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MINERS QUICKLY ADOPT NEW COMMUNICATION SYSTEMS

While the jury is still out on post-accident survivability, mine operators are seeing productivity improve from better communications

BY STEVE FISCOR, EDITOR-IN-CHIEF

Another June deadline for underground communications systems looms on the horizon. Two years ago most mines were still relying on antiquated trolley phones and paging systems. Hello in the headgate! Are we cutting coal today? A little more than 18 months later, a massive scale-up in technology has taken place underground. Nearly every underground coal mine in West Virginia has a new communications system.

How well the systems work is a subjective matter the Mine Safety and Health Administration (MSHA) will begin to assess after June 15, 2011. The definition of a “complete” system is difficult to quantify. The amount of coverage varies from mine to mine and system to system. Whether any of the systems will provide post-accident communications also remains unclear.

Underground coal operators have two choices for approved systems: wireless mesh or leaky feeder. With wireless mesh, the prevailing thought is that hopefully enough nodes would survive a major incident and self-heal to recreate a network and

restore communications to the face. Leaky feeder uses a redundant set of cables that serve as a backbone for wireless devices. The hope is that one cable would remain intact. No one knows whether either system will survive a mine explosion. The explosion at the Upper Big Branch mine would be the first to occur with a communication system mandated by the MINER Act. The investigation may eventually reveal some insight to the damage that system endured.

What is clear is the mines that have invested in a quality communications and tracking system will continue to reap rewards. MSHA will more than likely select those systems as the best available technology and use them as a benchmark for the industry. Another huge side benefit is that many of these mines have become more productive because of improved communications underground. The miners went from arcane hardwire phones every 1,000 ft to having hand-held radios with texting capabilities—1960 to 2010 in 18 months.

Sadly, there are the mines that did just enough to get by—those that purchased cheap, inadequate systems. In addition to the headaches of dealing with a forced, compliant system that probably does not work that well, they will most likely have to pay more money to either upgrade or replace those systems.

The massive communications scale-up that swept through the coalfields has been a learning curve for the mines, MSHA and the vendors. Many are continuing to improve on the systems they have developed. Some of those improvements could potentially reshape mine-wide monitoring systems and mine management. Beyond what is considered an approved communications and tracking system today, others are still looking at alternatives such as through-the-earth (TTE) systems.

MSHA Sets Another June Deadline

As of December 30, 2010, MSHA claimed it processed 42 approval applications for communications and tracking technology. Since the beginning of 2006, the agency has issued 178 new or revised approvals for communications and tracking products. It has observed 80 tests or demonstrations of 36 different communications and/or tracking systems at various mine sites. The agency has met with representatives from 76 communications and tracking system companies and discussed nearly 200 different proposals for development of mine communications and tracking systems.

In a Procedure Instruction Letter (PIL) dated December 14, 2010, instructing district managers on how to evaluate Emergency Response Plan (ERP) compliance, MSHA said it believes a suffi-



A miner installs an antenna for L-3's ACCOLADE system.

cient number of approved systems will be commercially available in time to permit mine operators with existing approved ERPs to have post-accident communications and electronic tracking systems installed and operational by June 15, 2011. If the communications and/or tracking system specified in an existing ERP cannot be installed and operational in the mine by that date, the district managers will ask the mines to submit a revised ERP with available technology. Similarly, any communications or tracking system that is not reasonably expected to be installed and operational in the mine by June 15, 2011, should be considered “unavailable.”

While most underground coal mine operators currently have revised and approved ERPs, only a small percentage of mines currently have complete installations of post-accident communications and electronic tracking systems, according to MSHA. Many mine operators are waiting for equipment to be delivered or for the system manufacturers to begin installation activities.

MSHA hosted a communications and tracking manufacturer summit meeting at the National Mine Academy in Beckley, W.Va., on May 12, 2010. At that meeting, many manufacturers indicated they believed that they could fill existing orders relatively soon, while others offered compelling explanations for additional time to fill all existing orders. Based on information from those vendors, the agency determined that a sufficient number of post-accident systems will be commercially available in time to permit mine operators with existing, approved ERPs to have these systems installed and operational by June 15, 2011.

Wireless Mesh Becomes a Reality Underground

In 2006, L-3 Communications was working with a coal operator on security issues when the mine inquired about communications technology. Through its experience working with the Defense Advanced Research Projects Agency (DARPA), a research and development agency for the Department of Defense, and the Defense Information Systems Agency (DISA) contracts, the company believed it could provide a wireless solution for the mines. “We tested a product at a CONSOL Energy mine with some encouraging results. As we were thinking about how we were going to adjust the system to accommodate the industry’s needs, we discovered NIOSH was planning to issue an RFQ for a wireless mesh system capable of voice communications and tracking to satisfy West Virginia’s requirements,” said Victor Young, vice president, mine solutions, L-3 Communications. “This was a great opportunity to advance the technology for underground coal operators.”

L-3 quickly put a team together. They understood communications, but they freely admit they knew nothing about mining. “We partnered with some experts, such as PyottBoone and Marshall Miller, along with a mesh provider—a total of five companies in all,” Young said. In May 2007, NIOSH awarded L-3 a contract to develop a prototype system to be installed in an operating mine. The mine selected was ICG’s Sentinel mine, near Phillippi, W.Va., a sister complex to the company’s Sago mine.

“It was a proud moment for our team,” Young said. “There were 18 bidders for that contract and NIOSH selected us.”

The entire process took about 20 months to complete. “We went through a number of phases with NIOSH,” Young said. “They helped us design the system in conjunction with an industry panel that included senior representatives from both ICG and CONSOL Energy. We collectively designed, built and installed the system at the Sentinel mine with four months operational testing concluding in February 2009.”



The L-3 ACCOLADE system transmits to the surface using a set of wireless nodes.

The MINER Act called for all mines to have their ERPs submitted by June 2009. L-3 needed to commercialize the technology quickly. West Virginia needed systems installed by September 2009. “We fast tracked the commercialization and went to market pretty quick,” Young said. “We started our first commercial installation at Arch Coal’s Mt. Laurel mine during August 2009. Toward the end of 2009, we installed a number of systems in West Virginia to satisfy state requirements. Since then, we have been installing four to six systems per month nationwide.”

L-3 now has a system installed in every state that mines coal underground. “We have orders for more than 70 systems with well over half of them installed,” Young said. “We are pressing ahead to meet the June 15, 2011, deadline.”

The systems are working remarkably well. “We have had to overcome some challenges,” Young said. “The nodes themselves have been fairly reliable. Every once in a while the antenna on the nodes has to be reset especially in low coal.”

After each installation, L-3 holds a number of training sessions to teach each of the crews how to work the handsets. It also trains the people who will be manning the operations centers. “Beyond the onsite training, we have a ‘help desk’ that provides customer support,” Young said. “We are launching a regional distributorship network to satisfy immediate needs that can’t be handled over the phone.”

The L-3 ACCOLADE system consists of a set of nodes that propagate 2,000 ft on average, according to Young. “We built it from the ground up,” Young said. “During the government contract days, we investigated the best frequency to propagate signals in coal seams. We found a sweet spot for coal mine propagation spectrum.

Obviously, the farther the nodes can be spaced out underground, the lower the overall cost of the system.” L-3 has installed systems with seven nodes and larger systems with 170 nodes.

“Coal operators are extolling some of the production benefits of the system,” Young said. A foreman at one of the mines operating in 42-inch coal in Pennsylvania told Young he would delay his retirement and continue to work because of the ACCOLADE system. He no longer has to crawl on his hands and knees for 3 or 4 miles every day because of the new communications system.

L-3 believes the ACCOLADE system is future proof. “It meets all of NIOSH future goals for communications and tracking systems, and a number of our customers realize that,” Young said. “It’s a digital system and there are a number of roadmap features we can add to enhance productivity, such as atmospheric sensors, other monitoring devices, etc.

“With \$16 billion in sales, L-3 is a large company committed to the coal mining industry,” Young said. “We see the ACCOLADE system as the mainstay in the U.S. and we believe it shows promise abroad as well.” Originally developed as a compliant-based system, Young said customers are seeing the added benefits of better communications.

The Next Big Thing: Mine-Wide Monitoring

Tunnel Radio’s President Mark Rose uses the automobile as analogy for leaky feeder. “It has an engine in the front, a fuel tank in back, four wheels, a steering wheel, some seats, and it has been around for a 100 years,” Rose said. “Can you improve on it? That’s

distributed wireless communications or leaky feeder. Yes, you can make it faster and cushier, and add options, but you can’t beat it. It’s a one cable solution that miners working in adverse conditions can expand and service.”

Tunnel Radio had communications systems and tracking devices ready to go by the original June 15, 2009, deadline, but the company’s tracking devices were not then approved and they lost out on a lot of work because of that. “We still have a significant number of mines in West Virginia—probably 20%,” Rose said.

The company has subsequently developed its MineAx digital tracking system more fully and it has increased data speeds. Tunnel Radio’s system now operates at DSL speeds over leaky feeder network. The company has sold more than 500 triple readers, which equates to 1,500 underground read points.

“We design an extremely robust tracking network,” Rose said. “Our tracking engineer is living the life of a Maytag repairman. That was our goal: 100% reliability. We know that when a dispatcher spends time and becomes more competent, their expectations raise on a daily basis as far as system accuracy and integrity. It doesn’t take too long to find out if the system is missing miners, plus they have the wireless communications to verify location.”

Customers have reported the tracking working through mantrips and steel buses. “At a recent symposium, our system was mentioned as one that exceeded anything they have seen,” Rose said. “A Pennsylvania regulator publicly vouched for its range and reliability.”

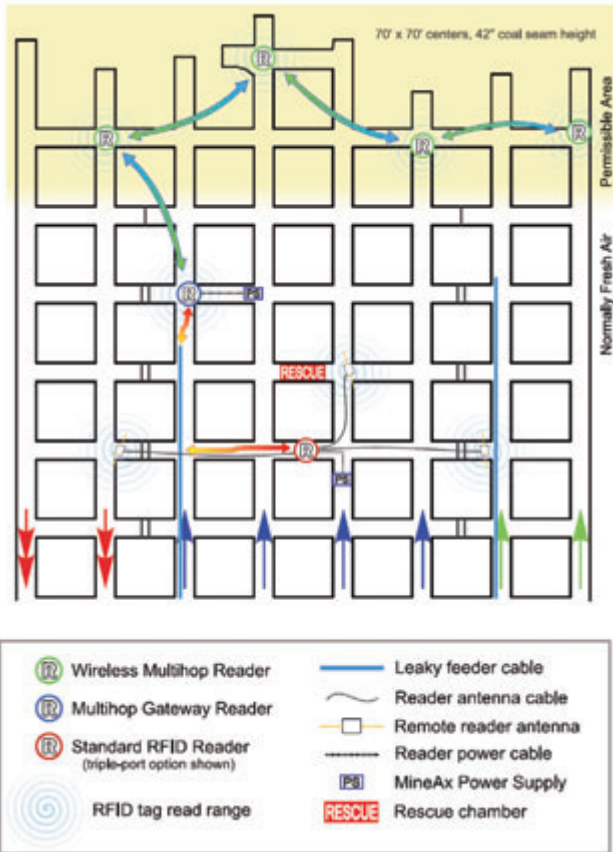
Rhino Resources uses the system at mines in 40-inch seams in Kentucky. “Working with them, we noticed that by the time the miners put three reader antennae systems up in 40 inches, they had a wired mess in the face area. Even though the reader linked back wirelessly, you had a convoluted system that was difficult to advance.” Rose went back to the drawing board.

To address this need, Tunnel Radio developed battery-powered, wireless readers with the ability to mesh. “We are referring to the system as Multihop,” Rose said. “We turned on that software, which allows one reader to wirelessly link to another and simultaneously collect tracking data. We sent one of our best technicians to Kentucky. He installed it and transmitted 350 ft non-line-of-sight around blocks of coal in 42 inches at the face. Nobody has ever heard or seen that kind of wireless range in that seam height on 70-ft centers. With line-of-sight, we got even greater distance.”

That deployment uses a radio network, where a gateway is networked by DSL speeds over the leaky feeder. From the gateway, it uses slave units that can hop wirelessly not only one time, but many times. “The leaky feeder links to the outside world and it gateways to the Multihop readers that can be deployed across the face or longwall because the wireless range is absolutely incredible,” Rose said. “This data all displays on the mine map on the surface. We have mines setup all wireless mesh if it is beneficial.”

Once the technician installed and launched the system, he left the site for the evening and the next day returned to find the miners had advanced the system by themselves. “Now, we have hit on something huge,” Rose said. “The miners have been advancing Multihop themselves for two months—a litmus test for field use and practicality. They love it!”

The obvious advantage with the Multihop readers is cable reduction on the section. The miners would only have to



This diagram illustrates how Tunnel Radio’s Multihop provides coverage in face areas.

advance the leaky feeder cable with the power moves as the headings advance. "Now the miners move a reader that is 6- x 12- x 4-inches instead of a box with hundreds of feet of cable." The gateway reader for the leaky feeder would be advanced up to the feeder-breaker or power center in the primary and secondary escape-ways, starting the all-wireless reader chain.

Rose wants to take the technology one step further. "We have designed a methane sensor for these readers deployed now right at the face reporting 24-7," Rose said. "There is finally a true wireless black box—actually it's gray—that has enough battery life and range to do this. Mine examiners can look at the system from home on the Internet and when he arrives on shift. He can see the entire mine and the history for the ventilation network. Methane sensors at the face can plot everything that has happened since he last visited the section." The RAMP for the methane sensor reader has been submitted to MSHA and two mining companies have submitted for experimental certificates to install.

Rose is passionate about technology and communications, and sometimes gets emotional wondering: What if? "We were quoting a system for a coal mine in New Zealand," Rose said. "Now there's no one at the end of line." Before the transaction could be completed, Pike River Coal suffered an explosion that killed 29 miners during December.

"If we have the technology and the ability, what the heck are we waiting for?" Rose said.

"We are not using a WiFi radio," Rose said. "We have hit the holy grail with this technology. It's a miracle. I have been doing this for 22 years and I have never seen anything like this. We are using a chip smaller than a dime to move data across those distances."

"Our system was designed from the ground up to do this job," Rose said. "We went to component-board level and designed a four layer board with the most advanced chips, with the most advanced programming with the least power consumption. We made it adaptable so that miners can place a couple of extra reader boards in there for multiple readers or maybe a gas card."

MSHA believes Tunnel Radio is on the right track, Rose explained. "We are using approved sensors," Rose said. "We just exchange the RFID chip for a gas sensor chip."

All of this technology has to operate at a very low current. "We were told that there was no such thing as a methane sensor that could run on 6 milliamps/hr, but we did it." Rose said. "So we found an approved sensor that can do that. It conserves battery life and it's all processor controlled."

Tunnel Radio can convert existing readers into Multihop with no price increase. "We are going to distribute a lot of methane sensors here really quick," Rose said. "We will give the first one(s) to each of our customers free. It's the least we could do for these miners. Our customers have already paid for a good product and they deserve it."

Tunnel Radio has the ability to look at all of these mines from its office in Oregon via the Internet, allowing technicians to update readers at any time as improvements are made. "We can run the software from here," Rose said. "We can see all of the miners from here."

Rose waxes nostalgic. "Basically, a bunch of 50-year olds dreamed this stuff up and a group of 30-year old software engineers are making it happen," Rose said. "They know they are working for a great cause."



A backbone splice point mounts to the rib. (Photo Courtesy of AFL)

For Leaky Feeder, Cables Make a Difference

Tunnel Radio provides both very high frequency (VHF) and ultra high frequency (UHF) distributed antenna or “leaky feeder” systems. Ultimately the company decided to go with UHF technology for underground coal operators for its MSHA-approved system. “I would not recommend VHF for use underground,” said Tom Hughes, president, Hughes Supply. “I’m worried about the coverage and UHF gives the miners far more coverage when used in conjunction with the 50-ohm cable.” Hughes sells and installs the Tunnel Radio’s leaky feeder system with the Radio Frequency Systems’ Radiaflex (RFS) cable.

Most mines in West Virginia have communication systems installed, according to Hughes. “Do they have them installed as complete as they need to be? I doubt that,” Hughes said. “Who is testing range and performance on these systems, and making sure what is installed meets requirements? Some mines will place an emphasis on it and others will wait to see what MSHA decides. MSHA inspectors will eventually determine the coverage.”

Hughes admits the Tunnel Radio system is not the cheapest, but he believes it provides the best range and the clearest voice communications. “The 40 leaky feeder systems that I have installed in underground coal have all been UHF,” Hughes said. “We use the RFS cable exclusively in those systems. It’s a 50-ohm cable and gives the best propagation of any product I have seen. It’s more expensive than the other cables, but miners get better coverage from it. The RFS cable provides the perfect backbone, not only for the communications, but also for the tracking.”

To be able to operate on battery power in a post-accident situation, leaky feeder system must operate with very little power. “The 50-ohm cable has the least amount of resistance of any cable we were able to find,” Hughes said. “We could extend the cable further without the additional expense of another MSHA-approved, power supply with a battery back-up.”

Many mines decided to opt for a leaky feeder system based on VHF technology that uses a less expensive 75-ohm cable. “I’m sorry, but I’m an old radio guy and VHF simply does not perform as well underground as UHF,” Hughes said. “UHF far outperforms VHF. We have seen it firsthand. There are limitations, but we are having far more success getting communications into the face areas with UHF.

“We initially considered a 75-ohm cable, then we were invited to another mine that had installed the RFS cable,” Hughes said. “They wanted to compare the Tunnel Radio system to another system. We took the amplifier off their cable and installed the Tunnel Radio system on that cable and the results blew us away. We were in 50 inches of coal going through stoppings and talking behind blocks in parallel entries three crosscuts away. Boys, we have found ourselves a cable, forget everything else.

“In the seam heights 50 inches and below, VHF is going to be extremely restrictive as to how much distance the miners can get out of those radios,” Hughes said. “I’m not sure how they will get the coverage short of running cable into the face area.”

Even though the Tunnel Radio communications and tracking system was developed for UHF, the company has adapted its tracking system and peripherals for VHF. “We recently went into the mine with a VHF system,” Hughes said. “We overlaid the Tunnel Radio tracking system onto it and it worked. We were not physically attaching anything to the existing leaky feeder system, which could be considered interfering with an MSHA approval on a competitive system. We were just transmitting a signal to it. How well will it work on the 75-ohm leaky feeder remains to be seen.

“We have a little trick to boost UHF signal in the face areas,” Hughes said. “It’s dependent on the mine and the conditions as to how the antenna array is established. In some cases, we can simply stick an antenna on the end of the RFS cable sticking out of the side of the spool and we get good communications in most of the face areas. Most mines require some ingenuity on getting the antenna array properly distributed. Our goal was to keep the cables out of the areas where the shuttle cars are operating because they are just going to tear them up.”

As it is with anything underground, the durability of cables has always been a concern. “It depends on the mine,” Hughes said. “Overall, the cable is holding up extremely well. As the longwalls or sections retreat, they respool the cable and reuse it in the development sections. It depends on how well the miners handle it. We have mines that have done this several times with the same spool of cable.”

The cable can be damaged by rock falls and equipment. “We had one customer that had intermittent problems,” Hughes said. “We brought a spectrum analyzer underground and traced it back to an 8-ft piece of cable. Fortunately, we were able to remove and draw the cable together with a splice box. Unfortunately, a miner can damage the cable and not know it,

NEW TTE DEVELOPMENTS



Lockheed Martin Engineer Dave LeVan with the MagneLink equipment.

Leveraging its advanced communications and signal processing expertise, U.S. defense contractor Lockheed Martin has successfully designed and developed the MagneLink Magnetic Communications System (MCS), a wireless, through-the-earth (TTE) communications system developed to meet the mining industry's post-accident emergency communications requirement. The system provides wireless voice communication and texting to give trapped miners fail-safe communication during a disaster.

In March 2010, Lockheed Martin tested MagneLink MCS at the Contrary Portal of CONSOL Energy's Buchanan mine in Mavisdale, Va. The system demonstrated successful two-way voice communications to a depth of 1,550 ft and two-way text communications to a depth in excess of 1,550 ft. Lockheed Martin and the Mining Safety and Health Administration (MSHA) are currently working to certify the equipment for use in mines. MagneLink MCS systems will be available following MSHA certification.

Instead of relying on transmission wires and the in-ground infrastructure currently required by miners to communicate via standard radio transmissions, MagneLink transmits magnetic waves through the earth that carry voice communications and text messages. The system has demonstrated it can operate at ranges sufficient to communicate from above ground into deep underground mines.

"MagneLink MCS will bring a significant emergency communications capability to the mining industry in the event of an accident where miners are trapped and have no other means of communicating with rescue teams on the surface," said Warren Gross, MagneLink MCS program manager.

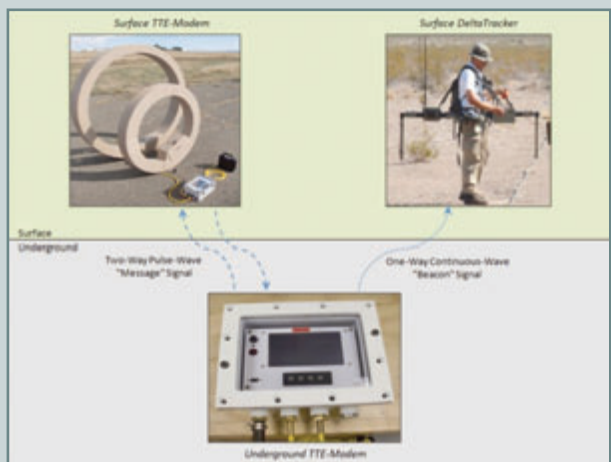
Lockheed Martin conducted an in-mine test of its MagneLink MCS at the National Institute of Occupational Safety and Health (NIOSH) test mine in Bruceton, Pa., on June 15-16, 2010. The system interfaced with hand-held radios similar to the miner emergency radios. It also functioned as a multi-band receiver, establishing communications with multiple MagneLink MCS units without the requirement for the units to be on the same channel to receive transmissions.

Engineers from Stolar Research Corp. and NIOSH also experienced success recently receiving TTE, wireless communication with underground personnel simulating trapped miners. Stolar's technical team has a 30-year history in

developing radio geophysics technology for the mining industry. In the early 1980s, the Raton, N.M., company pioneered the development of the Radio Wave Imaging Method for tomographic mapping of coal seams with electromagnetic waves. After the Wilberg mine disaster in Utah (1984), a mine-wide wireless communication system was developed and installed in 15 western underground mines for use in emergency and operational communication. Although initially useful, Stolar's communication system had not been revisited with a modern engineering effort until early 2010. In only a six-month time period, Stolar has created a low-frequency modem technology which is comprised of surface and underground transceivers used to communicate via TTE text messaging. This is similar to existing PED systems but allows two-way communication, is low-power, and is man-portable.

Stolar's recent development work on the communication technology was partially funded by NIOSH and field tested at several hardrock and coal mining sites between August and October 2010. Preliminary testing in the western U.S. has proven that Stolar's TTE technology can provide communication through a variety of rock types, with maximum depth capabilities ranging from 800 to 1,400 ft. The maximum depth at a mine is dependent on overburden rock type, thickness of layering, and the rock's physical and electrical properties. The most recent demonstration of Stolar's TTE technology was performed in southwest Pennsylvania, in the Pittsburgh coal seam. This demonstration achieved two-way text messaging in the deepest part of the mine (nearly 800 ft) with ample signal strength remaining; the maximum range at this site is projected to be nearly 1,100 ft. This demonstration was supervised by technical teams from NIOSH and mine safety groups. After this demonstration, Stolar is continuing research and development to add synthetic voice capability, reduce the size of the antennas and acquire full MSHA approvals.

Stolar's system is truly wireless and transmits electromagnetic waves through-the-earth to locations within the mine to successfully communicate with miners to locate their position for the fastest possible rescue. The underground transceivers can then communicate directly through the earth, back to the surface locations. Dr. Larry Stolarczyk has dedicated his research in radio geophysics, a combination of theoretical physics and subsurface electromagnetic wave transmission theory, to solving safety and health problems for the mining industry including mine safety and environmentally cleaner mining.



Stolar's surface modem communicates with an underground modem.



Most mines are using a military style connector, called a T-FOCA. (Photo courtesy of AFL)

but they realize it when the quality of the communications degrades.”

Hughes Supply began looking at leaky feeder in 2003 before Sago and the MINER Act. The company provided and repaired the trolley phone and the pager systems that were in use at the time. The companies that originally made those products were gradually disappearing from the marketplace, Hughes explained. “Used parts were difficult to find,” Hughes said. “We were salvaging what we could and hand-winding coils to make them work because you couldn’t buy them anymore.”

The company was telling its customers then that they needed to upgrade the mine phone systems. “We were trying to sell them leaky feeder phones, but they were not interested,” Hughes said. “Then the tragedies occurred in 2006 and everything changed.”

Today mine managers are realizing what improved communications could do for an operation. “The underground coal operators really had nothing before,” Hughes said. All of the approved systems are a vast improvement. It didn’t take long to see the advantages of being able to communicate and how it improved production. The safety issue forced the installation and tracking is probably still viewed as something they have to do. But, now I don’t think the miners would want to do without these communication systems.”

The Light Brigade Teaches Fiber Technology

One of the major advances with fiber technology is the integration of Ethernet type technologies, where many types of sensors and devices, such as SCADA, GPS (surface apps), communications and tracking, are all using the same protocol as far as the interface. The mines can easily integrate all of the sensors and devices, and place them on an Ethernet-based fiber network.

“More mines are starting to deploy fiber optic cable,” said Patrick Dobbins, general manager and vice president, The Light Brigade. “The cable is lightweight and easy to install. When combined with Ethernet based systems, mines can configure a network to suit their needs. They have the ability for Ethernet video, along with the paging capabilities of hubbing with a wireless node.” A division of AFL, The Light Brigade is a training segment for AFL on all fiber optic applications.

The Light Brigade has developed a training course focused on mining applications. “Since 1986, we have been teaching fiber optic training classes for different industries,” Dobbins said. “We have some core classes about fiber technology without being application specific. We have seen so much demand from the mines, we thought it was time to develop a course specifically for the mining industry.”

AFL researched the course criteria by contacting customers that had taken existing classes and performed a needs analysis. “We broke it down by application—underground vs. surface,” Dobbins said. “We were already onsite training on fiber theory and the basics of splicing, but we were also learning about the specialized applications. We learned a lot about the uniqueness of the mining environments. We took that information along with documentation and compiled it and wrote a mining course on fiber integration. We have already conducted four custom training classes at customer locations.”

This year AFL will be offering open classes in locations near the mines, such as Charleston, W.Va., or Salt Lake City, Utah. The classes are designed for smaller mining companies or those that only need to train a few technicians and can’t justify the cost of an onsite training course. The people most interested in these classes are the miners building the fiber network, such as electricians, electrical supervisors and some mining/electrical engineers.

Students learn about products such as all-dielectric self supporting (ADSS) cables or optical ground wire (static wire), to newer technologies such as specialized MSHA-approved cables. “We show technology alternatives and teach electricians and engineers how to design a solution for application problems,” Dobbins said. “We teach the technicians the skill sets they need to know, such as fusion splices and how to prep and terminate the end of the fibers to connect to the SCADA or the fiber management shelf. They also learn about installation rules about pulling cables to how to properly establish maintenance documentation.”

In the underground environment, the network is constantly advancing or being torn down, which creates the potential for damage. Most mines are using a military style connector, called a T-FOCA (tactical fiber optic connector). “The cable arrives in 1,000-ft lengths pre-connected with a hardened military connection that the miners cascade together and interface with the equipment in the sections,” Dobbins said. “That raises issues with storing the excess cable, cleaning and maintaining the connectors, and how they can place a temporary fix if a cable has been cut.”

Each application is different. When testing and troubleshooting a fiber link, Dobbins explained, there is a similar, step-by-step process for all applications. The Light Brigade conducts about 70% of its training for the mines on-site. “We believe in a 50:50 ratio between classroom and hand’s on learning,” Dobbins said. The next class is in February in Charleston, W.Va.