

Miners

Give a Nod to Nodes

New mesh networking technology boosts worker safety and productivity and fulfills new federal requirements.

By Byron Henderson

Hundreds of feet underground, nearly a mile away from the mouth of the mine, a miner realizes he needs to repair a key piece of equipment. Summoning an engineer used to mean a long walk back through the mine or a long wait for the man trip, a motorized shuttle vehicle. While the miner is walking or waiting, no coal is being dug, so these interruptions add up quickly in lost production. But now, with the push of a button on a wireless VoIP handset, miners can request that engineering resources be dispatched to a location without going anywhere. If the VoIP system is connected to the public phone network, staff in the mine may be able to get service assistance from equipment manufacturers while at the working face. In a few minutes, the miner is safely and productively back to work. Multiply this scenario by dozens or hundreds of times per week in a large mine, and there is an obvious, immediate positive impact to the bottom line.

But how did this step- and time-saving exchange take place nearly a mile down the mineshaft? Traditional cellular signals don't propagate through rock, and there's no time for laying wire phone lines

Compact wireless mesh node and antennas mounted on a support column are designed for harsh environments.

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that might be damaged by rock falls and moving equipment. The answer is third-generation wireless mesh technology based on the Wi-Fi 802.11 protocol. A series of multiradio enclosures, called wireless mesh nodes, propagate the signal down the length of the mineshaft and wirelessly connect miners working or traveling nearby. The nodes may be placed along entries, travel ways, beltways or in airway intakes and returns to wirelessly link miners at the working face to the rest of the mine, as well as to the office and managers outside the mine.

Improving Safety and Response

Besides the time-saving productivity boost, the wireless mesh nodes also provide infrastructure that delivers life-saving miner location and communications capability in case of an accident or disaster. Preserving the safety of underground mine personnel has been an important focus of government and industry. In the aftermath of the Sago mine disaster, a coal mine explosion in Sago, W. Va., in January 2006, the federal government set in place a timetable for underground coal-mining operations to upgrade procedures, equipment and technology with the passage of the Mine Improvement and New Emergency Response (MINER) Act in 2006. Major elements of the MINER Act require a wireless two-way medium of communications and tracking of individuals by 2009. A wireless communications system that provides two-way communications between underground and surface personnel and an electronic tracking system that allows surface personnel to independently determine the location of anyone trapped underground is key to meeting the requirements. New Wi-Fi wireless mesh technology delivers high performance and reliability at low cost over long distances in underground coal mines in numerous pilot and production mine networks, because it allows for reliable two-way VoIP communications and Wi-Fi location tracking.

Mining network communications and tracking supplier Active Control Technology (ACT) of Burlington, Ontario, Canada, has installed wireless mesh technology supplied by Mesh-Dynamics in a number of mines.

Underground Coal Mines

Underground coal mines, both “long wall” and “room and pillar,” are challenging settings for wireless communications. There are often multiple adjacent entries (tunnels) into the mine. At the least, the network must provide coverage in the belt entry, the main travelway, primary escape route and for the working unit at the mine face. Another challenging characteristic is that the mine is constantly changing: The working unit progresses forward everyday, and therefore the supporting infrastructure must move with the unit. Any communications systems must be easily deployable, configurable and resilient.

Because of the vehicle and human traffic and hazards such as moisture, rock fall and vibration, a compact and robust physical device is required. The safety and communications mission demands the ability to work from battery power and for isolated portions of the network to continue operation if disconnected by an incident. Because distances in the tunnels can be quite long, the mining environment poses unique challenges for real-time data over many hops.

A recent successful installation in a working room-and-pillar underground coal mine required long-distance connectivity for voice, location tracking and video process monitoring. Because the headquarters and processing plant is 3.5 miles from the main lateral entry to the mine, multiple hops were needed both outside and inside the mine. In a number of locations within the mine itself, wireless mesh nodes were secured to the roof bolt or supporting timbers and powered by a battery backup system. Individual miners carry wireless Wi-Fi VoIP handsets that provide voice connectivity to the PBX at the head-

quarters site, with public switched telephone network (PSTN) access via the PBX. Clear voice connections are provided at 12 hops to the farthest extent of the current installation.

A miner location and tracking system based on Wi-Fi is also supported over the wireless infrastructure, which helps fulfill the MINER Act requirements. In addition, an IP-based video camera remotely monitors a key junction of the belt system crucial to mine productivity. The mine operator enjoys multiple benefits from the installation. Besides fulfilling MINER Act requirements, mine personnel are instantly more productive through better communications. Requests for repairs, supplies, tools and other material may be made over the VoIP system, saving the time and inconvenience of multiple man-trip shuttles. The ability to remotely monitor the operation of key belt locations via video has also increased uptime and productivity.

Surface Mining Applications

Outdoor, aboveground mining sites also require wireless voice, data and video communications. There is an increasing need for up-to-the-minute status on operations, equipment and personnel, as well as a strong move toward mine automation. But because an open-pit mine is a constantly changing landscape, it's necessary for any network deployment to be simple to deploy and redeploy. The wireless mesh nodes act similar to “radio robots” to locate one another and quickly establish a network without operator intervention.

The nodes may also be in motion relative to one another and to fixed elements of the network, yet remain constantly connected. It's critical for mining enterprises to monitor the productivity of a haulage fleet and report that information back to local and corporate management. Additionally, visual monitoring through video cameras mounted on mining vehicles allows for immediate response from the control center rather than requiring a manned trip to a location in the

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mine. Extending the network into the mine also extends the private telephone network into the pit — vital for remote locations that are often without cellular service — and at much lower cost than satellite telephony.

In a recent installation in an open-pit mine, a fixed wireless mesh node was placed at the administrative office, and several relocatable wireless mesh nodes with solar power were deployed on trailers throughout the active area of the mine. Mobile mesh

nodes on haulage trucks and loaders provided communications for the automated mining application in use on the vehicles. Because of third-generation radio intelligence, the nodes maintain communications throughout the active area of the mine and can be easily relocated. Optional GPS capability allows managers to instantly locate any of the wireless mesh nodes and its host vehicle on a map view of the mine. Additional safety voice and video applications

may also easily be deployed over the wireless mesh infrastructure.

The wireless mesh technology provides the high performance, low delay and jitter, and mobility required for reliable communications in demanding mining environments. Best of all, networks deployed to increase miner safety may also boost productivity and vice-versa. As mining becomes more technical and automated, third-generation wireless mesh keeps the mining enterprise seamlessly connected from working face to office. ■

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