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Public Safety Communications and Interoperability

Key Points

- Challenges to achieving interoperability include incompatible radio equipment, lack of a common language, and the use of different frequency bands by different agencies.
- Radio technologies that promote interoperability include simplex or line-of-sight systems and conventional and trunked radio repeater systems.
- To promote interoperability, agencies should—
 - Optimize their internal communications systems.
 - Agree on basic requirements, set realistic goals, and collaborate to achieve a common goal.
 - Use low-cost solutions, such as preprogrammed radios, shared radio frequencies, and plain language (instead of agency-specific coded language).

INTEROPERABILITY CHALLENGES

Public safety agencies cannot communicate seamlessly for three primary reasons: incompatible frequencies, incompatible equipment, and lack of common language.

Incompatible frequencies. The Federal Communications Commission has authorized multiple bands of the radio spectrum for use by public safety agencies.

Four primary public safety bands exist:

- VHF Low or Low Band (30–40 MHz)
- VHF High (152–162 MHz)
- UHF (406–512 MHz)
- 700 or 800 MHz¹

Because agencies do not all operate on the same band, their communications devices are not interoperable. For example, a radio operating on a VHF Low radio system can communicate only with other radios in the same range with pre-programmed common frequencies.

Incompatible equipment. Even when agencies do use radio systems in the same frequency range, differences in equipment often prevent interoperability. Agencies that have different equipment can use a bridging device or gateway to connect the different systems or purchase a cache of radios to use in emergencies.² Using alternative radios for emergencies, however, requires first responders to carry and operate a second radio and requires agencies not only to pay for the additional radios, but also to monitor whether the batteries are charged.

Lack of a common language. The third barrier to interoperability is the lack of a common language among agencies. Many agencies now use numbered, coded language, such as “10-4,” which in one jurisdiction can mean “I understand” and in another jurisdiction can mean “Man down! Send backup!” Interoperability is more likely to be effective when public safety agencies use plain language radio communications, allowing first responders to accurately relay information from one agency to another.

RADIO SYSTEMS AND FEATURES

Public safety agencies rely on three main types of radio systems to overcome interoperability barriers:

- Simplex or line-of-sight systems
- Conventional radio repeater systems
- Trunked radio repeater systems

Simplex or line-of-sight systems. Simplex communication systems allow communication to flow in only one direction at a time. This type of radio communication does not rely on costly infrastructures such as tower antennas or repeaters—devices that regenerate or replicate a signal. Instead, first responders communicate using radios preprogrammed to common frequencies (commonly referred to as talk-around mode).

The drawback of a simplex or line-of-sight system is that it gives radio coverage only in a limited area, such as one city block. Such a limited coverage does not work for dispatchers, but it is used by firefighters and law enforcement special operations when they need their signals to penetrate a specific building or when operational security is critical.

Conventional radio repeater systems. A conventional radio repeater system uses a repeater installed in a place with a line of sight to a large geographic area, such as the top of a building or hill. A radio repeater system can be digital or analog and typically consists of one or more channels made up of input and output frequencies. Users select frequencies by changing channels. A conventional radio repeater system extends the operating range beyond what users on the ground can achieve. The drawback to the conventional system is that it is inefficient when used by large numbers of public safety personnel.

Trunked radio repeater systems. A trunked radio repeater system operates on the same principles as a conventional system. The difference is that a computer connected to a control channel sets the operating frequencies. When users press the push-to-talk button, they are requesting permission to transmit to a group of people who have the same privileges to use the channel. A group of users with common privileges is referred to as a trunk group. The control channel conveys a request to participate in a trunk group to the system, which recognizes the radio and assigns the correct privileges. If permission is granted, the system automatically directs the radio to the frequency that is assigned to the trunk group.

Trunked radio systems support many more users than conventional systems. The drawback is that they are generally much more complex and costly.

RECOMMENDATIONS TO IMPROVE INTEROPERABILITY

When choosing a system for a public safety agency, radio system planners need to conduct comparative analyses to determine which type of system is most appropriate for the environment and requirements imposed by their mission and operations.

The following are important tips to improving interoperability:

- Make sure your agency's communications systems work smoothly before attempting to be interoperable with another communications system.
- Sharpen your collaborative working relationships with other agencies before embarking on interoperability solutions.
- Get agreement from all stakeholders on a set of basic requirements and acknowledge that all systems need to be maintained, upgraded, and eventually replaced.
- Set realistic goals that fit the resources available and provide an achievable level of interoperability.
- Keep in mind these three low-cost interoperability solutions:
 - Preprogram all mobile and portable radios with national interoperability channels and frequencies (found at www.fcc.gov), a step that usually requires no additional infrastructure.
 - Share radio frequencies with neighbors on compatible radio systems.
 - Adopt plain language communications for day-to-day transmissions.

FOR MORE INFORMATION

- NIJ's Communications Technologies (CommTech) Web site: www.ojp.usdoj.gov/nij/topics/commtech
- Regional National Law Enforcement Technology Centers: www.justnet.org

NOTES

1. The 700 MHz band is allocated to public safety and will be available upon completion of the digital television transition on February 17, 2009 (see "Digital Television Transition and Public Safety," National Telecommunications and Information Administration, <http://www.ntia.doc.gov/otiahome/dtv/>).
2. For more information about implementing gateways, see NIJ InShort, *Interoperability Gateways/Interconnects*, NCJ 217105, March 2007.

