



Case Study: Increased Safety, Communications, Control, and Productivity in Underground Coal Mining

■ **Improving Safety and Response**

Preserving the safety of underground mine personnel has been an important focus of government and industry. In the aftermath of the Sago mine disaster, the US 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. One of the major elements of the MINER act is the requirement to provide a wireless two-way medium of communications and tracking of individuals during 2009. Key to the requirements is a wireless communication system that provides two-way communications between underground and surface personnel and an electronic tracking system that allows surface personnel to determine the location of any persons trapped underground. While a number of technologies have been proposed, MeshDynamics' WiFi wireless mesh technology has been shown to deliver high performance and reliability at low cost over long distances in underground coal mines in numerous pilot and production mine networks. The MeshDynamics network infrastructure allows for reliable two-way voice over IP communications and WiFi location tracking.

■ **The Demanding Mine Environment**

Underground coal mines, both "longwall" and "room and pillar", are challenging settings for wireless communications. There are often multiple adjacent entries (tunnels) into the mine. At the very least, the network will need to provide coverage in the belt entry, the main travel-way, primary escape route and the working unit at the mine face. Another key characteristic is that the mine is constantly changing: the working unit progresses forward every day and therefore the supporting infrastructure must move with the unit. Any communication systems must be easily deployable, configurable and resilient.

Because of the vehicle and human traffic and hazards (moisture, rockfall, 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. Most important, distances in the tunnels can be quite long, measured in miles. Reliable wireless communications requires many "hops" (node-to-node connections). MeshDynamics equipment in production mine environment delivers outstanding voice and data connectivity over a dozen or more "hops", providing coverage in extensive mining operations.

■ **Successful Mine Installation**

A recent successful installation in a working "room and pillar" mine required long distance connectivity for voice, location tracking, and video process monitoring. Because the headquarters and processing plant is some distance from the main lateral entry to the mine, multiple hops were needed both outside and inside the mine, a total distance of 3½ miles. [MeshDynamics MD4000](#) nodes are installed in a number of locations within the mine itself, secured to the roof or supporting timbers as appropriate for each location and powered by a battery back-up system.

Voice connectivity is provided from wireless WiFi Voice-over-IP (VoIP) handsets carried by individual miners to the PBX at the headquarters site, with PSTN (Public Switched Telephone Network) access via the PBX. Clear voice connections are provided at the furthest extent of the current installation, a total of 14 "hops".

A miner location and tracking system based on WiFi is also supported over the MeshDynamics wireless infrastructure. Along with the two-way voice communications, this helps to fulfill the MINER Act requirements. In addition, an IP-based video camera is being used to monitor remotely a key junction of the belt system that is crucial to mine productivity.

The mine operator is enjoying multiple benefits from the MeshDynamics installation. Besides fulfilling MINER ACT requirements, mine personnel may be more productive through better communications. Requests for supplies, tools, and other material may be made over the VoIP system, saving the time and inconvenience of multiple mantrip shuttles. The ability to remotely monitor the operation of key belt locations has also provided an increase in uptime and productivity.

■ **Unique MeshDynamics Technology Benefits**

The key to this successful installation is the ability to provide very high performance over a large number of hops. While most WiFi mesh solutions would fail after a handful of hops, MeshDynamics' patented and patent-pending solutions begin by providing two backhaul radios to each node. To overcome the problems of congestion and contention one radio is used to create a link to its upstream (nearer the wired source or "root") node. Another radio creates a link downstream to the next neighbor node. [\[More\]](#)

Thus, each node may be sending and receiving *simultaneously* to its upstream and downstream neighbors, unlike most competitive solutions, which must continually "turn around" between sending and receiving upstream and downstream. Because each link is managed independently, the available channels may be re-used across the network. This expands the available spectrum, increasing performance of the network 50 times or more compared to traditional mesh solutions.

MeshDynamics provides this networking power in a compact, robust enclosure requiring little room in the cramped underground environment. Low power draw and available battery power solutions permit use in harsh environments and provide back-up functionality in case of power failure or other incidents.



■ **About MeshDynamics**

Founded in 2002, MeshDynamics began shipping production units late in 2005 and has customers in many applications areas: mining and industrial sites, homeland security/defense; transportation (e.g., rail and air); military; public safety; and municipal (metro) networking. Customers are worldwide; sales are direct and through resellers.

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