Title

Post-Accident Network Probe for Underground Mines

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Abstract

Context

After an underground mine cave in, fire, explosion, flood, etc. the post-accident location and status of miners as well as the potential health and safety hazards of their environment is unknown.

Rescue team may attempt to contact miners by drilling bore holes and dropping a telecommunication line, but unless the trapped miners are in the immediate vicinity, these attempts to establish contact and monitor conditions will fail and precious time will have been lost. Underground networks based on a wired backbone will not work in many post-accident scenarios because cables will have been cut. Even when tentatively redundant closed-loop wired networks backbones are initially deployed, the operational complexity of continuously extending the network as the mine expands leads to the use of open-loop cable extensions for coverage in many active areas of the mine. Since fixing broken cables underground from surface via a bore hole is not realistic, an alternative solution is required for reliable and cost-effective post-accident backhaul communications to surface.

Development

The MineTrax Post-Accident Network Probe (PANP) is an alternative to Through-The-Earth (TTE) technology to achieve the same objective: post-accident two-way backhaul communications from an isolated area underground to surface. The difference is that the PANP is a lot simpler and cheaper than TTE, it supports a higher bandwidth and has no maximum depth limitation: via a ventilation shafts or a 2" bore hole, mine rescue teams can drop down the PANP via a cable and let the MineTrax self-healing, battery-powered wireless network underground re-configure itself is such a way as to use this "new" backhaul link to surface. Several PANPs can also be installed premptively (instead of reactively) close to the active areas to create additional permanent backhaul links to surface, effectively increasing the probability that at least one backhaul link will survive. If at least one backhaul link survives in the post-accident isolated area, the system won't experience any downtime.

Conclusions

TTE technology has its merits as a post-accident backhaul link to surface technology and MineTrax networks can use it as an alternative to leaky feeder, fiber optic or twisted pair for backhaul links to surface. Actually, Newtrax encourages the simultaneous use of several different types of backhaul links to maximize the probability of at least one backhaul link surviving the accident. Since the MineTrax network is self-healing, it will automatically re-organize itself to send/receive data from surface via any backhaul link available, including PANPs.

Future prospects and opportunities

In addition to enabling personnel tracking and two-way texting, the MineTrax self-organizing battery-powered wireless network is the ideal platform for many other applications because of its pervasive and persistent nature:

1. Ground stability monitoring with MineTrax-enabled geotechnical instrumentation manufactured by Mine Design Technologies Inc., including extensometers, sloughmeters and vibrating wire instruments.
2. Air quality monitoring with MineTrax-enabled gas detectors manufactured by CONSPEC Controls Inc., including CO, CO2, SO2 and H2S
3. Ventilation on demand with Simsmart Technologies Inc. expert system software
4. Energy management of pumps with Simsmart Technologies Inc. expert system software
5. Vehicle telemetry with ISAAC Instruments Inc. data loggers and sensors