PUBLIC SAFETY WIRELESS NETWORK

Achieving Interoperability through Cooperation and Coordination

Wireless interoperability means no man, woman, or child will lose his or her life because public safety officials cannot talk to one another. The development of standards for digital public safety wireless communications is an important part of improving wireless interoperability. Standards help make public safety communications systems more compatible, so law enforcement personnel, firefighters, emergency medical personnel, and other public safety officials can talk with each other more efficiently and coordinate their efforts to save lives and protect property.

Standards affecting public safety communications have been in development for approximately 20 years. Solid progress has been made, but it is critical that these efforts continue. To raise awareness of standards-related issues and suggest some possible solutions, the Public Safety Wireless Network (PSWN) Program has developed this guide. I recommend it to you as a potential catalyst for improving and evolving existing standards. I would also like to thank my colleagues on the PSWN Executive Committee who contributed to the development of this guide and endorsed its contents. Special thanks go to the members of the Executive Committee and friends of the PSWN Program who gave additional time and effort to complete this guide.

Sincerely,

Mr. Steven Proctor
Executive Vice-Chair, PSWN Executive Committee, and
Executive Director, Utah Communications Agency Network

About The PSWN Executive Committee

The PSWN Executive Committee is comprised of senior-level executives from local, state, and federal public safety agencies from across the country. Members have proven expertise or accomplishments in the field of law enforcement, fire and rescue, emergency medical services, public safety communications and information technology. The objectives of the committee are to raise awareness on the communications difficulties encountered by public safety personnel and to provide program guidance to the PSWN program as it works to achieve interoperable public safety communications.

This guide was prepared by the Public Safety Wireless Network (PSWN) program. This program is a joint initiative of the Department of Justice and the Department of the Treasury. For more information, visit the web site at www.pswn.gov or call 800.565.PSWN.

PUBLIC SAFETY

Wireless Communications
Standards Awareness Guide

Today, the Nation is experiencing significant growth and population clustering in urban and urban interface areas. These changes have placed new and challenging demands on public safety service providers. They face threats of extreme life and property loss, not only from natural disasters—hurricanes, floods, fires, earthquakes, and the like—but also from terrorist threats and civil disturbances. Unfortunately, major emergencies have become more the norm than the exception. They require rapid response and coordinated information sharing by all public safety agencies—fire and rescue, emergency medical services (EMS), and law enforcement—from all government levels, local, state, and federal.

Many computer users remember when personal and business computers from competing manufacturers were completely incompatible. Peripheral equipment from one source did not work with disks and files from a second source or other system components from a third. The inconvenience was extremely frustrating. In addition, equipment costs were high and consumer choice restricted.

Today, public safety wireless communications systems suffer from similar incompatibility problems. With these radio systems, however, convenience is not the issue. Public safety wireless communications exist to help save lives and protect property. Law enforcement personnel, firefighters, emergency medical personnel, and other public safety officers need to be able to talk with each other to coordinate their efforts.

Instead, all too often emergency responders must make extra efforts to communicate effectively. Nearly all public safety personnel use two-way radios for communications, but when several agencies or jurisdictions respond to an emergency, they often cannot talk with each other. Police and firefighters in a given region, for example, may not be able to communicate via radio. Likewise, rescue personnel may be unable to communicate with their radios on a network operated by their colleagues in the next county. These problems result from a number of possible factors, such as inadequate coordination, insufficient funding, and the use of different frequency bands. Another major impediment is the technical incompatibility of public safety systems due to the development and proliferation of wireless communications equipment utilizing incompatible proprietary technology schemes.

Interoperability of public safety wireless communications systems is an issue that affects everyone in the Nation. If public safety personnel cannot talk to each other because of incompatible communications equipment, they may be unable to save citizens' lives or their own.

FM

Clear, unimpeded, immediate

INTEROPERABLE

communications are vital to the success of

public safety personnel in saving lives and

safeguarding property.

What Is the Problem?

The need for open standards in public safety wireless communications became urgent about 20 years ago. Previously, the technical compatibility of voice communications systems relied on common use of frequency modulated analog—"analog FM"—signaling. This was, in effect, a de facto standard. In time, manufacturers, working independently, began making improvements to enhance the functionality and efficiency of their products. Better systems emerged, but unfortunately, each manufacturer used a unique signaling protocol to provide enhancements such as trunking, and equipment from different manufacturers was incompatible. The problem was exacerbated a few years later when manufacturers again developed unique, proprietary protocols, this time to provide over-the-air encryption of sensitive information. This practice has continued, and vendors continue to build wireless equipment to incompatible, proprietary protocols.

Equipment manufacturers give various reasons for their reluctance to adopt open standards completely. Some contend it is problematic to build infrastructure equipment that fully complies with open standards because the standards usually contain intellectual property rights, or "IPRs." They argue that obtaining licenses for IPRs makes standards compliance too expensive. Some manufacturers also assert that building to current standards is too risky because of perceived uncertainties about "true standards" and because standards continually evolve in response to changes in technology and user needs. Problems notwithstanding, it should be noted that many manufacturers have been very active participants in standards development, and their contributions have been invaluable in achieving the progress made to date.

The public safety community generally believes that industry deals with IPRs in other (i.e., commercial) standards. For example, manufacturers license several IPRs included in the cellular standard (IS-95) published by the Telecommunications Industry Association (TIA). As a result, public safety users believe that IPRs should not impede equipment research and development for life-saving public safety systems. In addition, most public safety agencies have already endorsed a suite of standards developed through an American National Standards Institute (ANSI)-accredited process, so industry's actual risk should be minimized. These standards have been developed—with significant industry assistance—by TIA and the Electronic Industries Alliance (EIA), and the standards suite is called TIA/EIA-102. The public safety community also considers it reasonable for standards to continue to evolve. Its members believe that new standards-compliant equipment may also be made backward compatible to ensure reasonable interoperability with legacy equipment, such as analog systems. Further, the new standards-compliant equipment can be forward compatible with new standards being developed, to protect the community's investments in a manufacturer's equipment.

To increase its robustness, in fact, the present set of open standards needs to evolve, and manufacturers need to continue to play a major role in this evolution. Standards to address the "inter-subsystem interface," which includes the fixed-station and console interfaces, would strengthen the existing suite of voice and data standards. They would also promote increased competiti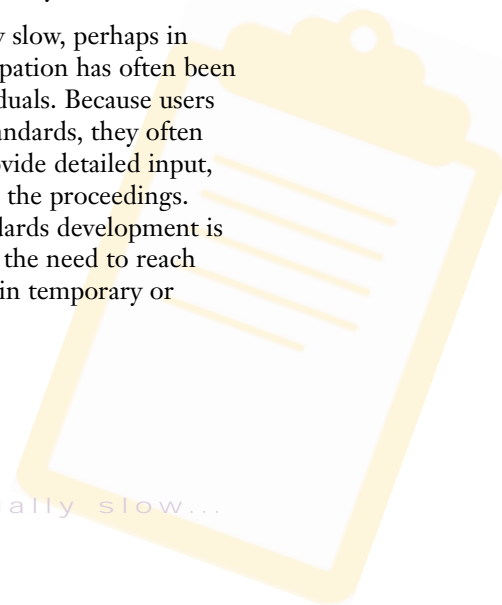on. As it stands now, in their absence, radio infrastructure components for a system *must* come from a single supplier because they are built to proprietary protocols. If an agency needs to join an interoperable network, for example, or expand coverage by adding a tower site using an existing trunking controller, it must buy the new equipment from the manufacturer that built the rest of the system infrastructure. Such lack of competition typically raises prices and reduces buyers' choices.
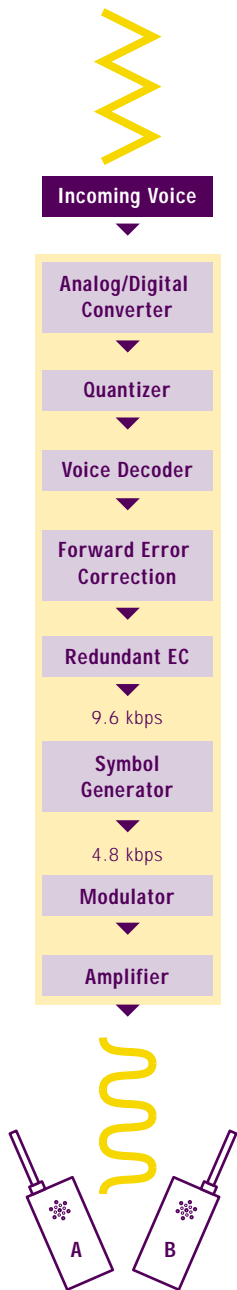
Standards development is usually slow, perhaps in part because public safety participation has often been the responsibility of a few individuals. Because users have much to gain from open standards, they often bring urgency, a readiness to provide detailed input, and a set of defined objectives to the proceedings. When user participation in standards development is limited, conflicting interests and the need to reach consensus may frequently result in temporary or extended stalemates.

standards

DEVELOPMENT

is usually slow...

Incoming Voice

▼

Analog/Digital
Converter

▼

Quantizer

▼

Voice Decoder

▼

Forward Error
Correction

▼

Redundant EC

▼

9.6 kbps

▼

Symbol
Generator

▼

4.8 kbps

▼

Modulator

▼

Amplifier

▼

A   B

Standardization under Project 25 permits conversion of voice sound waves to a digital format understandable by subscriber units and infrastructure components from any compliant manufacturer.

In general, the public safety community has lacked sufficient resources to support broad, vigorous, ongoing participation in standards development. Although some groups have contributed funds and staff time to standards development, additional resources are needed to dedicate personnel to the effort, defray frequent travel expenses, and pay for the engineering and public safety expertise necessary to analyze proposals from a technical, as well as an operational, perspective.

What Has Been Done?

Industry and individual members of local, state, and federal public safety agencies have engaged in a long-term standards development process known as Project 25. Working together, participants have established unambiguous sets of procedures and specifications that have been adopted and published by TIA and EIA. The results are commonly called the TIA/EIA-102 or Project 25 standards suite.

This successful, 10-year partnership between public safety and industry has developed voice and wireless data standards for digital public safety wireless communications. Current standards specify how voice sound waves are converted into digital format and how subscriber units (e.g., mobile and portable radios) and infrastructure components communicate with each other over the air. Together, these standards represent a major accomplishment.

In Europe, standards development has been under way for several years. The European Telecommunications Standards Institute (ETSI) defined the Trans-European Trunked RAdio

(TETRA), recently renamed TErrestrial Trunked Radio Access, as the digital trunked radio standard for Europe. TETRA was defined largely to meet the mobile radio needs of oil companies, utilities, railways, and authorities, as well as public safety providers. The standard was designed to accommodate Europe's high population density. Discussions are taking place in several forums to determine whether TETRA is viable for public safety use in the United States and, if so, whether it will help or exacerbate current interoperability problems.

Some manufacturers are also overcoming obstacles and beginning to build equipment compliant with the open architecture standards. Increased competition has already begun, with a number of vendors supplying standards-compliant subscriber units, enabling mobiles and handheld radios from different sources to interoperate. Likewise, two manufacturers now offer repeaters (i.e., equipment that expands communications coverage areas by retransmitting messages) for use in Project 25 systems.

In addition, states and regional consortiums are installing equipment that complies with the Project 25 suite of standards. The State of Michigan is the first to implement a standards-compliant system designed to provide radio communications for all state agencies. Local and federal agencies are also invited to join the system. As a result, the fully implemented system will provide the backbone for truly interoperable public safety communications across all government levels throughout the state.

Meanwhile, some users are precipitating action on additional voice standards. By providing enabling resources, for example, the Federal Law Enforcement Wireless Users Group (FLEWUG) and the Public Safety Wireless Network (PSWN) Program have recently prompted progress on the inter-subsystem interface standard. For Phase II, Project 25 has established two task forces, one to work on the fixed-station interface and the other on the console interface. When these efforts reach fruition, users should have increased selection of many trunked and conventional infrastructure components. When several manufacturers can offer an item, buyers often benefit from price and service competition.
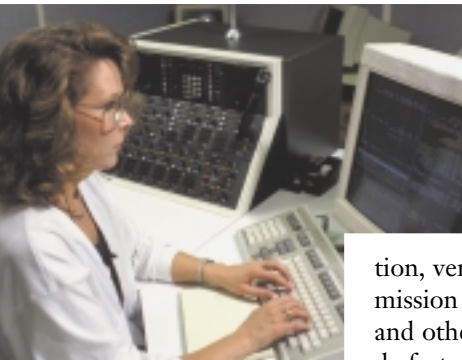
The Project 25 Steering Committee has also identified the need for wideband, high-speed data standards and established an effort commonly called Project 25/34. Project 25/34, in turn, will contribute to the Public Safety Partnership Program being created by TIA and ETSI to address data standards. In addition, very large present and potential data transmission markets have led commercial enterprises and others to create digital standards—sometimes de facto, but still effective. Cellular digital packet data (CDPD) is one example and the Internet Protocol (IP), another. Public safety agencies can often take advantage of these developments, either by contracting for existing commercial services or by incorporating these technologies into their own private networks.

What Remains To Be Done?

It is important for equipment manufacturers to design and manufacture standards-compliant radio infrastructure that is available to the public safety community. In particular, it would be valuable for industry to develop infrastructure compliant with open standards in the very high frequency (VHF) band. Although several state and local public safety entities are replacing their current networks with ultrahigh frequency (UHF) systems, the majority of U.S. public safety users—most state and local agencies and nearly all federal agencies—continue to operate in the VHF band. Federal VHF systems, for example, must comply with a National Telecommunications and Information Administration (NTIA) narrowband mandate to move to technology with improved spectrum efficiency by January 2005. As a result, virtually all federal agencies must replace their land mobile radio (LMR) infrastructures.

In a related effort, the public safety community should be made aware of available equipment that complies with accepted standards. Efforts are under way to establish interoperability processes and procedures and perform testing to verify standards compliance of LMR equipment. The results of all this work should be widely disseminated to help the broad public safety community continue to become increasingly educated consumers of wireless communications equipment. Likewise, proof-of-concept interoperability solutions using standards-compliant components should be piloted. The results of the pilots should then be showcased at public safety forums.
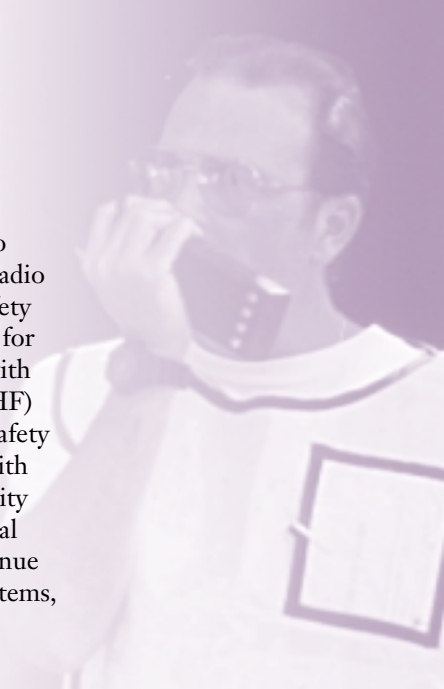
LMR *infrastructure*

It is also essential to raise awareness in the public safety community—through publications, videos, and conference events—about the importance of its involvement in the standards development effort. This endeavor is much too important to depend on the personal initiative of a few concerned users. It requires dedicated personnel with adequate travel funds and access to engineering expertise. These resources are imperative, given the value of the potential outcomes—efficient investment of public funds and effective, life-saving execution of public safety missions. The immediate investment promises near- and long-term payoffs in dollars and lives.
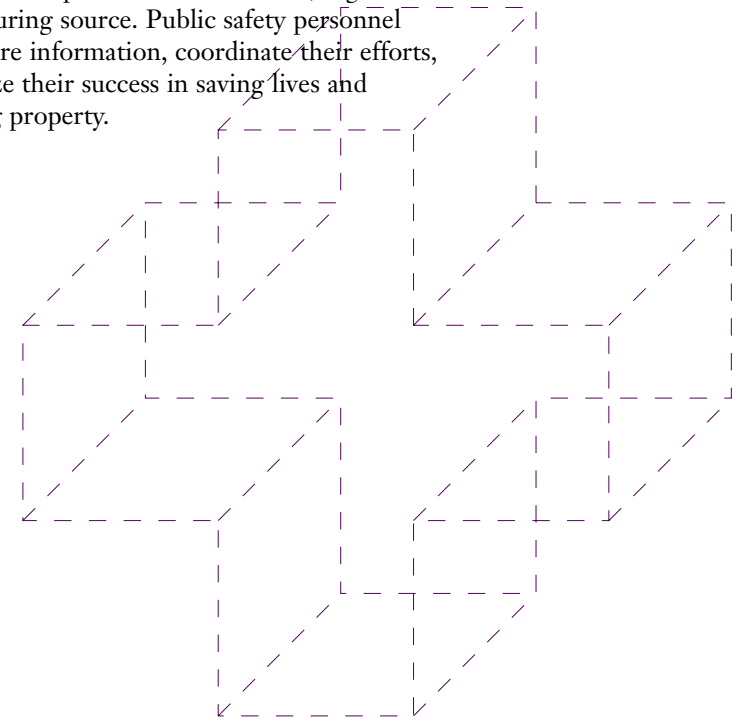
At the same time, the public safety community should guard against engaging in more standards development activities than it has resources to support. In this regard, it should assess thoughtfully whether to pursue the development of data standards independent of those already being created in commercial arenas and elsewhere. On the other hand, none of the many wireless data efforts in progress fully fits public safety needs. Public safety users must weigh the opportunity costs of attempting to use standards that do not fully meet their needs against the economic costs and operational advantages of participating in the standards development process to ensure satisfaction of their needs.

Why Does It Matter?

Public safety communications must be interoperable for everyone's sake. If public safety personnel cannot exchange information and coordinate their response to an emergency, they risk loss of life—their own and the lives of the citizens they protect.

Open standards must be adopted and implemented. When equipment is built to open standards, components can operate with each other, regardless of manufacturing source. Public safety personnel can then share information, coordinate their efforts, and maximize their success in saving lives and safeguarding property.
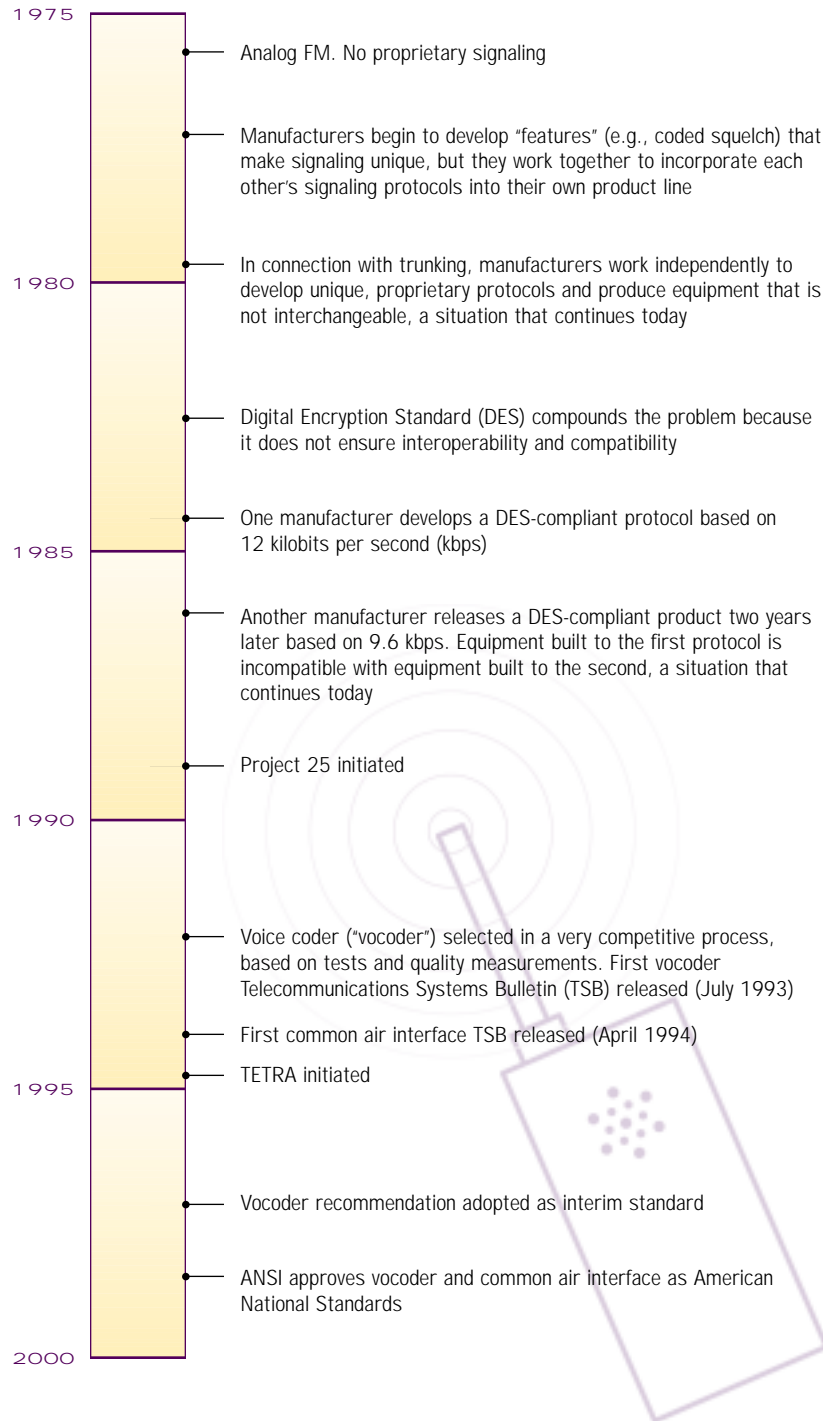
STANDARDS
lead to *inter operability*

Open Standards Development

1975

- Analog FM. No proprietary signaling

- Manufacturers begin to develop "features" (e.g., coded squelch) that make signaling unique, but they work together to incorporate each other's signaling protocols into their own product line

- In connection with trunking, manufacturers work independently to develop unique, proprietary protocols and produce equipment that is not interchangeable, a situation that continues today

1980

- Digital Encryption Standard (DES) compounds the problem because it does not ensure interoperability and compatibility

- One manufacturer develops a DES-compliant protocol based on 12 kilobits per second (kbps)

1985

- Another manufacturer releases a DES-compliant product two years later based on 9.6 kbps. Equipment built to the first protocol is incompatible with equipment built to the second, a situation that continues today

- Project 25 initiated

1990

- Voice coder ("vocoder") selected in a very competitive process, based on tests and quality measurements. First vocoder Telecommunications Systems Bulletin (TSB) released (July 1993)

- First common air interface TSB released (April 1994)

- TETRA initiated

1995

- Vocoder recommendation adopted as interim standard

- ANSI approves vocoder and common air interface as American National Standards

2000

For Additional Information

TIA 102 Project 25 Technical Documents

To obtain a CD-ROM containing most documents related to Project 25 which is distributed for public entities by federal provider National Communications System Technology and Standards Division (N6). Call 703.607.6200 or visit www.ncs.gov/n6. This CD-ROM is also available from The National Law Enforcement and Corrections Technology Center (NLECTC) for Federal, State, and local government agencies only. Please contact asknlectc@nlectc.org or call 800.248.2742.

Telecommunications Industry Association (TIA)

For information on APCO Project 25 Systems and Standards Definition Document and other more recent documents about Project 25, call 703.907.7700 or visit www.tiaonline.org/standards/search.cfm?keyword= project+25

Trans-European Trunked Radio (TETRA)

For more information on TETRA, latest updates, details concerning the memorandum of understanding between participating government bodies, the goals and objectives of this standard, and the future of the program, visit www.tetramou.com/MoU/index.htm

Association of Public Safety Communications Officials (APCO)

For information about Project 25 including technical documents, updates on standards, access to on-line interest groups, and discussion forums call 888.APCO.911 or visit www.apcointl.org

Public Safety Wireless Network Program (PSWN)

For information regarding public safety communications interoperability, and wireless communications systems planning and implementation, call 800.565.PSWN or visit www.pswn.gov