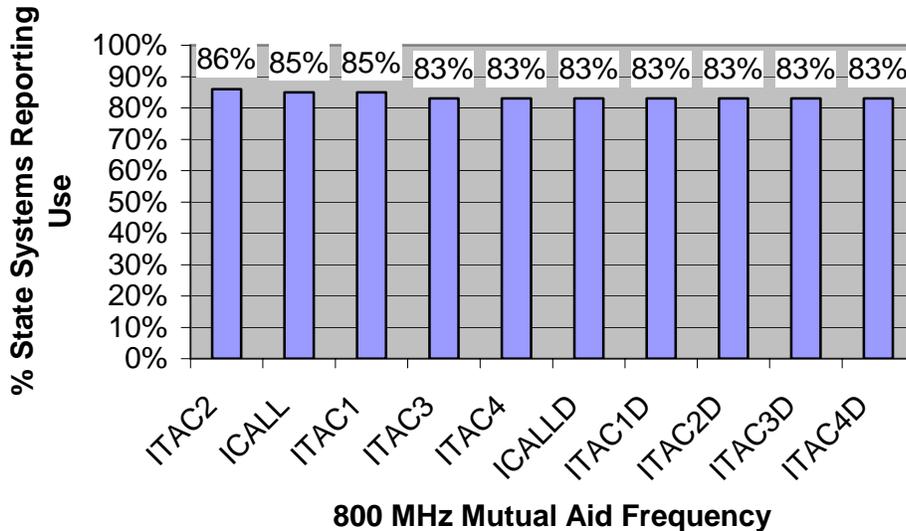


Figure 5 - % of State Systems using 800 MHz Mutual Aid Frequencies

Within the State Agencies, all ten mutual aid channels in the 800 MHz band have been implemented, but only for interoperability in the 800 MHz band.

State Agency VHF system access to mutual aid channels is limited to seven of the ten available mutual aid channels. WISTAC channels are not implemented in state agency radios.

Unfortunately, the mutual aid channels are band specific. So interoperability using these channels will be limited to entities that are currently using or planning to use similar bands.

The UHF band has only two channels available for interoperability, WISPERN and POINT. None of the 7 County or 5 State systems reported using these channels.

Stakeholder interviews again confirmed the importance of the WEM study findings. They rated the change in the need to interoperate with other public safety agencies as **4.6** (where 1 = greatly decreased to 5 = greatly increased). While the need to interoperate is certainly voiced, the capabilities are not robust enough to meet the expressed needs.



However, the overall situation is not as bleak as portrayed. During the interviews, 62% of the stakeholders indicated that they had at least one channel designated for mutual aid. In some cases this channel was a link to another local system, and in others the link was a mutual aid channel. The WEM data in Table 6 supports this and shows that the percentage of systems reporting using at least one mutual aid channel for both VHF and 800 MHz is approximately 85% of the VHF-reporting systems and 80% of the 800 MHz-reporting systems are utilizing at least one mutual aid channel.

**Table 6 – Municipal/County Systems using Mutual Aid Channels
 (quantities are approximate)**

	VHF	800 MHz
Systems in WEM Survey	2600	300
Systems not reporting (blank response)	500	50
Systems reporting Mutual Aid Channel use	2100	250
Systems using at least one mutual aid channel (of those using mutual aid)	1779 (85%)	200 (80%)

Many County entities reported using more than one mutual aid channel, as shown in Figure 5 below:

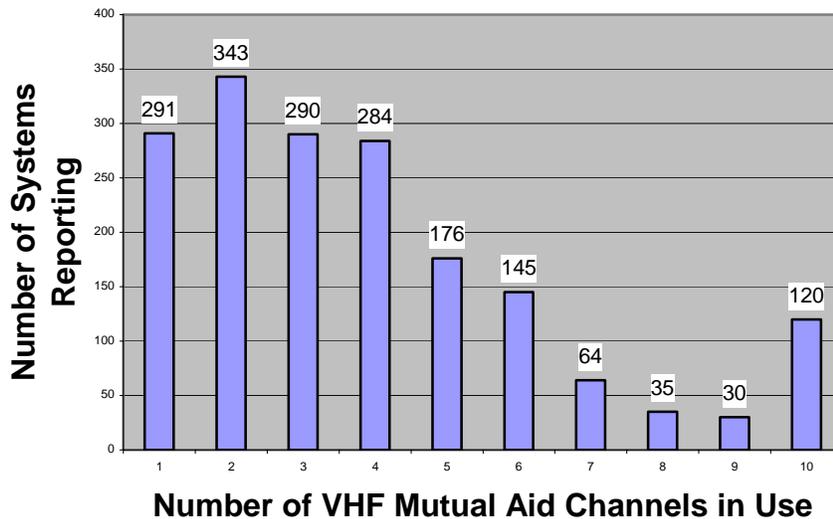


Figure 5 – Distribution of County VHF Mutual Aid Channel Use



However, there were over 300 VHF County systems that reported no use of any of the ten available VHF mutual aid channels

In the 800 MHz systems, 187 of 200 systems reported using all ten mutual aid channels.

Regardless of the shortcomings of technology, planning, or funding, the interviews confirmed the widely held belief that public safety managers and first responders are quite resourceful in getting their job done. The stakeholder interviews reported the use of the following approaches to interoperating in today's environment:

Table 7 – Current Approaches to Interoperability

Method	Score
Share Frequencies	93%
Mutual Aid Channels	93%
Cellular Phones	87%
Share Spare Radios	62%
Patch	62%
Mobile Data Systems	56%
Cross-band Repeaters	25%

Stakeholders' responses were measured by individual category, not as a cumulative total of the categories. There also was some cross-over between the categories 'Share Radios' and 'Mutual Aid Channels.' Some stakeholders viewed them as one in the same.

9.4 Radio Communications

Voice radio communications is connection specific, meaning users in one agency tend to talk to their dispatcher or each other. Communications to another agency is typically not possible unless they share mutual aid channels or are on a trunked system. Typically, as is the case in Wisconsin, mutual aid channels are limited in capacity and both agencies must be operating in the same frequency band since multi-band radios are currently not economically viable.

The WEM data indicated that interoperability is highest in both the Counties and the State Agencies with the Wisconsin State Patrol, which maintains a statewide radio network. The various levels of interoperability



today are show in Table 8. As mentioned previously, the use of the different frequency bands limits the ability to talk between systems.

Table 8 – Radio Communications Interoperability with State Agencies

State Agency	County	State Agency
WSP	87%	71%
DNR	72%	29%
DOC	13%	43%
DCI-DOJ	13%	29%
DOT	7%	14%

The stakeholder interviews indicated a slightly different result, rating the ability to interoperate with local/county police the highest. They also indicated the ease of interoperating with the State Patrol slightly above average, as shown in Figure 6 below (where 1= poor to 5 = excellent):

EASE OF CURRENT INTEROPERABILITY WITH AGENCIES

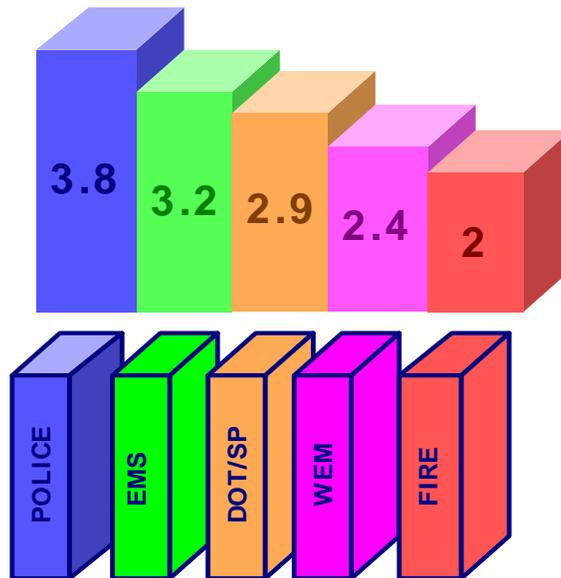


Figure 6 – Stakeholder Ratings of Ease of Interoperability

Interestingly, there were separate responses for ‘Police’ and the ‘State Patrol.’ Stakeholders presented a view reflective of local realities. Police



talk to EMS frequently and in many cases EMS reports to a local law enforcement authority.

The WEM Survey summary data showed limited communications to Federal agencies. It reported that 45% of counties and 29% of state agencies could communicate to at least one Federal agency. The most common connections were to the FBI and the U.S. Forest Service. The Federal agencies numbered fifteen in total.

The pattern shows counties and state agencies have specific communications links, which are limited in capacity. Mutual aid channel access should go up with the requirement to put sets of mutual aid channels in new radio equipment. The new radios will have the added capacity to accommodate the mutual aid channels.

Wisconsin Emergency Management has purchased two ACU-1000 cross band switches, which link different frequency sets and allow communications interoperability. The ACU-1000 is a switch that allows wireless communication systems to be combined at the audio baseband level by using the received audio from one radio system as the source audio for one or more transmitters of differing technologies. The net effect is that disparate systems do not “interoperate” but are rather interconnected. This function is not new and in the past was accomplished via an audio patch at a dispatcher’s console. Systems like the ACU-1000 have merely automated the process based upon a predetermined set of rules.

One ACU-1000 unit is located in the WEM mobile command center, and the other one is in a specially designed communications support trailer. The WEM Mobile Command Center was used last year at “Harley Fest.” WEM experienced good results from the ACU-1000 at Harley Fest, but it should be recognized that that this was a pre-planned non-emergency use of the equipment. In addition to WEM, some counties have or are contemplating purchasing ACU-1000 systems. Kenosha County is one that has purchased a system.

ACU-1000 systems do have limiting factors. You must have a radio for each frequency set that needs to be linked. Existing problems on the radio systems that are connected to the ACU-1000 are not resolved by the connection, so problems such as coverage area, static, sound quality, and dead spots existing before using the ACU-1000 will remain.

9.5 Reasons for the current interoperability situation

The major problems to achieving interoperability that were cited in the WEM Survey summary data were as follows:



- Lack of frequencies
- Incompatible frequencies
- Lack of standards
- Lack of common system radio channels
- Disparate technologies used by local agencies
- Frequency crowding
- Obsolete systems
- Limitations in funding

The impact of the inability to interoperate became resoundingly clear in the interviews where stakeholders stated that the lack of radio communications interoperability has hampered 87% of the agencies responding to a call at some point in time. Clearly this situation cannot go on much longer.

Stakeholders indicated the severity of the following obstacles to interoperability for their agency (where 1= not a problem to 5= major problem), as shown in Table 9:

Table 9 – Stakeholder view of Issue Severity

Category	Score
Limitations in funding	4.6
Different bands	3.9
Availability of frequencies	3.9
Analog vs. digital	3.8
Conventional vs. trunked	3.8
Different coverage areas	3.4
Poor coverage	3.3
Political/turf issues	3.3
Availability of radios	3.1
Cooperation	3.1
Quality of connection	2.9
Delays in patching	2.2

It's not a surprise that "limitation in funding" is the most severe obstacle to interoperability for the stakeholders. System designers will have to address system-based obstacles (e.g. different bands, availability of frequencies, analog vs. digital and conventional vs. trunked) in light of today's economic realities. Other non-technical obstacles are equally formidable and must be dealt with in choosing the best path to be taken. For example, the issue of "political/turf" challenges was not a surprise given the strong "home rule" environment within the State. Further



attention will be given to this in the final phase of this study where governance and funding alternatives will be addressed.

9.6 Operational Challenges

Serious system operational conditions that directly affect performance can also limit the ability to interoperate. Stakeholder interviews identified the following conditions, as shown in Table 10 (where 1 = not a problem to 5 = major problem):

Table 10 – Stakeholder view of operational issues

Category	Rating
Not enough channels	4.1
Outdated equipment	4.0
Not enough talk groups	3.8
Not enough equipment	3.5
Dead spots	3.3
Different types of equipment	3.2
Fading	2.6
Battery problems	2.6
Operational difficulty	2.6
Equipment size/weight	2.2
Frequency interference	2.0
Static	2.0

The severity, amount, and complexity of the problems discussed in Sections 8.5 and 8.6 demonstrate why very few counties or state agencies are without interoperability problems. Only five counties and four state agencies indicated on the survey that they had no interoperability problems.

9.7 Mobile Data Systems

Mobile data systems (MDS) can be used in Wisconsin to augment the ability of various entities to interoperate, although these systems are currently oriented towards sharing access to information resources and data. The available applications portfolio across the areas provides valuable information to the users, but offers little in the way of real-time interaction. The primary benefit is more efficient use of voice channels, because a request for data does not have to involve a conversation with a dispatcher. That is not to say that MDS will not evolve to provide interoperability.



9.8 CapWIN

The Capital Wireless Integrated Network (CapWIN) project is a partnership between the States of Maryland and Virginia and the District of Columbia to develop an integrated transportation and criminal justice information wireless network. This unique project will integrate transportation and public safety data and voice communication systems in two states and the District of Columbia and will be the first multi-state transportation and public safety integrated wireless network in the United States. The project will have national implications in technology transfer including image/video transmission and the inclusion of transportation applications in an integrated system. (<http://www.capwin.org>). The CapWIN project is designed to be monitored for progress by interested parties from across the nation.

9.9 Other Efforts within Wisconsin

The Wisconsin State Patrol has done a great deal to introduce mobile data throughout the state by opening its network to other users without usage charges. Promising regional efforts have also been started. FOXCOM, a union of four counties (Brown, Calumet, Outagamie, and Winnebago) is making strides to integrate mobile data systems. Interoperability is a key concern in this effort and faces many of the same issues as voice. FOXCOM staff stated that radio communications interoperability is a future task. DOT also has an effort underway that is looking at mobile data systems and their present and future uses.

The percentages of MDS connections to local, regional, and state systems were available from the WEM Survey summary data as shown in Table 11.

Table 11 – Mobile Data Connectivity Distribution

Counties	State Agencies
Local = 45%	Local = 9%
Regional = 8%	Regional = 9%
State = 66%	State = 27%

By using the Interoperability Matrices for analysis, it was quickly shown that only two Counties and one State Agency had MDS links at all three levels – local, regional, and state.

Data from the WEM Survey showed that in the Counties, the highest level of connectivity was to the WSP network. This was not the case for State



Agencies, where the connections were scattered without a particular pattern.

Mobile data systems were also discussed in the stakeholder interviews, where 87% indicated that they are using mobile data communication today or would be within the next 2 years.

Mobile data communications is growing in importance within public safety operations. Stakeholders' use of mobile data systems is increasing evidenced by those planning increased applications, as shown in Table 12:

Table 12 – Uses of Mobile Data Systems

Application	Currently use	Plan to use within 2 yrs.
Free Text	56%	81%
Records Management	43%	81%
E-mail	18%	68%
Images	6%	75%
Report Writing	6%	68%



10 Conclusions and Next Steps

Wisconsin, like most states, faces many challenges to public safety mobile radio communications interoperability. At this time, Counties and State Agencies have limited choices to solve the interoperability challenge.

In this first phase of the project, we identified and assessed current PSMR conditions. The next phase builds upon this assessment to develop recommendations and a plan to improve interoperability.

Wisconsin is approaching the issue of public safety mobile radio by choosing to be inclusive of all types of disciplines and jurisdictions in its planning process. This is the preferred approach and through prudent policies in the management of grant money, Wisconsin will maximize its investments thereby improving interoperability across the State.

Wisconsin has an embedded base that is primarily analog, conventional, wideband, and aging radio equipment. The Federal Communications Commission has ordered '*narrowbanding*' of radio frequencies below 512 MHz. This includes frequencies in the low, VHF, and UHF bands. Simply stated, the FCC order created a timetable on which the size of a frequency channel will be halved and then halved again. Analog frequencies will be most affected by this change, which will mean decreased audio quality and performance.

The challenge of moving to comply with the FCC order should be viewed as an opportunity for Wisconsin. Compliant radio systems will provide access to improved audio quality, performance, and advanced features. New systems will also offer a path to standards-based trunking radio systems. Wisconsin will be able to reduce its diversity of frequency bands from four to two, VHF and 800 MHz. This will increase interoperability in-band by providing full access to the sets of mutual aid channels exclusive to that particular band. Complexity in the infrastructure will be reduced, which will allow system operators to more readily deal with communications interoperability.

To accomplish the change, Wisconsin must develop strategies for funding in the public safety mobile radio arena. Stakeholders in their interviews cited that 'lack of funding' was the largest problem they faced.

Perhaps the biggest obstacle facing Wisconsin is the lack of a consolidated plan to improve public safety mobile radio interoperability. Wisconsin has moved decidedly to remove that barrier by commissioning this Plan. With proper planning, and a concerted effort on the part of users, public safety mobile radio interoperability is an attainable goal for Wisconsin.



One additional challenge that the project faces is to further define the degree of interoperability that is desired. There is a broad range of options, with a broader price tag, to be considered. The 'do-nothing' approach would be to continue as things are done (or are not done) today. Alternatively, a full seamless interoperable statewide system is probably neither likely or affordable. The challenge will be to determine the operational and technical solutions that will provide the best possible approach for the needs of the State and local agencies.

While the current picture of interoperability depends heavily on the use of mutual aid channels, the remaining phases of this program will provide additional insights into other potential improvement areas the State can consider going forward. In Phase II, the analysis of technology alternatives will provide a great deal of information on how the various technologies and processes available today can be utilized to improve statewide interoperability. Some of these technologies, such as IP networking and programmable/portable baseband switching, are relatively new and are as yet untested in statewide deployments, but may offer potential applications for Wisconsin. Also included will be the potential use of commercial technologies, such as 'direct connect' features of commercial wireless services, that are being considered mostly as adjuncts to the traditional public safety mobile radio systems.

Phase III will provide insights into the potential methodologies for both obtaining and allocating funding, including how to prioritize the use of the funds that will be limited, whether they are from internal State sources or Federal grants. This phase will also address alternative governance methodologies and will outline several of the approaches in use by states and large municipalities. Drawing on information from the Skills and Leadership survey, it will also outline the most likely alternatives for Wisconsin to consider, given it's unique emphasis on the "home-rule" relationship with the municipal governments across the state.

Finally, Phase III will bring together a set of operational and technical specifications which the State can utilize going forward to foster a greater level of interoperability across the state agencies and local municipalities.



Appendices

Appendix A

Public Safety Mobile Radio Information Resource Guide

Appendix B

Stakeholder Interview Form and Interview Results

Appendix C

Interoperability Matrix – Counties

Interoperability Matrix – State Agencies

