CHAPTER 2:

Five Key Reasons Why Public Safety Agencies Can't Talk

Historically public safety agencies have depended upon their own stand-alone communication systems. There are not only different systems for different agencies within one jurisdiction, neighboring jurisdictions maintain their own systems, too. There are approximately 2.5 million public safety first responders in the United States working for 18,000 State and local law enforcement agencies, 26,000 fire departments and over 6,000 rescue departments, plus Federal and tribal law enforcement, and other agencies such as Federal and State emergency management, transportation, and the public utilities who need to talk to one another during critical incidents.

There are five key reasons public safety agencies cannot talk—incompatible and aging communications equipment, limited and fragmented funding, limited and fragmented planning, a lack of coordination and cooperation, and inadequate and fragmented radio spectrum.

- In many jurisdictions radio communications infrastructure and equipment can be 20 to 40 years old. Different jurisdictions use different equipment and different radio frequencies that cannot communicate with one another, just as different computer operating systems will not work together or an AM receiver will not accept an FM signal. There are limited uniform standards for technology and equipment.

- There is limited funding to update or replace expensive radio communications equipment, and different communities and levels of governments have their own funding priorities and budget cycles.

- Planning is limited and fragmented. Without adequate planning, time and money can be wasted and end results can be disappointing. Agencies, jurisdictions, and other levels of government compete for scarce dollars, inhibiting the partnership and leadership required to develop interoperability.

Can You Imagine?

Imagine that each local government designed and constructed their own streets, roads, and transportation systems without considering or coordinating with their neighbors. While this might work well for traveling within each jurisdiction, travel among jurisdictions would be a disaster. Streets would not line up, and travel from city to city would be nearly impossible.

With few exceptions, this analogy effectively describes the current condition of our public safety communications infrastructure. Most public safety agencies cannot directly communicate with other public safety agencies in their region, even when numerous agencies collectively respond to an emergency.

- The human factor is a substantial obstacle—agencies are naturally reluctant to give up management and control of their communications systems. Interoperability requires coordination and cooperation. It requires a certain amount of shared management, control, and policies and procedures.

- There is a limited and fragmented amount of radio spectrum available to public safety.

"One lesson learned after Hurricane Andrew and echoed during the wildfires of 1998 was that Florida's communication systems are inadequate to ensure an appropriate and integrated response to disasters. Although we have made improvements in the past 6 years, we still need to focus on increasing our response capacities through improving equipment and ongoing training for response personnel."

Phillip Lewis, Chairman, Governor's Wildfire Response and Mitigation Review Committee

Reason 1: Incompatible and aging communications equipment

The radio communication system infrastructure and equipment—towers, control and dispatch stations, handheld and mobile radios—can be 20 to 40 years old in many jurisdictions. Antiquated systems and aging equipment mean escalating maintenance costs, reduced reliability, and obsolescence for public safety agencies. Public safety field personnel rely on their radios for assistance or back up in emergencies. Many radio systems in use today are obsolete or will become obsolete as manufacturer support is discontinued for older equipment. As systems deteriorate, field personnel are in danger and citizens are at risk, both in day-to-day and emergency operations, if they cannot exchange voice and data communications with dispatch and other field personnel.

The radio communication systems used by various agencies and jurisdictions are often at different stages of their life cycle. Some jurisdictions may expect their existing communications system to meet their needs for another 10 years, while others may have recently implemented new systems that they expect will meet their needs for the next 20 years. Others are barely functioning and in need of immediate replacement.

Different jurisdictions use different equipment and different radio frequencies that cannot communicate with one another, just as different computer operating systems will not work together or an AM receiver will not accept an FM signal. Some of the newer digital radio communication systems will not even communicate on the same radio frequency because of proprietary software (software that is unique to a manufacturer and incompatible with other manufactured systems) that prevents communica-

"In virtually every major city and county in the United States, no interoperable communications system exists to support police, fire departments, and county, State, regional, and Federal response personnel during a major emergency. Radio frequencies are not available to support the post-incident communication demands that will be placed on them, and most cities have no redundant systems to use as backups. Portable radios will not work in high-rise buildings unless the buildings are equipped with repeater systems. Most U.S. cities have separate command-and-control functions for their police and fire departments, and little to no coordination exists between the two organizations. Furthermore, with few exceptions, first-responder commanders do not have access to secure radios, telephones, or video-conferencing capabilities that can support communications with county, State, and Federal emergency preparedness officials or National Guard leaders."

America Still Unprepared, America Still in Danger,
Council on Foreign Relations, October 24, 2002.

tion. There are limited uniform standards for technology and equipment. Standards development must incorporate user input and encourage the development of compatible equipment.

There are interim solutions to the problem of incompatible equipment. Boulder County, Colorado, is using the ACU-1000, a gateway or interface between radio communication systems that use different equipment or frequencies, to connect disparate radio systems. The Boulder County Drug Task Force is a partnership of Denver area agencies, an area of seven counties and many municipalities, all working to reduce the drug problem. The agency radio systems are attached to the switching system of the ACU-1000. The dispatch center has a computer program that allows point and click "patching" or connection of various agencies. More than one patch group can be connected simultaneously to seven operations. The system was also successfully employed during the Colorado wild fire situation, where it was used to patch together two fire departments using different radio systems.

Reason 2: Limited and fragmented funding

There is limited funding to replace and update expensive communications equipment, and different communities and levels of government

Technology is only one of the tools

Interoperability requires more than equipment—critical incident management, training, and operational policies and procedures that govern interoperable communication systems need to be in place as well. To achieve the unified response required in critical incidents, there must be an active effort from all—from the public safety service providers to the State and local elected and appointed officials—to break down traditional jurisdictional boundaries and change the collective culture of operating in isolation. But it requires more—without disciplined management and training, the best radio communication systems will not provide interoperability. Public safety service providers need standard policies and procedures and training on radio equipment, including drills on mutual aid in critical incidents.

True interoperability must comprise a comprehensive strategy that combines radio communication systems, radio training and drills, common terminology, standard operational procedures, and a unified incident command when the situation warrants it.

have their own funding schedules and budget priorities. Regulations in one jurisdiction may conflict with those in another. Instead of combining dollars, funding is usually stovepiped to meet individual agency or jurisdiction needs. With few exceptions, public safety agencies have historically developed systems based on individual needs when planning a radio communication system. Spending decisions are based on old strategies that did not consider the need for interoperability. Requesting additional money to change radio communication systems is difficult as local, State, and Federal governments face budget shortfalls. As any public official knows, there are many important interests competing for scarce dollars. Short-term strategies to incrementally improve existing radio communication systems with limited resources need to be explored and developed.

The State of Minnesota is saving money by combining funding as it is developing interoperable radio communication systems. In the 1980s, when Minneapolis and St. Paul experienced rapid population growth, new suburban law enforcement, fire, and EMS agencies were finding it difficult, and in some cases impossible, to find radio channels they could license for their two-way systems. Public safety professionals urged the legislature to develop a radio system that could utilize new spectrum bands that were being made available to public safety by the Federal Communications Commission and, at the same time, improve the ability of separate agencies to talk to one another.

The legislature authorized a planning commission that met for several years, developing a plan for an integrated region-wide radio system and, ultimately, passing legislation to create the Metropolitan Radio Board. At the time the Board was created, both the State of Minnesota and Hennepin County were planning separate upgrades of their outmoded radio systems. The separate legacy systems were, in effect, "silos" that could not easily communicate with outside entities. With passage of the legislation, the legislature hoped to encourage the idea of a shared infrastructure that would improve the ability to talk between agencies and, at the same time, provide significant economies of scale.

Minnesota's new 800 MHz radio system participants include the State of Minnesota's State Patrol, the Minnesota Department of Transportation (MnDOT), and the Department of Natural Resources; the Metropolitan Council, including Metro Transit and Metro Mobility; Hennepin and Carver Counties; and the cities of Minneapolis and Richfield among others. MnDOT—the lead agency for the State's two-way radios—financed half the cost, partly through general obligation bonds, and partly with monies from the State's trunk highway fund. The other half of the capital costs have come from the Metropolitan

Radio Board, through revenue bonds issued on its behalf by the Metropolitan Council. The debt service is provided by 4 cents—a part of the 9-1-1 surtax—collected monthly on all wired and wireless telephone lines statewide. Planning is underway to design and build the second phase of the system, which entails extension to the remainder of the metro area. Another effort is planned in the coming session of the legislature to expand the system statewide and to review the governance structure.

Reason 3: Limited and fragmented planning

Planning for interoperability is limited and fragmented. Funding budgeted for the planning effort, a critical element of the process of developing interoperability, is still scarce. Without adequate planning, time and money can be wasted and end results can be disappointing. Agencies and jurisdictions, and different levels of government compete for scarce dollars, inhibiting the partnership and leadership required to develop interoperability.

The strength of the interoperability effort in Indiana was based on strong partnership, leadership, and coordinated planning. Indiana's State Police Superintendent was a strong advocate of a statewide, integrated public safety communication system that any public safety agency could use. His goal was to bring together every public safety agency—local, State, and Federal; fire, EMS, law enforcement, emergency management, and transportation—in Indiana so they could communicate with one another. To build support and coordinate planning for the proposed integrated communications system, the major statewide law enforcement associations and the Federal Bureau of Investigation (FBI) came together to form the Integrated Law Enforcement Council (ILEC). Subsequently, the statewide organizations representing the fire service, EMS, and counties, cities, and towns came on board. This council became the major conduit for communication and planning between the local, State, and Federal governments. To bring together over 475 cities and towns, 92 counties, and innumerable townships to share a common vision required a massive communication effort. Over the first 4 years of the effort, the ILEC held 4 governor's summits, numerous regional meetings, and focus groups. It conducted a survey of the public safety agencies and published a newsletter for all of the constituents of its members and for the members of the General Assembly and Congress. The first implementation of Project Hoosier SAFE-T as the initiative is known, was with demonstration projects in three areas of the State. This played a critical proof of concept role in the planning process.

In 1999, the Indiana General Assembly created the Integrated Public Safety Commission (IPSC), which serves as the governance body for Project Hoosier SAFE-T. Today, IPSC has begun the 4-year phased construction of its interoperable radio communication system. The first implementation in Johnson County has every public safety agency from the volunteer fire department to the sheriff's department to the Indiana State Police and Department of Natural Resources on the new system. As the system is implemented, communication is ongoing with the local, State, and Federal agencies that are interested in coming on the system. The local agencies are involved with the planning of the system design and have input into the location of the towers in their areas to maximize the system's benefit to them.

Reason 4: Lack of coordination and cooperation

The human factor is a substantial obstacle—agencies are naturally reluctant to give up management and control of their communications systems. Interoperability requires coordination and cooperation. It requires a certain amount of shared management, control, and policies and procedures. There is no one solution for every jurisdiction, but jurisdictions should consider altering the current pattern of spending in isolation. Public officials can consider sharing costs and benefits with another jurisdiction or consider sharing infrastructure such as radio towers.

The Capital Wireless Integrated Network (CapWIN) is a multi-State, multijurisdictional wireless public safety system. This partnership of communities and agencies serving Washington, D.C., Maryland, and Virginia, is working together to develop an Integrated Mobile Wireless Public Safety and Transportation Network that will enable public safety and transportation officials from over 40 local, State, and Federal agencies to communicate with one another in real time. CapWIN will provide firefighters, law enforcement, transportation officials, and other authorized emergency personnel with wireless access to multiple government databases during critical incidents, giving first responders and other public safety officials pertinent information to make critical decisions.

The strength of CapWIN is the partnerships that have developed and the sense that agencies have to work together for the greater good of their citizens. Partnerships must be formed to share resources. Public safety agencies must change the way they have done business in the past and work together to meet the challenges of the future.

Reason 5: Limited and fragmented radio spectrum

There is a limited and fragmented amount of radio spectrum available to public safety. Radio spectrum is electronic real estate—the complete range of frequencies and channels that can be used for radio communications. Spectrum is the "highway" over which voice, data, and image communications travel. Radio spectrum, one of our Nation's most valuable resources, is a finite resource—what exists today is all there ever will be. Public safety shares radio spectrum with television and radio broadcasters, government users, and other commercial consumers, who require spectrum for everything from garage door openers to cell phones. The Federal Communications Commission (FCC) has allocated certain frequencies to public safety, but it is inadequate and scattered across the spectrum, making it difficult for different agencies and jurisdictions to communicate. Initially, almost all public safety spectrum assignments were confined to the low frequency range, but as technology advanced and improved, transmission at higher frequencies became possible and the FCC assigned additional frequency bands to public safety. The result—public safety operates in 10 separate bands, which has added capacity, but which has also caused the fragmentation that characterizes the public safety spectrum today.

Today's public safety agencies operate in assigned frequencies across 10 or more different bands of radio spectrum.

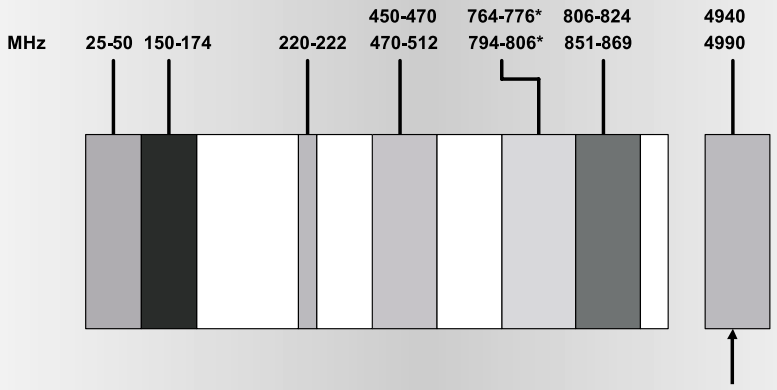
Public safety has changed, and emerging technologies that require the use of additional spectrum can assist in making them more responsive to the needs of the public they serve. New applications are quickly being viewed as critical to the public safety mission and are used for a wide variety of activities, such as geographic positioning, continuous vehicle location, report transmission, electronic messaging, and access to data repositories (e.g., National Crime Information Center). With these technologies, public safety can have real-time access to and transmit building plans, mug shots, fingerprints, and photos of accidents, injured persons, and crime scenes. Use of these technologies not only enhances the capability of individual units and agencies, it assists in activities in which interoperability is key, coordinating the activities of multiple agencies or personnel.

As technology advances and improves, more and more electronic devices, both public and private, require spectrum in order to operate. As a result, spectrum is becoming more scarce and more valuable, and is eagerly sought by competing private and government interests.

Spectrum "101"

- Radio spectrum is a finite resource. It is the electromagnetic real estate in the sky. What exists today is all there will ever be. It cannot be created or increased. What exists must be re-allocated and better managed.
- There is an inadequate amount of radio spectrum dedicated to public safety.
- The limited amount of radio spectrum allocated to public safety is subject to interference from commercial wireless services, radio and TV broadcasters, and from our Mexican and Canadian neighbors.
- The radio spectrum allocated to public safety is not contiguous. Narrow frequency bands for public safety are scattered throughout a wide spectrum range which severely limits the ability of public safety to communicate across agencies and jurisdictions.
- The ability to harness radio spectrum is limited by technology. In most cases, industry, not public safety set the standards for equipment and software. Their needs, not those of public safety, drive research and development.

Public Safety Radio Spectrum Bands



***Requires TV Clearing in most urban areas**
(TV Channels 60-69)

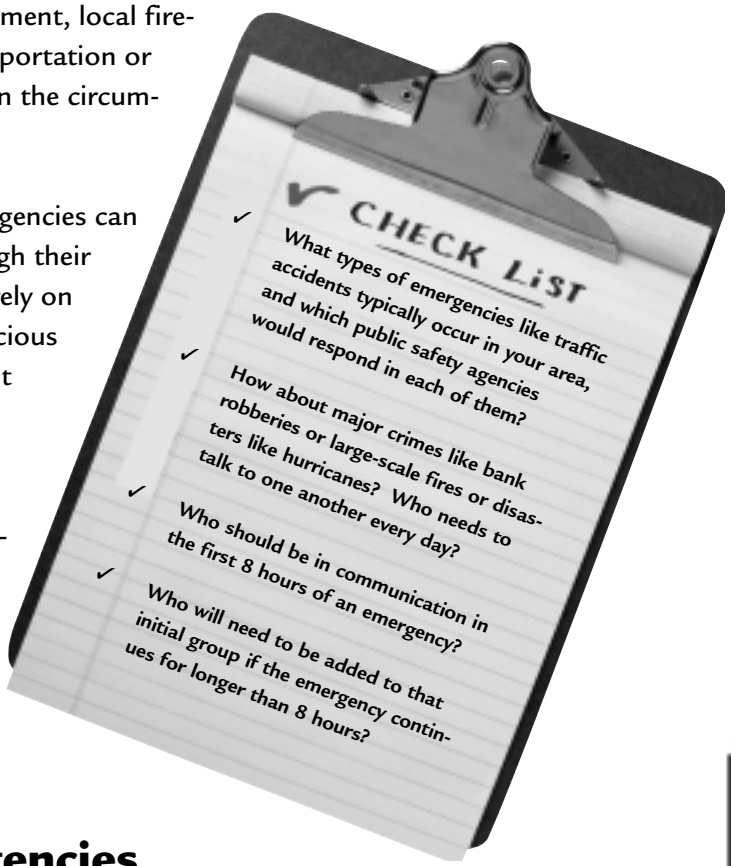
4.9 GHz
New Public Safety Broadband Spectrum

CHAPTER 3:
Are You Prepared? Assessing Interoperability

What is the status of your public safety radio communications?

To develop a basic snapshot of interoperability, ask the following questions:

Consider what happens when there is a major traffic accident on one of our country's interstate highways. In most areas, multiple agencies respond, including the State and local law enforcement, local firefighters, local emergency medical personnel, transportation or highway department personnel, and, depending on the circumstances, hazardous materials teams.



Unfortunately, in most areas, few if any of these agencies can share information directly with one another through their radio communication systems. They must either rely on face-to-face communication, which can waste precious minutes, or relay information through independent communications and dispatch centers.

There are assessment tools that can be used to determine the level of interoperability in your community, region, or State. At the end of this guide, there are tools for public officials to use to assess current interoperability, existing radio communications infrastructure, and financial resources.

Frequently occurring emergencies

Some types of emergencies occur on an almost daily basis. These include major traffic accidents, violent crimes, hostage situations,

industrial accidents, and similar incidents. Think about what types of incidents occur in your community, State or region. Which agencies would be likely to respond to these emergencies? Typically, several law enforcement agencies—the police, sheriff, State Patrol, etc.—would respond to these incidents. In addition, several emergency service agencies—the fire department, EMS, and Hazmat teams—might also respond.

It had been 30 years since Indiana residents had been witness to a blizzard like the one that slammed into northwest Indiana in early 1998. Roads were blocked with stranded vehicles and desperate drivers inside awaited rescue. Rescue efforts were slowed when law enforcement, emergency medical services, and the department of transportation could not communicate with one another on their radios during the snowstorm.

— **Les Miller,** *Chair,*
Governance Working Group
Executive Director,
Integrated Public Safety Commission,
Indiana State Police

While often not considered part of the public safety response, public infrastructure agencies, such as transportation, public works, and the utilities, provide important services in these emergencies and cannot be overlooked.

Which of these agencies can directly communicate through voice and/or data to share information? More than likely, few, if any, of these agencies can directly communicate with one another.

Major crimes or incidents

Major crimes or incidents include bank robberies, child kidnappings, large-scale fires, chemical leaks, large-scale industrial accidents, train derailments, school shootings, airplane crashes, and similar occurrences. Have any of these incidents occurred in your area or could they? Which agencies would be needed to respond to or be used in mitigating the effects of these incidents? Multiple law enforcement, emergency services, and public safety support agencies would likely respond. On the way to the scene and after arrival, who would be able to directly communicate with one another?

Large-scale disasters or incidents

Large-scale disasters and incidents include hurricanes, tornadoes, earthquakes, terrorist attacks, and similar incidents. Which of these events have affected or have the potential to affect your jurisdiction? No jurisdiction is immune.

Response by any number of agencies, including State and possibly Federal emergency management agencies, would be needed during and after the incident. Returning to some sense of normalcy would require the total cooperation of these agencies. Cooperation requires the ability to exchange information. On-the-scene, real-time radio

communication across typical communication boundaries is a necessity. Communication is the key to minimizing loss to life and property.

What radio communications system resources do you have?

Radio communications systems are expensive. Costs will vary depending on the level at which the system is to be developed, used, and/or shared and whether systems will be upgraded, replaced, or designed from scratch. While there is no way to accurately assess the costs of such systems, they can range from a few hundreds or thousands of dollars to more than a billion dollars. At the State level, replacing basic radio systems for a single public safety agency can cost between $100 million and $300 million. When considering statewide systems that involve multiple agencies, the costs are in the hundreds of millions, even as much as $1 billion for large State efforts, such as New York. Figures cited for developing interoperability nationwide have ranged from $18 billion to three times that figure. With this financial stake, it is important that systems meet current and future needs.

Ensuring that new communications systems are not obsolete before the first radio is issued is a daunting task. Planning is critical and must begin with an assessment of existing radio communication systems to establish a baseline that includes an analysis of operational processes—how and under what conditions radio communications operate in their current state, and technical operations—the equipment and software that allow radio communication systems to work.

Where do you need to be?

In everyday events and major incidents, agencies have different communication needs and requirements. Research different past events and possible major incidents to determine the answers to the following questions.

With whom do I need to communicate?

- Local, State, and Federal public safety and transportation agencies
- Other government agencies

The Kinneola, California, firestorm drew thousands of firefighters, the U.S. Forest Service, local law enforcement, the Highway Patrol, and emergency medical services to support firefighting and rescue efforts. Also on site were the Red Cross, the Salvation Army, Los Angeles Parks and Recreation, utility companies, railroad and transportation, volunteers, and the media. As the fire raged out of control, the VHF channels used for tactical situations became overloaded and communications interoperability became increasingly difficult. Although all fire departments were supposed to be equipped with VHF radios, some did not have them and others had changed the designations of the tactical channels.

— Source: ATLAS Project Report

- State and Federal emergency management agencies
- Local, State, and Federal government officials
- Media
- Medical community
- Utilities
- Private agencies

How do I need to communicate?

- Direct voice communication
- Direct data communication with access to multiple data sources
- Cellular telephone
- Fax
- Email
- Web site

What information do I need to exchange?

- Records management information
- CAD (Computer Aided Dispatch) data
- Intelligence information
- Unit status
- Incident management information
- Traffic information
- Weather information
- Road information
- Bureau/Department of Motor Vehicle information
- Criminal history, stolen property, wants and warrant information
- Pictures, including mug shots, incident and accident scene photos
- Inventories/lists of resources available and /or needed
- Building plans
- Hazardous materials handling information
- Medical information
- Direct voice interaction
- Direct data messaging
- Other data sources

When do I need to exchange information and communicate?

- Should this communication link be available at all times?
- Should the communication link have to be connected by someone?
- How much time is acceptable to develop this communication link?

Under what circumstances does the agency need to communicate?

- Criminal investigations
- Traffic-related incidents
- Manmade and/or natural disasters
- Terrorist attacks
- Routine duties
- Special events (sporting events, civil disturbances, demonstration, holidays, etc.)
- Other functions

Where are you now?

Identify your current communication/information systems' status.

My agency can communicate with the following agencies:

- Local, State, and Federal public safety and transportation agencies
- Other government agencies
- Local, State, and Federal government officials
- State and Federal emergency management agencies
- Media
- Medical community
- Utilities
- Private agencies (Which ones are key to your agency?)

Which agencies need to communicate but can't do so using the current radio communication systems?

My agency can communicate using the following methods:

- Direct voice communication
- Direct data communication with access to multiple data sources
- Cellular telephone
- Fax
- Email
- Web site

How can you accomplish this critical task?

My agency can exchange the following information:

- Records management information
- CAD (Computer Aided Dispatch) data
- Intelligence information
- Unit status
- Incident management information
- Traffic information
- Weather information
- Road information
- Bureau/Department of Motor Vehicle information
- Criminal history, stolen property, wants and warrant information
- Pictures, including mug shots, incident and accident scene photos
- Building plans
- Hazardous materials handling information
- Medical information
- Direct voice interaction
- Direct data messaging
- Other data sources (list)

The communications links are available:

- At all times
- Link has to be connected by someone (e.g., physically established by dispatch personnel)
- The time is acceptable to develop this communication link

Under the following circumstances, the agency can communicate:

- Criminal investigations
- Traffic-related incidents
- Major manmade or natural disasters
- Terrorist attacks
- Routine duties
- Special events (sporting events, civil disturbances, demonstrations, holidays, etc.)
- Other functions (list)

How do you get where you need to be?

Who should be involved in developing the interoperability plan?

- Who are the stakeholders that need to be involved in the planning?
- Which decisionmakers should be involved in planning?
- What type of technical and field expertise will be needed to develop the plan?
- Will outside expertise be needed to develop this plan?

What are the roles and responsibilities of all agencies that are involved?

- Law enforcement
- Transportation
- Emergency medical services
- Fire
- Utilities
- Emergency management
- Other (list)

Will addressing this problem enhance your ability to serve and protect the citizens?

- Is the plan cost effective?
- Are goals realistic and attainable?

Who are potential partners, champions, and allies?

- Who has resources that can be shared to help agencies involved accomplish their missions?
- Who understands the communications problems faced by those involved and is willing to champion the process?
- How can the plan include shared networks and resources?
- How can trust be built into developing the plan?
- How can all parties feel ownership in this plan?
- How can more of them be enlisted to join the effort?
- What political partners, champions, and allies can be developed?
- What media partners, champions, and allies can be developed?

What are the priorities of the plan?

- What should be done in the first phase (most critical)?
- How many phases will the plan require?
- How much time is needed to accomplish the plan? (controlling expectations)

What are the technical solutions available to address the problem?

- Technical plan

What funding is available to address the problem?

- Grant funds (local, State, Federal, private)
- General funds

What can I do right now?

There are a number of interim solutions that can be implemented in the short term to improve the level of communications interoperability. Some of these solutions include the following:

Deploying second radios

In jurisdictions where there is a need to communicate with another jurisdiction with an incompatible system, one solution is to provide a second radio in patrol cars or fire or EMS vehicles. If the radio installed is a VHF or UHF unit, this can be a relatively low-cost solution. There are some disadvantages—it can be difficult for personnel to monitor different systems, especially during an emergency, and installation space for additional radios is often at a premium in modern emergency vehicles. Most important, interoperability occurs only when within the coverage of the other radio system or when talking point to point.

Channel patching

Various technologies are available to "patch" or connect different radio frequencies. The simplest form of patching is installing a radio that can access another system in the dispatch center and making an audio patch with wiring. A more technologically advanced example of patching, the ACU-1000, connects each attached radio through a switching system. The dispatch center has a computer program that allows point and click connection of various agencies. More than one patch group can be connected simultaneously to

- Special funds
- Other funds (list possible sources)

Once the answers to these questions have been carefully considered, you will have a more accurate understanding of communication system needs and how to ensure that your system meets current and future needs.

What financial resources are spent on public safety communications?

The nationwide investment in radio systems and supporting infrastructures for most public safety and public service interoperability is already substantial. As agencies replace aging equipment and adopt new technologies, the amount of money invested in telecommunications equipment will continue to grow. What existing radio communi-

Interim solutions to improve interoperability

a number of operations, and cell phones can also be connected to other radio frequencies. Unless the ACU-1000 serves as a transmission site, it and other forms of patching work only in those areas where system coverage overlaps. Other similar products exist.

Radio cache

In areas where day-to-day and first response mutual aid interoperability is good, a cache or stored supply, of portable radios can be used to provide interoperability to second-echelon mutual aid. As an incident develops, new personnel arrive at the staging area. As assignments are made, personnel are given portable radios with the channels necessary to communicate with incident command. Portables are multi-channeled and on-the-spot programmable so that additional channels can be added as needed for tactical operations.

Use of commercial services

In some circumstances, cell phones, and other commercial services, can bridge an interoperability gap. The applicability of these solutions for general public safety communications is limited by cost and lack of flexibility. The Federal government is working with the commercial services industry to provide priority access services over cellular phone systems to a limited number of public officials across the country.

cations infrastructure do you already have? What financial resources are budgeted for public safety communications? What are you already spending on public safety communications? Developing interoperability does not necessarily require new spending—planning for interoperability can be incorporated into the process of replacing and upgrading radio communication systems.

Change is difficult and when change comes with a price tag, it becomes even more difficult. Prior to looking outside of the community, jurisdiction, region, or State for possible solutions, a complete assessment of the resources—both the existing public safety communications system infrastructure and financial resources—that already exist must be conducted. Once this list is developed, then appropriate actions can be determined to fill in the gaps. Each community, region, or State has a reservoir of hidden or untapped resources. Conducting this assessment avoids the duplication of existing resources and unwise expenditures of time and money.

Agencies with similar needs may be duplicating each other's purchases or could benefit by working together to achieve economies of scale. How much could you ultimately save if you coordinated planning and spending with other agencies or jurisdictions in your community, region, or State? For example, the cost to procure equipment for a 5-channel digital trunked radio system with 500 users and a single base station site, as would be found in a medium-sized community with a population of 75,000 to 100,000, has been estimated by industry to cost around $2,700 per user. If this community could consolidate with surrounding communities to implement a 20-channel digital trunked radio system with approximately 2,400 users and 2 base station sites, as would commonly serve a population base of 375,000 to 500,000, the cost per user drops to $2,400—a savings of about $300 per user or a savings to the original community of 500 users totaling about $150,000.

It should be noted that this cost analysis example highlights the costs of standalone versus consolidated systems, based upon the cost reductions that can be obtained through large purchases and the efficiencies obtained with larger trunked radio systems. This example is based on implementing new technology, digital trunked radios in the radio bands most commonly used by today's first responders, primarily fire and law enforcement departments.

With annual radio system maintenance costs of about 10 percent of equipment costs, this same community of 500 users would double this savings over the typical 10-year life of this radio system. Importantly, this savings is for equipment costs only. Ongoing personnel and equipment savings from the consolidation of dispatch centers can easily exceed this equipment savings each year. A major advantage of consolidation is that interoperability among the users of the consolidated system is inherent in the design of the system, assuming proper operational guidelines are developed by the participating agencies.

Emerging Technologies

Technology is changing at a rapid, almost exponential rate. Future communication systems may be web based or use satellite technology. As you plan, consider how technology development may affect your long-term interoperability solutions.

Software defined radios
Not yet universally available or optimized, software defined radios are a different concept than the traditional radios that are limited by their design to operate in a narrow portion of the radio spectrum. A software defined radio is a universal radio that can talk to many different types of radios. It uses software to perform all of its signal processing, allowing a single communications device to communicate with many different wireless systems by simply running different software. For example, a device can be re-programmed to be an analog cellular phone, a digital PCS phone, a cordless home phone or even a garage door opener, baby monitor, or television. In addition to incorporating multiple communication devices into one, a software radio can be upgraded to enable new standards and services. Technical and regulatory hurdles must be overcome before software defined radios become a reality.

CHAPTER 4:
How Can You Achieve Interoperability?

Achieving interoperability is a challenging job. This is not a "one size fits all" problem and there is no single solution. There are short- and long-term strategies for solving interoperability—some involve improving coordination and cooperation, while other strategies require longer term planning and implementation of new systems, policies, and operating procedures. Understand what your first responders need. Planning needs to include policies and procedures, developing a governing structure, and identifying potential resources. Encourage realistic expectations, solutions take time.

Understand what your first responders need. Planning needs to include policies and procedures, developing a governing structure, and identifying potential resources.

Developing a plan for improving interoperability

A well-developed, coordinated plan is the cornerstone to any successful initiative and accomplishes the following:

- Defines the vision, goals, and objectives of what you are ultimately trying to accomplish.
- Describes the specific problems or needs that are to be addressed.
- Identifies any potential partners and their roles and staffing requirements.
- Proposes a detailed budget and timeline.
- Outlines a marketing strategy.
- Includes an operational plan that addresses how the project will be funded now and in the future.

Without adequate planning you will not know what you have, where

you want to go, or what you need to get there. Mistakes will be made, time and money will be wasted, and the end result may not be what you intended.

Role of elected and appointed officials in the planning process

Elected and appointed officials are responsible for approving the annual public safety budget. In this role, they can help to eliminate barriers to interoperability by encouraging public safety agencies to engage in cooperative planning, investment, and operations.

Elected and appointed officials should consider asking their public safety agencies the following questions:

- What is the public safety vision of an interoperable radio communication system? What are the goals and objectives? What actions can elected and appointed officials take to help make interoperability a reality?

- Is there a well thought-out, coordinated plan to develop interoperable radio communication systems for public safety agencies within the jurisdiction? If not, why not? Has the elected or appointed official read or been briefed on the plan?

Planning principles

A plan is developed by examining existing conditions and needs, considering opportunities and alternatives, and adopting goals and objectives. Interoperability plans should comprise the following components—a communications system plan; a deployment plan; an operations, maintenance, and training plan; and a financial plan.

There are several principles to be considered when developing a plan for interoperability:

- It should be standards driven. It is easier for different jurisdictions or different departments to work together if they develop mutually agreed upon standards or values.

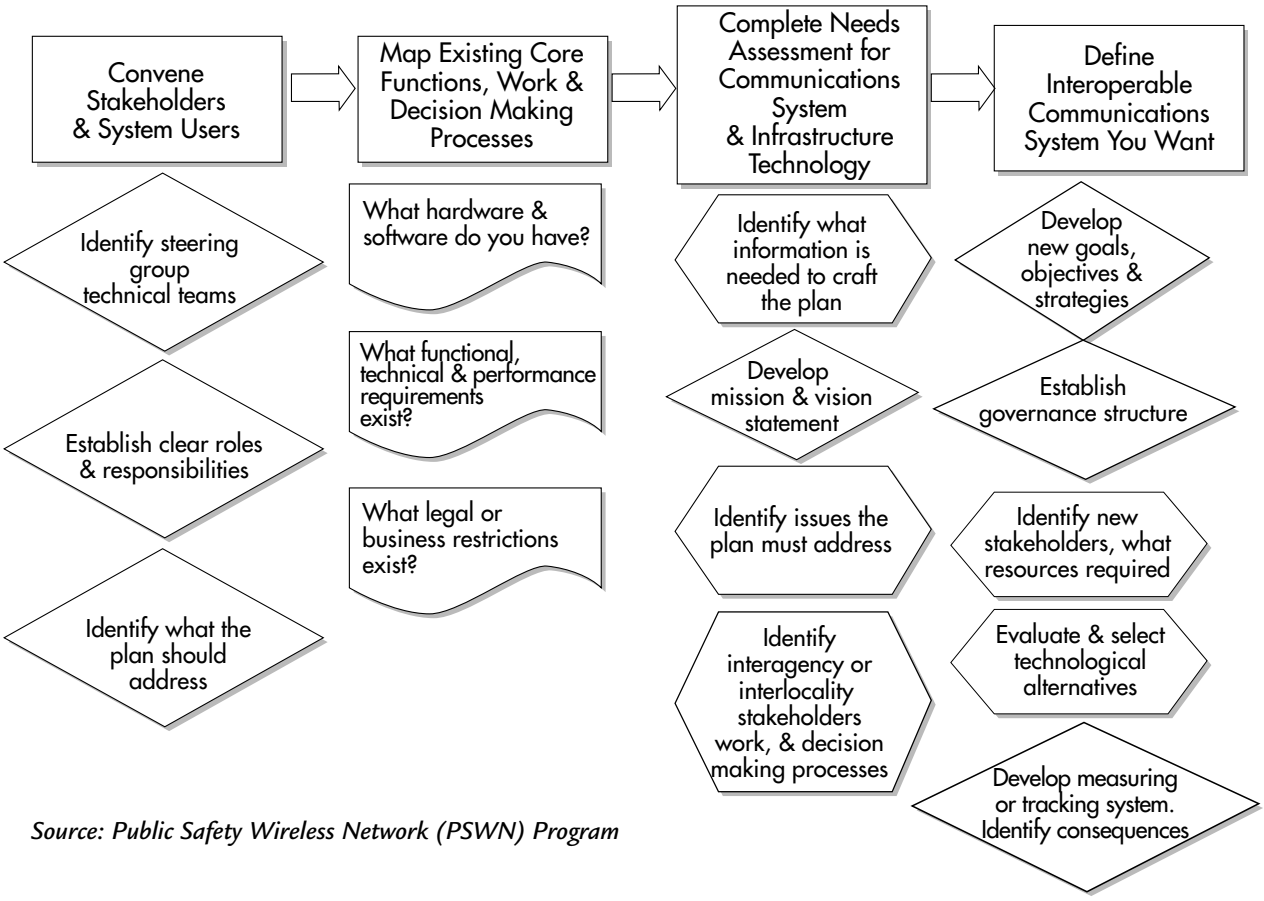
- It should be scalable. The solution should be able to accommodate

more than one range or level. For instance, it should be able to be used locally between agencies or localities, statewide, and at multi-state and national levels

- It should provide an ROI [Return on Investment]. The planners should be able to determine the return on the resources invested to the community, region, or State so constituents and agencies can understand what is gained in human and financial terms by developing interoperability.

- It should allow for incremental development. Most States, regions and communities do not have the resources to develop full interoperability in one budget cycle. Develop a plan that can get the job done in smaller steps.

Interoperability Planning Process Flow Chart



Source: Public Safety Wireless Network (PSWN) Program

- It should ensure internal and external security. Any architecture developed to create interoperability should be able to maintain existing secured information and maintain the privacy level for data required by law.

- It should ensure there is interface with political approval processes and that it can accommodate normal budget cycles, legislative structures, agency roles, and decision-making cycles.

CHAPTER 5:
Governance Structures for Improving Interoperability

Making interoperability a reality requires public safety agencies and jurisdictions to work together to develop common solutions and systems. The primary reason public safety radio communication systems are not interoperable today is because agencies within jurisdictions and neighboring jurisdictions have developed radio communication systems independently.

The primary reason public safety radio communication systems are not interoperable today is because agencies within jurisdictions and neighboring jurisdictions have developed radio communication systems independently.

What is a governance structure?

A governance structure is the group that is authorized to make decisions about and oversee the implementation of an interoperability initiative. The governance structure can be an existing board, committee, council, or commission that has been authorized for this job, or a board, committee, council, or commission that has been created specifically to oversee the interoperability initiative. Governance can also be the shared responsibility of two or more entities or individuals.

Why create a governance structure?

Technology itself cannot solve all problems and even the best-equipped effort will soon bog down without an effective governing body to chart its course. A well-defined governance structure improves the process of any major project, particularly the challenging process of developing interoperability, by enhancing communication, coordination, and cooperation; establishing guidelines and policies; and reducing turf battles. Governance structures play a crucial role in securing funding for local, regional, and State efforts. For many agencies, jurisdictions, and States, funding is a key barrier to interoperability—funding for both the interoperability initiative itself and funding for the governance structure that will plan and implement the effort.

Another important advantage of a governance structure is the level of jurisdictional and agency equality it brings to the effort. It can set the stage for involvement by small agencies that might not otherwise have the resources or the inclination to participate in a large agency or jurisdiction dominated regional consortium.

Governance structures must weather political storms and other changes. The governance structure and its vision, goals, and objectives may need to be reviewed as the interoperability effort moves forward to ensure that it continues to meet the needs of the effort as it evolves. Because elected and appointed officials typically hold seats on the board or committees, the governance structure is affected by political cycles. The composition of the structure may change radically every 2 to 4 years, and it is possible to lose a strong supporter; however, this does not need to overshadow the important contributions that elected officials can make to the governance structure. In this context, the support for and process of the interoperability effort must become institutionalized.

What do public officials need to know?

To exercise leadership successfully, public officials do not need to become radio communication technology experts, but they do need to know the answers to the following questions.

- What vision of interoperability do the public safety agencies have? What do they hope to accomplish? What is the mission of the interoperability effort?
- What are the goals and objectives of the interoperability effort? What do you want to achieve and how can you get there? What problems do you want to solve? What systems need to be interoperable to solve the problems identified?
- Who are the stakeholders? Who are the lead agencies, if any? Who are the users and how many would be impacted as a result of interoperability?
- What kind of agreement do you need to create a governance board? Memorandum of understanding (MOU), joint powers agreement, statute or ordinance, or informal guidelines.
- Which agencies and officials should be included in the governance board? Law enforcement, including State police, State patrol, sheriff and police; fire department; EMS; transportation; social services; public works; schools; elected and appointed officials; and others.

The governance structure generally performs the following tasks:

- Defines a vision for public safety communication interoperability that addresses the nature, scope, and objectives of the effort.
- Develops a strategy for implementing interoperability.
- Formulates and approves policy to guide implementation and operation of the interoperability system.
- Oversees implementation-related activities, including infrastructure, equipment, and others.
- Identifies and addresses implementation issues, including resolving conflicts and overcoming obstacles affecting interoperability.
- Identifies and quantifies fiscal and other resource requirements associated with the implementation of an interoperability effort.
- Facilitates cooperation and collaboration among the principals within participating agencies.

The additional key element—leadership

Leadership is key to the success of the interoperability initiative. Leadership can come from political leaders, agency heads, public safety, or well-respected members of the community, region, or State. Because of the particular challenges of developing interoperability, it is important that the leader or leaders assume the role of project "champion." Public officials are faced with hundreds of competing needs as they make decisions that define policy and fund government services. Because there are so many priorities, a champion must be able to emphasize and keep alive the significance and importance of the interoperability issue for the decisionmaking body.

A leader must be committed to the vision and goals of the effort and able to focus on the project until its completion. An effective leader must be knowledgeable about the issues and able to communicate the benefits of interoperability to the general public. An effective leader

"Fire and rescue departments from different jurisdictions routinely work together to provide emergency services to the public, but they cannot always communicate with one another. It is critically important that the entire fire and emergency services community support the need for improved communications interoperability and additional spectrum. State and municipal officials and the organizations that represent them nationally, working with emergency first responders, are an integral part of this significant effort to improve interoperability."

Chief Randy Bruegman, President, International Association of Fire Chiefs

understands political and institutional dynamics, has the respect of the rest of the team, and the passion and time to devote to the effort. Good strong leadership is key to direct inclusive, collaborative planning at the local, State, and Federal levels. Nothing moves fast without a champion.

Guiding principles for a governance structure

Ensure involvement and participation from all agencies and jurisdictions involved. Turf battles can significantly be reduced or eliminated if all relevant agencies and jurisdictions, regardless of size, are brought to the table and allowed fair involvement and participation.

There is no right or wrong way to build a governance structure. Governance structures can be formal or informal but tend to begin with agreements, such as MOUs, by the people who will be most affected by the structures. Governance structures can be created in a number of other ways as well, through State law, joint powers agreements signed by agencies in separate jurisdictions or by several jurisdictions in a region, or signed charters or other agreements. Whatever the agreement, the document should be a statement of general goals that identifies the members and the decisionmaking process.

As you establish a governance structure, consider the following guiding principles.

- Ensure involvement and participation from all agencies and jurisdictions involved. Turf battles can significantly be reduced or eliminated if all relevant agencies and jurisdictions, regardless of size, are brought to the table and allowed fair involvement and participation. If a statewide or regional system is being developed, the governance structure should be representative of all the disciplines and levels of government.
- Set realistic goals and objectives with a reasonable timeframe for the plan to work.
- Identify immediate short-term successes that can be achieved early on in the planning process. Such achievements will motivate participants to strive for long-term accomplishments.
- Explore and secure funding for both the governance structure to be able to do its job and to fund the interoperability effort. Funding problems and concerns are major obstacles to interoperability and can mean success or failure of the effort.

- Maintain ongoing, open lines of communication with all agencies and jurisdictions involved. A governance structure helps to facilitate ongoing dialogue and other communication between the stakeholders. With all parties, or representatives of the parties at the table, needs and concerns will be addressed to the extent possible. Structures can be destroyed when decisions are made by cliques within the structure, when essential parties are excluded from the communication links, and when parties involved are not open and honest.

- Obtain the support of county boards, mayors and city councils, governors and State legislators, and other elected and appointed leaders. Many efforts fail because they do not have the support of elected and appointed officials, such leaders do not understand public safety radio communication needs, or they do not include elected and appointed officials in the planning process.

The key to a successful effort resides within the strengths of committed leadership and the governance structure. Well-defined and structured governance will empower the effort because it requires the cooperation of both the public safety agencies and elected and appointed officials. These groups possess the detailed process knowledge about their communities, regions, or States that can provide deep and broad perspectives on interoperability needs. Elected and appointed officials can play vital roles in the development, implementation, and institutionalization of interoperability. Working together, they can give governance structures a voice in the political arena and statutory authority, help fund interoperability efforts, and bring professional management and knowledge to the process.

Examples of mechanisms to establish governance structures

A number of mechanisms to establish governance structures have been or can be used to formalize partnerships between agencies and jurisdictions. Examples include the following:

- **A voluntary consortium** can be as simple as a series of informal meetings of public officials from several agencies or jurisdictions to discuss how to improve interoperability. These early meetings generally expand to include other stakeholders. It offers flexibility and adaptability in improving interoperability across jurisdictional

boundaries. Often, this type of organization is better able to focus on user needs and outcomes.

- **Joint powers** is a written compact or agreement that specifies participants, structure, and funding, accompanied by a set of bylaws.

- **State agency leadership** relies on the State's resources and expertise to launch the effort to improve interoperability. This approach can be used to host or incubate initial efforts until a longer term governance structure is formed or it can serve as the long-term host of the effort; for example, an integrated public safety commission.

- **Local jurisdiction as host** is formed when a local jurisdiction, such as a city or county, agrees to lend its expertise to an interoperability effort. Few policy decisions would be made by the host jurisdiction, instead those decisions would be made by all participants.

- An **interstate compact agreement** and organization is a written contract among States to cooperate on a policy issue or program that extends across and through State boundaries. Such compacts can gain additional authority by receiving approval by Congress.

- **Public authority or quasi-government taxing authority** is a government business organization that has dedicated sources or revenue and the ability to operate independently of other jurisdictions.

- **Metropolitan planning organization sponsorship** involves at least some initial association with the federally designated Metropolitan Planning Organization (MPO) in a region, most often known as Councils of Governments (COGs). These organizations offer the advantage of bringing a regional or multi-jurisdictional perspective to solving problems.

- **A Memorandum of Understanding (MOU)** is an agreement of cooperation between organizations that defines the roles and responsibilities of each in relation to others with respect to an issue over which the organizations have concurrent jurisdiction.

CHAPTER 6:
Funding Strategies for Achieving Interoperability

Once consensus to seek an interoperable radio communication system is reached, the most difficult part of the process begins—funding the system. How much funding is needed will depend on the method chosen to achieve interoperability. The least expensive methods include channel patching or using a cache of radios. Funding for these interim solutions can often be found in existing budgets, but these methods have significant limits to their usefulness as discussed in Chapter 3.

Current budgeted amounts for communication systems can help to address the cost factor when combined with reallocated sources of funds and new funding resources, including Federal and private grants, leasing of infrastructure, and fees.

Developing a funding strategy

A funding strategy is a plan for how you will pay for all components needed during the entire life cycle of a system—the financial resources required for planning, operations, training, maintenance, and system replacement. A funding strategy may include more than one funding source. For example, a funding strategy could include financing the planning process with funds from the current budget, new equipment purchases through capital appropriations, and equipment replacement through a lease-purchase agreement over a period of several years.

Does your funding strategy for radio communication systems promote interoperability within your own jurisdiction? With other jurisdictions? If the answer is no, you are not alone. Many jurisdictions have started replacing their systems without thinking of ways to improve interoperability among their own agencies, but you can pave the way for interoperability by preparing for the next budget cycle.

- Understand the scope of the communications challenge. Make sure that agencies can provide an accurate, detailed report on the extent of the interoperability problem and what infrastructure and funds are really needed in the next year and in the next 5 years.

- Determine what is already being spent on radio communications technology on an annual basis. Your jurisdiction may already be spending dollars that can be incorporated into plans to replace or upgrade existing systems. Reprioritize those dollars to ensure that communications spending supports interoperability.

- Learn what cost-reduction strategies have been considered recently to handle the entire communication problem, not just radio communications. Traditional approaches to these projects, such as stand-alone systems built to serve one agency or one jurisdiction, can inhibit the consideration of different, more cost-effective approaches.

The key is to work together. As a group comes together, each participant can identify their own potential sources of funding. Identify ways that these sources can be tied together within the local, State, regional, and Federal government partners.

Obstacles to Avoid In Establishing a Governance Structure

✔ Turf issues among users, agencies, or governmental bodies
✔ Politics
✔ Inadequate funding
✔ Untrained personnel and support staff

Cost-cutting measures

The highest degree of interoperability is achieved when government entities agree to migrate to a single communication system that provides coverage for all. For a variety of reasons, trunked systems are usually the technical choice in this case, but, unfortunately, these systems are very expensive and require action by a governmental body to fund them. Currently budgeted funds for communication systems will not be enough to fund long-term efforts to achieve interoperable radio communication systems such as trunked systems. They can help to address the cost factor when combined with reallocated sources of funds and new funding resources, including Federal and private grants, leasing of infrastructure, and fees. The first step, however, is to look at innovative ways to cut the costs of implementing interoperability.

Many public safety agencies used shared systems and resources instead of building independent systems. Not only do shared systems support interoperability, jurisdictions can save money by leveraging economies of scale in making expenditures. Shared systems can be between different levels of government, such as a local, State, and Federal shared system; by several jurisdictions at the same level of government, such as several counties sharing resources; or by multiple agencies within one jurisdiction, such as one system for law enforcement, the fire department, and EMS. Partnering to create interoperable radio communication systems is practical aside from the financial considerations. It makes sense to

share tower sites and other infrastructure—nobody wants more towers in their neighborhood.

Shared systems

When multiple agencies or governments share a system, unfeasible under conventional systems, costs of the new system will automatically reduce for each agency. The cost of the infrastructure, controller, towers, fixed equipment, connectivity between the towers and its ongoing costs (maintenance, leased lines for connectivity, etc) are shared.

Volume pricing

Lower pricing, especially for user equipment, can be a byproduct of a shared system because of the higher volumes. It also can result in better pricing than smaller agencies could ever obtain because their purchases can be combined with those of larger agencies to obtain volume discounts. Developing purchasing alliances or compacts are another method of lessening costs. Agencies with similar needs may be duplicating each other's purchases.

Use of existing infrastructure

The cost of constructing a new tower with the site improvements and equipment needed for public safety can cost over $300,000 before the costs of the manufacturer's fixed equipment is added. If a governmental entity owns infrastructure that can be used for the new system or commercially available infrastructure can be found, significant reductions in costs can be realized. Tower companies will sometimes build towers for a prospective user of the site, such as a cellular or pager company, or to lease space for communication systems. The tower owner receives the benefit of having an anchor tenant. The conversion of upfront capital costs to long-term leasing costs can be of great benefit. Depending on how good the leasing rate is and how long the leased site is used, the cost of leasing can equal or even exceed the cost of constructing a new tower. A specific fiscal analysis must be conducted to determine which method makes sense.

Shared information

Contacting other governmental units that have already contracted with prospective vendors can provide valuable information on the prices the vendor has charged to others.

Presenting the case for funding interoperability

Radio communication systems are technologically complex and often less visible than other capital investments. The need to upgrade this critical infrastructure is often misunderstood. Separate local and State governance creates barriers to more effective, efficient, and often less costly shared systems.

Public officials know the difficulties in obtaining funding for more visible equipment such as new patrol cars, fire trucks, or ambulances. Obtaining funding for a new interoperable communication system is even more difficult. Examples of ways to present the case for funding interoperability include the following:

- Provide examples of other entities that have implemented a similar system and saved money over the cost of developing a stand-alone system.
- Bring in outside experts to confirm your position and confirm the benefits are real.
- Provide cost figures, if possible. Provide the assumptions used to develop the cost.
- Indicate cost-saving measures that have been taken to demonstrate fiscal responsibility.
- Engage the media's interest and therefore the public's long before the issue comes up for a vote by the fiscal body. Take the media and key decisionmakers on a ride-along to observe the problem firsthand. Demonstrate the difference between the old system and the new for the media and, if possible, for the decisionmakers.
- At the public hearing, fill the room with the persons most affected by whether or not the system is funded—public safety personnel in uniform. Make sure the attendees are representative of all the prospective agencies. Make sure that uniformed personnel contact their representatives consistently.
- Bring in other public officials who intend to become a part of the new system and who can testify that funding is necessary.

Financing methods

Financing methods most often used include lease purchase agreements, capital appropriations, and bond proceeds. A government entity can use more than one financing method to achieve full funding. It is important to remember that financing methods used to fund assets like radio communication systems generally must match the life of the asset. For instance, individual radios usually cannot be financed using bonds, but radio communication systems can.

Lease purchase agreements or fee for service

With most jurisdictions facing shrinking budgets, the search for alternative financing methods that do not require large capital investments has led to fee for service or lease purchase agreements. A private company or source can build and own the communications system and lease it back to a government entity for a charge, which usually includes a maintenance agreement.

Capital appropriation

As opposed to long-term financing, capital appropriation is in the pay as you go category. The funding comes from revenues that are collected from current year taxes and fees. The government entity sets aside the funds to be used for capital projects that usually take less than 10 years to pay back. Capital appropriations are also used to reduce dependency on long-term financing.

Bond proceeds

This is a long-term financing method that can be used for purchases that average 20 years to pay back. For instance, a government entity needing $5 million for towers and other infrastructure could prepare a public bond issue. The government entity obtains the money right away and makes payments through their debt service budget. A stream of revenue will still need to be identified to satisfy bondholders.

Revenue enhancement

Some local and State governments have adopted specific fees, increased existing fees, or diverted some of the revenues from existing fees to fund new communication systems. *The Report Card on Funding Mechanisms for Public Safety Radio Communications*, a detailed report by the Public Safety

Wireless Network (PSWN) Program, a program of the U.S. Department of Treasury and the Federal Bureau of Investigation, provides an in-depth review of existing funding options and new funding mechanisms.

- **E-9-1-1 fees**—Funding for interoperability can come from fees collected from special fees, such as the enhanced 9-1-1 fee for both landline and wireless communications. These funds are normally used to fund call taking and dispatch equipment in the dispatch center and equipment to determine the location of a wireless caller. Expect opposition from telephone companies who currently receive a great deal of the monies from these fees for lease or sale of the equipment, as well as from some dispatch operators who fear that they will receive less funding.

- **User fees**—Many interoperable communication systems charge user fees to other agencies based on the number of radios used by the agency. This is particularly effective in funding long-term costs; however, charging user fees can present fiscal and psychological barriers for agencies deciding to come on to the system.

- **Motor vehicle fees**—Some States have used either existing fees or increased fees on motor vehicle and boat transactions. Due to the large number of transactions, these fees can generate significant funds.

- **Gaming fees**—Several States having gaming operations that generate significant sums of revenue. Diversion of the existing revenue collected or increasing the amount of revenue collected can provide a significant source of funds, both in the short and long term.

Transportation funds

Some transportation funds can be used for public safety communications. Federal Intelligent Transportation Systems (ITS) and Congestion Mitigation and Air Quality (CMAQ) funds have been used for this purpose.

Public/private partnerships

Revenue can be generated by using a governmental entity's assets (towers or land) to develop leasing revenue from a commercial communications company. Of course, this can present significant public issues.

Other funding sources

Are you aware of the existing funding available through State and Federal sources that can supplement your local resources? Funding sources should be reviewed and prioritized based on whether they are currently available, they will last more than a year or two, and whether you can reasonably predict that this source will be around in the future.

A list of potential Federal funding sources can be found at the end of this guide.

CHAPTER 7:
Why Radio Spectrum Matters to You

What is radio spectrum?

If you asked the average person to define radio spectrum, most would not be able to provide a satisfactory answer, yet it is one of our country's most valuable resources. Radio spectrum transmits electronic signals. More than 98 percent of all public safety agencies use wireless radios as their primary means of communication. Without spectrum, the radios are useless. Originally allocated to voice transmissions, radio spectrum is now used to transmit video and data. As technology evolves, the growing number of electronic devices require more and more radio spectrum to operate. As a result, spectrum is fast becoming more scarce, more valuable, and more eagerly sought by competing private and governmental interests.

The radio frequency spectrum within the United States extends from 9 KHz [kilohertz] to 300 GHz [gigahertz] and is allocated into more than 450 frequency bands. 900 MHz [megahertz] cellular telephones are licensed to operate in a 900 MHz band and common garage door openers at 40 MHz. The Federal Communications Commission (FCC) regulates the use of frequencies and has allocated certain portions of the spectrum for the specific use of public safety agencies. Initially, almost all public safety communications were confined to the low end of the frequency range, but as technology advanced and improved, transmission at higher frequencies became possible and the FCC assigned frequencies in different bands, offering a temporary solution for congestion and crowding. The result—public safety operates in 10 separate bands, which has added capacity, but which has also caused the fragmentation that characterizes the public safety spectrum today. Imagine dividing the country into many slices and then placing mountains in between those slices. Getting one from one slice (frequency band) to another is made more difficult because of those mountains (non-public safety frequency bands). Many of the new digital 800 MHz trunked systems are based on proprietary techniques, so even when operating on the same 800 MHz frequency, communication from one manufacturer's radio cannot be heard by another manufacturer's radio.

Radio Spectrum Issues

VHF (25-50 MHz)
- ➢ Used by many commercial applications resulting in overcrowding
- ➢ No public safety quality radios being produced today

VHF (150-174 MHz)
- ➢ Inadequate capacity in most areas
  - ✔ Extreme overcrowding in metropolitan areas
  - ✔ Fully occupied even in rural areas
- ➢ Inefficient allocation between Federal/Non-Federal use

UHF (450- 512 MHz)
- ➢ Extremely crowded in metropolitan areas
- ➢ Heavily occupied in other areas

700 MHz
- ➢ Blocked by TV stations in most metropolitan areas until 12/31/06 OR when 85% of households have DTV
- ➢ Canadian/Mexican border issues
- ➢ Potential for interference from commercial services
- ➢ Equipment cost and tower siting requirements (due to more limited range than UHF/VHF) can be a problem

800 MHz
- ➢ Very limited capacity in most metropolitan areas
- ➢ Facing harmful interference from commercial users
- ➢ Equipment cost and tower siting requirements (due to more limited range than UHF/VHF) can be a problem

This resource, that cannot be seen or felt, but without which, lives could and would be lost, is critical to public safety agencies. It is not just in major disasters such as the World Trade Center terrorist act or the Oklahoma City bombing; it is vital for day-to-day operations—traffic and industrial accidents, police chases, drug busts, or just being able to communicate with one another from different sections of the city or town. Public safety mandates that personnel have access to effective radio spectrum not only to serve the public, but also to ensure their own safety.

Funding problems and concerns are major obstacles to interoperability and can mean the success or failure of the effort.

What has been done?

In 1995, the FCC adopted a plan regarding radio spectrum requirements at that time and through the year 2010. Recognizing that it did not have enough information from the user community to adequately address the problem, the FCC and the National Telecommunications and Information Administration (NTIA) established the Public Safety Wireless Advisory Committee (PSWAC) to evaluate the wireless communications needs of local, State, and Federal public safety agencies through the year 2010 and recommend possible solutions. The membership of the PSWAC encompassed a broad range of local, State, and Federal public safety agencies; public service providers; equipment manufacturers; commercial service providers; and the public at large.

The following year, PSWAC submitted its final report to the FCC and NTIA that sounded the alarm regarding the extent to which the lack of adequate radio spectrum hampered and would continue to hamper public safety mission-critical activities. This hue and cry indicated that an additional 97.5 MHz of radio spectrum is needed by the year 2010 to enable public safety to keep pace with its expanding needs. To date, only 24 MHz has been made available as the result of congressional and FCC actions and, unfortunately, this is not available due to TV incumbency. Even with this allocation, that still leaves a gap of 73.5 MHz of radio spectrum.

Most recently, the FCC has formed a Spectrum Policy Task Force to assist the FCC in identifying and evaluating changes in spectrum policy that will increase the public benefits derived from the use of radio spectrum. The Task Force recently released a report that addresses public safety communications issues, among other issues. A link to that report and FCC website addresses are provided at the end of this guide.

700 MHz and digital television

In 1997, Congress committed 24 MHz of the radio spectrum in the 700 MHz band to public safety; however, the reallocation is tied to the relocation of analog television channels as part of the television industry move to digital television (DTV) and upon the availability of equipment that can use that allocation. All radio equipment operating in this new band will be interoperable with the existing base of 800 MHz band users. Another portion has been allocated for direct licensing to the States. The 700 MHz band is particularly well suited for wide area (county, large city, State) systems that can accommodate all public safety users and are inherently interoperable.

In most major metropolitan areas, some or all of the 700 MHz radio spectrum allocated for public safety is blocked by ongoing television broadcast operations on channels 63, 64, 68, 69 (and to some extent by adjacent channels 62, 65, and 67). Current law permits those TV stations to remain on the air until December 31, 2006, or until 85 percent of households in the relevant market have access to DTV signals, which ever is later. There are about 250 million television sets currently in use in the United States. Only 3.5 million (14 percent) are capable of receiving DTV signals directly or through a set-top box and current prices for DTV are not consumer friendly. The ability of public safety to use the 700 MHz radio spectrum is contingent upon how fast the public replaces its analog televisions with DTV.

The timeline established by Congress for broadcasters to relinquish the spectrum is behind schedule and, at the current rate, it is unlikely that transition to DTV will occur by 2006. Milestones were also set, and to date, several have been missed. If the milestones are not met, public safety will be denied access to this valuable radio spectrum for many years. One final caveat—although the 700 MHz and 800 MHz bands are emerging as the primary public safety bands for the State and public safety community, at this time, no mobile, portable, or base station radio equipment operate in the 700 MHz band. Further, no public safety equipment is readily available that can support both bands, and since the 2006 date is somewhat elusive, no public safety agency can logically budget for equipment that uses radio spectrum that is not yet available for them. This inability to plan affects the manufacturers.

They will not fund development of radios when customers do not exist. They will not expend time, effort, and money until the spectrum is available and funds have been budgeted.

What about 800 MHz?

The existing public safety radio spectrum in the 800 MHz band is being used by many State and local governments for current wide-area interoperable radio communications systems; however, the 800 MHz band currently faces growing interference problems from commercial radio operations. The FCC is considering proposals to address that interference problem by clarifying responsibility for correcting interference and to reconfigure the band to reduce the potential for interference. Some of these proposals would also increase the amount of 800 MHz band radio spectrum available for public safety use, which would provide additional capacity for new and existing interoperable radio communication systems.

In addition to the interference problem, there is another problem facing the 800 MHz band. All of the designated public safety channels in the 800 MHz band are already assigned to users in most major metropolitan areas, leaving little or no room for new system development or expansion of existing systems. Radio spectrum in the adjacent 700 MHz band has been allocated for public safety, but as discussed previously, it cannot be used in most heavily populated portions because of ongoing television broadcast operations on the same frequencies.

Standards

Standards are helpful in promoting public safety communications interoperability. The use of standards for equipment and software may alleviate many of the interoperability problems faced today. This is not a new problem—the need for open standards in public safety wireless communications began about 20 years ago. Prior to that time, the technical compatibility of voice communications systems relied on the common use of frequency modulated analog or analog FM, signaling. In effect, this was the standard; however, as manufacturers began making improvements to the functionality and efficiency of their products, they began using signaling protocol that was unique to each manufacturer. They developed proprietary systems that were incompatible with other manufactured systems in the same way that the personal computers of the 1980s could not read each other's data or use each other's software. Due to this incompatibility, representatives of industry and local, State, and Federal public safety

agencies recognized the need to collaboratively develop standards for voice communications.

Through a joint effort of public safety users and multiple radio manufacturers, the ANSI/TIA/EIA-102 Phase I standard, commonly referred to as Project 25, became an example of a standard that can lead to improved interoperability. Project 25 consists of a suite of standards including procedures and specifications that are targeted specifically at mission critical requirements of public safety. Unlike many other communication standards and technologies, the user needs drove the development of Project 25, which has been endorsed by several public safety organizations and Federal Government agencies. Additionally, the Federal Communications Commission (FCC) has chosen the Project 25 suite of standards for voice and low-moderate speed data interoperability in the new nationwide 700 MHz frequency band based upon public safety user recommendations.

Making spectrum more efficient

Digital versus analog systems

The 700 MHz band is specifically set aside for modern radio systems with high spectrum efficiency that require digital technology. Digital technology has several advantages over analog. It is much more spectrally efficient, allowing a greater number of users over the same bandwidth. Digital signals have a better voice quality over longer ranges than analog signals. Digital transmissions are computer code, making encryption and increased security an inherent capability. Digital transmissions are easily encrypted by simply encoding and decoding the bits and bytes through software programming in the radio. And finally, data are data—whether voice, text, or full-motion video, it's all ones and zeros. This makes integrated voice and data radio systems easier and allows for the acquisition of one communication system instead of two redundant and highly expensive systems.

Trunked versus conventional systems

Radio systems utilize frequencies through conventional or trunking operations. A conventional system, still the most popular system type in the United States, utilizes a single dedicated frequency or channel for each specific communication requirement. If an agency has three frequencies for its radio system, it might use one channel for all car-to-station trans-

missions, one channel for station-to-car transmissions, and the other for car-to-car transmissions. When an emergency medical technician keys the microphone and transmits on a frequency, everyone else using that channel must wait until he or she is finished before making their own transmission. When no one is talking on a channel, that frequency is sitting idle and not being used.

Trunking is a relatively new radio technology, developed in response to frequency shortages in public safety to increase radio spectrum efficiency. Trunked radio systems provide a relatively efficient system for multiple agencies in a geographic area that can share a radio system. Trunking is a computer-controlled system that uses all the available frequencies in a pool, allocating an open frequency each time someone on the system pushes –to talk. Users are programmed into computerized groupings called talk groups, based on the operational criteria of the agency or agencies on the system. Patrol officers in a particular sector could be placed within one talk group, detectives in another, tactical teams in another, and administrative personnel. All of the system users utilize the same pool of frequencies. When a user keys the microphone, the system selects an open frequency and puts the user on it. When the user stops transmitting, that frequency immediately becomes available for the system to assign to the next user. In this manner, frequency idle time is drastically reduced, and users within a properly sized talk group spend far less time waiting for a clear talk-path.

Radio technology in use today is limited by geography. Radio communications depend on frequency assignments, which are specific to a geographic area, and on the physical characteristics of power and emissions that are limited to a specific radius around a radio tower. Towers can be interconnected and frequencies reassigned to create a large coverage area, such as a statewide radio system; however, the operations of an extended area system become extremely complex. Before the last few years, statewide systems were rarely constructed for public safety uses. Public safety relied on local conventional radio systems licensed to a single user organization. With the advent of trunked radio systems, carrying very high price tags and requiring complicated frequency coordination, the idea of regional, countywide, and statewide public safety systems with many user agencies is becoming more common.

The availability of adequate radio spectrum and interoperability go hand and hand. Any community, region, or State considering implementing or upgrading radio communication systems must understand the importance of this vital and limited resource.

CHAPTER 8:
Conclusions

Achieving interoperability is a challenging job, particularly in these times of budget shortfall for all levels of government. Without the collective voices of elected and appointed officials, without partnership, cooperation, and leadership at all levels, it's a job that will not get done. This guide can be the first step in developing interoperable radio communication systems that ensure we can talk. It can be the catalyst that initiates the public sector discussion required to develop interoperability.

Just as our economy and society are becoming more global, the business of protecting life and property on the local level has become more mobile, more sophisticated, more information dependent, and more dispersed. Needs are changing. The growing need for interoperability is affecting strategic decisions to share radio systems and dispatch centers, to build systems with extended coverage areas, and to establish systems as utilities rather than viewing radio communication systems in the traditional sense as an internal tactical and operations function. This conceptual growth and development is natural and useful. Ten years ago most cellular and paging suppliers were providing only local service, but they have recently combined their radio spectrum to create national services. As users become more dependent on mobility in a wider area, public safety radio has to evolve.

The more public safety and public service users are on the same system, the more inter-agency interoperability, both during day-to-day routine operations and during a crisis. Criminal deterrence and apprehension is improved, fire and EMS response is more efficient, and highway maintenance is safer. This means better public safety for all. As you begin to discuss and plan for interoperability, remember the following considerations.

Focus on and understand first responder needs.

First responders to emergencies include law enforcement agencies, fire departments, emergency medical services, and public service providers.

Understanding the interoperable communication needs of these responders should be a first step in improving interoperability.

Planning should include both short- and long-term strategies.

There are numerous strategies for improving interoperability. Some involve improving coordination and cooperation among responding agencies and jurisdictions, and can be implemented in the short term. Other strategies require longer term planning and implementation of new communications systems, policies, and operating procedures.

Focus on partnership rather than competition. Develop a common voice to facilitate budget and policy decisions. Make decisions through consensus where possible, with a strong bias toward inclusion.

Recognize that strength in improving interoperability is built by working together with agencies and jurisdictions that have traditionally been viewed as competitors. Developing a common voice with these agencies and jurisdictions at all levels of government will help budget and policy decisionmakers support efforts to improve interoperability. Making decisions through consensus, including as many of the various interests involved as possible, will strengthen these partnerships as well as the level of commitment to these partnerships by individual interests.

Encourage realistic expectations, solutions take time. Encourage investment in pilots, planning, and discussion. Utilize existing resources wherever possible.

Improving interoperability is a complex endeavor. There are no "one

size fits all" solutions. It may require agencies and jurisdictions to develop new and improved working relationships and could involve substantial changes in how individual agencies operate in terms of communication. Expect to make progress, but allow adequate time for the progress to be substantial. Sometimes the most progress is made through small steps that test strategies and approaches. These can provide a firmer foundation for future success.

Attempt to maximize economies of scale, but balance the size of the effort against diminishing return.

Economies of scale can be realized by sharing resources among agencies and jurisdictions. Leverage these economies through the participation of other agencies and jurisdictions, recognizing that as the size of the effort increases, the difficulty of implementing solutions may also increase while the benefits may not increase correspondingly.

Grant guidelines should encourage partnering to improve interoperability.

Most current State and Federal grants targeted at improving public safety communications are awarded to individual agencies or jurisdictions. Improving interoperability requires coordination and cooperation between agencies and jurisdictions. All awards should encourage guidelines, criteria, or requirements that encourage or provide incentives for agencies and jurisdictions to partner with others and work toward improving interoperability.