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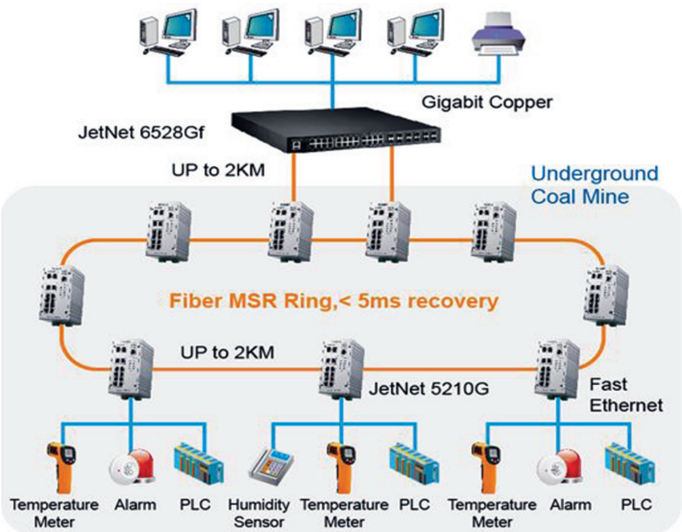
Adoption of mission critical communications in mines

In recent years, significant strides have been made to improve the safety of the workers and enhance production in mining industries. Accurate monitoring and locating the miners and explosives are crucial to make a quick response in fatal situations. A robust and reliable communication network is essential to monitor the mine environment in timely manner. However reliable communication in the underground mine environment is a daunting task. Extreme humidity, temperature, vibration conditions and the presence of heavy machinery in mine environment make electromagnetic wave propagation difficult. Currently short-range radios such as Radio Frequency Identification (RFID), Wi-Fi , ZigBee, Bluetooth and ultra wide band (UWB) have been used in the mining industry to spur realtime localization and tracking applications. However, communications based on these short-range radios, often require the dense deployment of access points that result in high installation and maintenance costs.



Recently Cycleo of Grenoble, France developed a new wireless technology, Long Range (LoRa) aimed at providing up to 20 km connectivity with low power consumption which is a blessing for mine environments. The main competency of LoRa is its adaptive data rate and Chirp Spread Spectrum (CSS) modulation scheme. CSS exhibits high robustness against thermal noise, multipath fading, and Doppler effects. LoRa significantly increases the communication range and robustness with the cost of a reduced data rate. LoRa data rates range from 0.3 kbps to 50 kbps per second and the battery life of the end devices can easily be several years. These features make LoRa technology very promising in the underground mine. The LoRa physical layer employs the chirp spread spectrum to modulate the information bits [6] . In this technology, each symbol is spread in a fixed bandwidth, BW, and the time duration of the symbol is varied according to an index called spreading factor (SF) which can range between 7 and 12. The length of the chirp symbol is Ts=2SF/BW Chirp spread spectrum uses its entire allocated bandwidth to broadcast a signal. Because the chirps utilize broadband of the spectrum, the chirp spread spectrum is also resistant to multipath fading and Doppler effect. Hence, it significantly increases the communication range and robustness with the cost of a reduced data rate.

Source: Ahasanun Nessa; Fatima Hussain; Xavier Fernando "Adaptive Latency Reduction in LoRa for Mission Critical Communications in Mines" 2020 IEEE Conference on Communications and Network Security (CNS)