

## **PervCom's active 2.4 GHz RFID tags, attached to cap lamps, track miners' locations and contain sensors for measuring temperature, humidity and air quality.**

By Dave Friedlos

Sept. 5, 2008—Indian startup company [PervCom Consulting](#) has developed a combined real-time location system (RTLS) and real-time sensing system (RTSS) able to simultaneously track persons and assets, as well as monitor environmental conditions. The combined system, PervTrack, utilizes battery-powered RFID tags, routers and sensors compliant with the IEEE 802.15.4 standard to create a wireless mesh network.

The [Central Institute of Mining and Fuel Research \(CIMFR\) Dhanbad](#) is currently piloting the system in the Bagdigi coal mine to monitor workers underground and in potentially dangerous environment conditions, while the Indian aluminum mining company [Vedanta](#) is trialing the system, minus the sensors, to track vehicles and other mobile assets.

CIMFR's deputy director, Laxmi Bandyopadhyay, says the institute received backing from India's [Ministry of Information Technology](#) to develop an underground tracking application. "It can be difficult to track miners underground, and we felt that RFID would give us the best solution," he explains. "So we approached PervCom to develop a mine-specific RFID system."

CIMFR and PervCom are devising the system together, with CIMFR providing the mining expertise and system requirements, while PervCom focuses on software and hardware. PervCom developed the PervTrack RTLS, which employs active RFID tags operating at 2.4 GHz, attached to miners' cap lamps. Six R-101 routers were then placed at strategic locations throughout the mine, forming a wireless mesh network compliant with the IEEE 802.15.4 standard, and two miners were issued tags to test the system.

The routers receive and forward data transmitted by WiTrak Tags, and serve as nodes in the wireless mesh network formed by other routers, tags and gateways within their vicinity. The location of the miner and tag is determined by the tag's position relative to the nearest router, which has a transmission range of up to 1.3 kilometers (0.8 miles). The tags also act as a communications device, with miners able to send pre-coded messages to a central station by pressing a button on the tag. In addition, they can receive alerts from remote monitoring stations.

It was then decided, Bandyopadhyay says, that the system could also monitor environmental data, including the detection of potentially poisonous gases, such as carbon dioxide or methane. PervCom developed the RTSS, in which the company's WiSense WiS-101 sensor-actuator nodes were embedded into PervCom's existing WiTrak WiT-101 RFID tags. The wireless nodes contain temperature, humidity and air-contaminant sensors capable of detecting smoke and fire, and of monitoring the air quality in buildings.

Information is transmitted in multi-hops to a remote monitoring station, where it is then transferred to bespoke PervTrack software. The data is sent at specified intervals to software that analyzes the information and automatically generates an alert if the measurements exceed specified levels.

The system could be vital in detecting the emission of toxic gases, Bandyopadhyay says, and in tracking and rescuing miners during emergency situations. "We are in the earliest stage of the trial," he states, "but it is working well and has shown some promising results in terms of improved safety."

In the coming months, CIMFR and PervCom hope to expand the areas of the mine in which the system operates, as well as extend the parameters for monitoring mine gases. The companies are presently awaiting clearance from the nation's [Directorate General of Mines Safety](#) to deploy a larger pilot involving 100 tags and 30 routers. According to Bandyopadhyay, the technology could also be utilized to monitor conditions in hilly regions, and to warn of impending landslides.

Vedanta, meanwhile, is also trialing PervTrack RTLS to monitor industrial vehicles and other mobile assets entering and leaving its factory. Each asset will be fitted with a WiT-101 tag, which communicates its current location through the wireless mesh network to the nearest R-101X router, placed at strategic locations. PervCom is presently implementing 25 routers and 20 tags ahead of the pilot. The asset's location can then be viewed through the PervTrack software running at the control station. PervTrack software provides map-based views, alert notification and reporting from a single, scalable unified platform. The Web-based application enables Vedanta to monitor the location data online, in real time.

The pilots are essential, says PervCom director Somprakash Bandyopadhyay, in addressing the number of challenges and issues involved when deploying RFID in an underground environment. "We had to confront issues such as power consumption and how long the tags can operate in a mine environment," he says. "There are also issues around dust, moisture and humidity, which are found underground. The tags, routers and other equipment have to be able to withstand the environment."

Furthermore, it was necessary to determine the optimal frequency for operating underground. PervCom opted for 2.4 GHz active tags compliant with the IEEE 802.15.4 standard. The system also complies with the ZigBee standard (which is also based on IEEE 802.15.4). Somprakash Bandyopadhyay, however, says testing revealed systems operating only on the ZigBee standard had limitations in terms of the number of hops the signal could make. With PervTrack, an RFID tag's signal can hop as many as 15 times, from tag to tag or router, and on to gateway.

When the pilots are completed, Somprakash Bandyopadhyay says, PervCom plans to move to a full-scale rollout, beginning locally before targeting the overseas market. The company intends to specifically target mining and chemical companies that have the greatest need to monitor assets and environmental conditions.

"These can be dangerous environments," he says, "and if there is an emergency, such as gas or toxic

leak, this system will detect the leak and alert staff, and ensure the company knows where its people are. We are just at the beginning of our journey, but when we are finished, companies will be able to have an integrated RTLS and RTSS system, and will be able to see the position of their miners and the status of environment conditions—all online."