

Linking Up

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Drill operator interfaces with Modular's DISPATCH Underground FMS via the touch-screen mobile device.

New communications and site-management solutions make it easier to keep track of what's happening underground

A quick scan of the current list of MINER Act-compliant communications and tracking systems on the U.S. Mine Safety and Health Administration (MSHA) website shows there about two dozen vendors

providing equipment designed to allow mine operators to variously locate, identify, track and communicate with their underground workers in accordance with the act—a 2006 law passed by the U.S. Congress to improve the preparation, resources and technology available for responding to major underground mine accidents. The act specifically focused on the coal industry, but many of these listed vendors also are active in the hard rock mining sector. In addition, there are numerous solution providers in the international marketplace who are beyond the purview of MSHA and the MINER Act.

Consequently, there is a wide pool of technical resources available to underground hard rock mine operators for solving their communication and tracking operational challenges, and with a steady stream of innovation flowing into this area, the technological pool is getting deeper as well.

The latest advancements include everything from complete systems to specific components, and come from both well-known, established providers and new-to-the-industry startups. Here are some examples of recent developments.

MODULAR'S UNDERGROUND FMS GETS A REDESIGN

Arizona, USA-based [Modular Mining Systems](#) installed its first DISPATCH Underground system in 1991 to meet the needs of a diamond mine operation in South Africa. Modular's development team started with the open-pit version of its DISPATCH Fleet Management system (FMS) and modified it to address the unique challenges presented by the underground environment. The Underground system continued to evolve over the years, and according to the company, has been successful on many levels. However, it still looked, felt, and behaved much like its surface-based predecessor.

That changed with the recent release of the DISPATCH Underground 2015 FMS, said Modular, with the integration of new underground-specific functionality, migration from the Linux OS to the Microsoft Windows platform, and an extensive user interface redesign.

A key feature of the re-engineered underground FMS is its out-of-the-box compatibility with all common underground communications protocols, enabling mines to integrate the DISPATCH Underground system into their current voice and data network infrastructure. Because the system is designed to work with any existing 802.11 (Wi-Fi), SIAMnet or leaky feeder network, mines can avoid costly hardware investments or disruptive upgrades. "If a mine is running an IP-addressable network, the DISPATCH Underground 2015 system can probably use it," said Ed Bardo, global sales manager, Underground Fleet Management and Safety systems, at Modular.

The DISPATCH Underground system's Store & Forward feature ensures that data integrity is maintained if equipment travels outside the wireless data network. While operating without communications, event data is stored on the mobile device installed in the cab of each equipment unit. When communication is restored, the mobile device automatically forwards the collected data to

the central server, where it is integrated into existing central database records and reconciled in real time.

The system provides real-time equipment location tracking via RFID tags affixed to mine infrastructure and RFID tag readers mounted on mobile equipment. Modular says its convention of using stationary tags and mobile tag readers provides high positioning resolution at a low cost.

RFID technology monitors equipment position below ground, while GPS technology monitors haulage unit position on the surface. The bimodal positioning system, which automatically determines when to use RFID or GPS technology, enables mines to track the location of LHDs, trucks, development drills, production drills, and auxiliary units wherever they are operating.

The company noted that, having been in operation for 25 years and commissioned at some of the world's largest underground mines, the DISPATCH Underground system has moved more tons per day than any other underground system on the market, and with its latest update provides customers with increased operational visibility, connectivity and adaptability.

"The system is flexible enough to be introduced at any stage of the mining process. However, the earlier system adoption happens in the mine life cycle, the greater the opportunity for process optimization," said Neil Ferreira, product manager, Fleet Management, at Modular.

CENTRALIZED CONTROL, SITE-WIDE INTEGRATION

[PBE Group's](#) MineBoss 2.0 is another full-scale, centralized control system that can accommodate a mine's requirements for everything from basic atmospheric monitoring to collecting real-time operations information. PBE (formerly Pyott-Boone Electronics) has recently extended its footprint in global mining communications by acquiring the Australian company Minecom in 2012 and Mine Radio Systems (MRS) in 2013. In fact, Minecom's leaky feeder system is the core of a digital two-way radio communications system employing Motorola DP 3400 handheld units at Dundee Precious Metals' Chelopech mine in Bulgaria, following a mine upgrade project that included establishment of real-time, mine-wide data monitoring and collection and asset tracking, among a number of benefits gained from communications-system improvements.

MineBoss 2.0 provides integration and visibility for site-wide activity and allows control from a centralized location. It provides audible and visual warnings and alarms, contains an integral database management system and is designed for future scalability and mobility. It also allows different sound files to be associated with different events and alarms for customized alerts to various changes in the pumps and fans being monitored by the system.

According to the company, MineBoss 2.0 monitors and controls atmospheric monitoring, tagging and tracking systems, leaky feeder communication systems, belt and conveyor systems, fire and dust



The Lightship worksite management app runs on cell phones using the Android or iOS operating systems.

suppression systems, power supplies and battery back-up, fans and air flow, weight scales, pump controls, and can relay logic and analog signals from third-party products.

Last year, PBE gained MSHA approval of its BDA 4 amplifier, which provides local and optional remote diagnostics to indicate the current state of the amplifier for ease of maintenance of a site's leaky feeder system. It supports voice and high speed data transmission, incorporates bidirectional amplifiers, has wired and wireless interconnectivity and a third auxiliary band. The BDA-4 amplifier's third amplified band can be used for paging, radio or evacuation systems.

The BDA-4 amplifier also allows the PBE personnel and vehicle tracking system to become a hybrid solution by offering the underground tag reader enclosed in the amplifier. This hybrid solution, which is compatible with MineBoss 2.0, reduces the cost of adding key safety products such as underground tracking by eliminating the need for additional power and cabling requirements.

WORKSITE MANAGEMENT VIA CELLULAR

Cellular phones aren't commonly regarded as mine-duty communications and tracking devices, but if worksite management technology developed by British Columbia-based Lightship gains a niche underground, miners could find themselves communicating with, and being identified and tracked by the cell phone in their pocket, working in concert with a leaky feeder system.

Lightship launched its application in early October. The cloud-based program, also called Lightship, is described as providing site management teams with a "bird's-eye" view, in real time, of an entire worksite. It employs nonproprietary system technology and hardware, and is designed to connect with mobile devices and worksite sensors to track and communicate with workers, while providing an historical record of all worksite events.

Jae Reichel, CEO of Lightship, commented at the product launch: "Instead of having to rely on technologically limited radio systems and stand-alone equipment monitoring, site teams will now have clear, real-time awareness of their entire worksite, even in remote locations."

Reichel told E&MJ that his company is focused on creating "core" communications systems that are capable of using almost any type of backhaul system employed by a customer, including the leaky feeder systems widely used in underground mines. Developing a voice-communications system for

underground that works with cellular devices wasn't the major challenge—in the Chelopech mine, for example, cellular phones reportedly work quite well underground—but finding a nonproprietary device or technology that allowed the phones to “know where they were” for location and tracking purposes was a problem, he explained.

That obstacle disappeared when Bluetooth 4.0 networking (also known as Bluetooth Low Energy or Bluetooth Smart) capabilities were introduced commercially in popular cell phone brands using either the Android or iOS (Apple) operating systems. Bluetooth 4.0 offers a flexible development architecture for creating applications that allow common devices used in the Internet of Things (IoT) to communicate with applications that reside on Bluetooth Smart-compatible smartphones or tablets. Lightship's underground communications and location capabilities are based on worker-carried cellular devices communicating with Bluetooth 4.0 beacons placed throughout the mine, which in turn report to WiFi access points and, through them, to the leaky feeder system.

Reichel maintains that conventional two-way radios aren't the most efficient way to disseminate to and collect information from a widely scattered workforce—channels are usually limited, and workers learn to mentally tune-out background chatter, possibly missing important messages in the process. Why not use off-the-shelf, modestly priced cell phones instead of radio sets that cost much more, he asked, and why not gain the ability to selectively identify and transmit information only to those workers who should receive it? “With Lightship, a dispatcher can, for example, with just a couple of keystrokes call up a list of every mechanic on site, and then send a message intended only for them,” he said.

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