



## Case Study - Remote Control of "Longwall" Mining Machinery Improves Safety and Productivity

### ■ **Operator Safety through Remote Control in Dangerous Environments**

With increased focus on safety in underground coal mines, efforts are being made to reduce risks to miners in any way possible. "Longwall" mining differs from "Room & Pillar" mining in that the mine roof is *expected* to fall when operations are concluded in a particular area of the mine. For this reason, roof supports are not as extensive at the working mine face. This holds obvious danger to the miners operating at the mine face using the mining machines called "shearers".

One way to reduce this risk is to remove the miners from the immediate area in which the machines are being operated by as much as one mile. But to efficiently operate the shearer, the miner must still be able to see the coal face, a problem from a mile away. The obvious solution is to put full motion video cameras on both working ends of the shearer (the shearer operates both forward and backward). Because of the precision nature of the mining process, there cannot be any meaningful delay in the image from the video camera to the machine operator. This demands very high performance and minimal delay and jitter for the video connection. And because the area being mined is to be allowed to collapse when mining operations are complete, it is impractical to install any sort of permanent infrastructure, such as network.

A wireless video connection is the obvious solution, but it must deliver high performance over many "hops" (node-to-node connections). MeshDynamics equipment in production mine environment delivers outstanding video connectivity over many "hops", making remote mining machine operation practical and cost-effective. MeshDynamics MD4000 nodes have all of the characteristics to support the operation of precision heavy machinery from a distance, providing connectivity for high quality video over the multiple hops necessary to ensure that the miners are removed to a safe operating zone. (In some cases, it may be decided to operate the machine from the surface - which requires even more hops.)

### ■ **Successful Remote Mining Deployment**

A recent successful demonstration of remote mining involved a "continuous miner" shearer operated remotely. The MD4000 wireless mesh network offered high quality video of the working faces to the remote operators. Operators were able to observe the operation and performance of the machine, adjusting controls as necessary without exposing themselves to the dangers of the immediate area being mined.

Over thirteen hops with a 5.8 GHz backhaul, the MD4000 network provided a consistent 18Mbps throughput, more than enough to support the two 15fps video cameras with PTZ controls. Delays through each MD4000 node are only 1-2 milliseconds, providing the real-time video necessary for successful remote operation.

Because of the dynamic nature of the typical longwall mining operation, the mine itself is constantly being reconfigured. As the mine face moves forward, sections of the mine are allowed to collapse and new areas are opened. As part of this deployment, it was demonstrated the MD4000 network instantaneously and automatically adapts to the changing environments. MD4000 nodes may be redeployed to new areas of the mine as these are opened, instantly joining the existing network to provide coverage for the video application. No complex network engineering is required.

With this network in place to provide remote operation of the longwall shearer, it is also possible to extend the network to the surface and connect it to the PBX/phone system and other data and voice network. This could ease the maintenance and support of the mining machinery by allowing real-time phone support at the site of the operators and/or equipment as well as to allow access to on-line technical documentation from underground.

### ■ **Unique MeshDynamics Technology Benefits**

The key to this successful deployment is the ability to provide very high performance for high-quality video 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, delivering the video performance necessary for efficient real-time remote observation and control of the mining machinery.

MeshDynamics' software creates an RF-aware "radio robot" in each MD4000 node. This distributed dynamic radio intelligence constantly monitors the surrounding radio environment. The node locates adjacent nodes in the network as they are added. Based on this continual scanning of the environment, the MeshDynamics nodes form a network in an independent, but coordinated fashion, with relationships based on highest performance, interference rejection, and optimal re-use of channel assignments for maximal network bandwidth. In the remote mining environment, this continuously and automatically adapts the MD4000 network to the changing configuration of the mine and locations of the mining machinery.



**Wireless for the Outdoor Enterprise™**



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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