

Fire Engineering

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When silence isn't golden

BY LYNNETTE LUNA

On April 16, 2007, firefighter Kyle Wilson was part of a crew dispatched to fight a residential fire in Woodbridge, Va. He died in the line of duty.

A detailed report on the incident recently released by Prince William County Department of Fire and Rescue concluded that problems associated with the use of the county's Motorola digital trunked radio system contributed to the tragedy. Issues reported by other firefighters during that incident, which was further complicated by strong winds, ranged from signal distortion and transmission failure to radios displaying "out of range" signals.

Fire safety advocates now are encouraging fire departments across the country to study the incident in hopes that future tragedies could be avoided. Prince William County's fire department, through further tests, concluded that digital portable radios are "extremely vulnerable to poor environmental conditions and interference of digital noise from ambient sources, which negatively impact the ability of emergency personnel to effectively communicate."

A handful of fire and police departments, fearing the loss of lives, have opted to continue using analog systems even when the rest of their county's emergency personnel are using digital trunking systems.

The common complaint, which most affects fire departments, concerns the digital vocoder's inability to differentiate between a voice transmission and background noise - whether a chain saw, sprayed water or personal alarm. Background noise renders the voice transmission distorted and often unintelligible. Another critical problem is that digital radios lose contact inside buildings. "In most cases, it is a very political and sensitive position to abandon expensive technology and go back to something that is old," said Daryl Jones, owner and president of Telecommunications Engineering Associates, which manages public safety systems throughout the San Mateo area in California. "But many agencies are finding that complaints from line personnel, both in fire and police, are so significant."

The Boise (Idaho) Fire Department spent about \$1 million two years ago on mobile and portable radio equipment to join a cutting-edge countywide 700 MHz digital trunking system. While training users on the system, the fire department discovered problems with voice intelligibility when a firefighter's low-air alarm went off. That led the department to investigate the issue further, and it found more instances where alarms interfered with the quality of voice transmissions. Today, artment and other fire departments in the county remain on analog VHF radios while the rest of the county operates on the 700 MHz digital trunking system.

"Right now our dispatch center wants to dump VHF," said Paul Roberts, a captain with the Boise Fire Department, "[and] we are trying to look at alternatives to at least get on a system that will lessen the load on dispatchers having to patch all of this together. ... But until there is a solution to the digital processing of speech when you have competing noises, we have to stay on analog."

The problems associated with digital systems became known in 2006. Since then, the International Association of Fire Chiefs (IAFC) established a Digital Problem Working Group and appointed Chief Charles Werner of Charlottesville, Va., to serve as its chair. So far, the working group has explored the creation of a best practices solution to work around the problem until a long-term solution can be found. Prince William County's findings have been forwarded to that group for inclusion in the process.

The National Institute of Standards and Technology (NIST) also is analyzing the problem, as are radio manufacturers such as M/A-COM and Motorola. They are expected to jointly release a formal analysis - in conjunction with the IAFC - that encompasses best practices to help departments to minimize the problems.

"We're running through this scientifically and hope to distribute a wrap-up summary shortly," Werner said.

Roberts, who chairs the IAFC testing group, says the testing - conducted by radio engineers - involves taking words that sound alike and requiring the listener to distinguish which word is being said over the background noise of chainsaws and hose sprays.

Motorola declined to comment, saying it was cooperating with the testing and awaiting the conclusions from NIST and the IAFC.

But Chris Lougee, vice president with LMR vendor Icom America, says digital technology would help solve these background noise problems. "Everyone knew from the beginning that the P25 vocoder was a half-rate vocoder. As you speak into the microphone, you are converting human voice into a data stream that is reassembled at the end," Lougee said. "TIA ... is encouraging a move to a full-rate vocoder, which we are doing. It vastly improves the amount of audio and quality."

Lougee added that, scientifically speaking, digital signals penetrate buildings better than analog signals. "I'm puzzled by that problem," he said. "All of our testing shows that a digital signal produces a higher-quality signal in noise conditions than an analog signal."

Nevertheless, perception has a nasty way of becoming reality, and first responders' perceptions are based on what happens in the field and exacerbated by complaints from the front line.

"The perception of quality of communications in my opinion is much lower on trunked radio systems because it's always based on a comparison of what an agency had before," Jones said. "If they are coming off an analog system that provided 100% coverage and go to a digital trunked system that has different characteristics and less coverage, it's going to be worse."

However, others say the problems have to do with training, as digital systems operate differently than analog. For instance, digital systems require key-up time, forcing first responders to hold down the transmission key longer before they can begin talking. "It's a long and arduous process to educate police and firemen to change the way they have always communicated," Jones said.

But Roberts says best practices aren't the total solution. "They can be easily implemented on a normal day-to-day basis," he said, "but take the same firefighting crew and put them in a panic state. Then I would argue that a lot of best practices are not always utilized."

The Phoenix Fire Department peth the issue. In 2004, the department gathered radio experts and conducted a study of a 700 MHz/800 MHz digital trunked system that covered a 2000-square-mile area. The study concluded that radios lost contact inside buildings and that users often encountered delays and background interference. The department today still operates on a VHF analog system, despite the fact that the rest of the city operates on a digital system.

"Back when we first started working on this project and told our working group that we needed simplex channels, we got a lot of guff about it," said Leif Anderson, deputy chief with the Phoenix Fire Department. "It took us a month or two to finally give them enough information about our problems. ... The SWAT team is now using our simplex channels because they can't have a delay for critical communications."

Today, the department is close to finding a way to bridge its analog system with the rest of the city so that dispatchers don't become overwhelmed with patching the communications systems together, Anderson said. For nearly two years, the department has been studying the use of digital vehicle repeaters (DVRs) mounted on fire trucks that surround the incident area.

"Think of DVRs as being two mobile radios linked together, one working in simplex and the other in duplex or trunked mode," Anderson said. "We'd use the simplex mode when talking to each other on the fireground, but messages to the dispatch center go through the duplex mode."

The Phoenix Fire Department has done much testing of the DVRs around dense buildings that typically pose significant transmission problems. The department is now at a nearly 100% success rate. Now it is moving its existing drills throughout 19 different cities in the department's jurisdiction of about 2500 square miles.

Additionally, the fire department has developed standard operating procedures in case they lose communications. The procedures mostly involve repeating messages. For instance, to ensure a fireground message reaches the dispatch center, an incident commander on the outside - who also would have heard the message on the simplex radio - relays the message to the dispatch center. "We've always done this back forth, and it's always been successful," Anderson said.

The operating procedures also involve some changes to the DVRs. "There aren't many customers who use DVRs in simplex-to-trunked mode," said Anderson, "so our vendor had to do some algorithm work. We want every apparatus to have a master/subordinate relationship. If one failed, the next one would take over." Futurecom Systems is the department's DVR vendor.

In the future, Anderson expects firefighters to carry radios, such as the Motorola XTS 5000 radios, with multiple decks and talk groups that will enable first responders to do their jobs much the same way they do today. A call would be dispatched, and the firefighter would be told which tactical radio channel to switch to - simplex or trunked.

For Anderson, it has been a long and arduous process. "We have a saying, `The sooner we resolve this problem, the sooner we get to go back to the station,??' he said. "That applies here."

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