

Industrial Technologies Program

Wireless Mine-Wide Telecommunications Technology

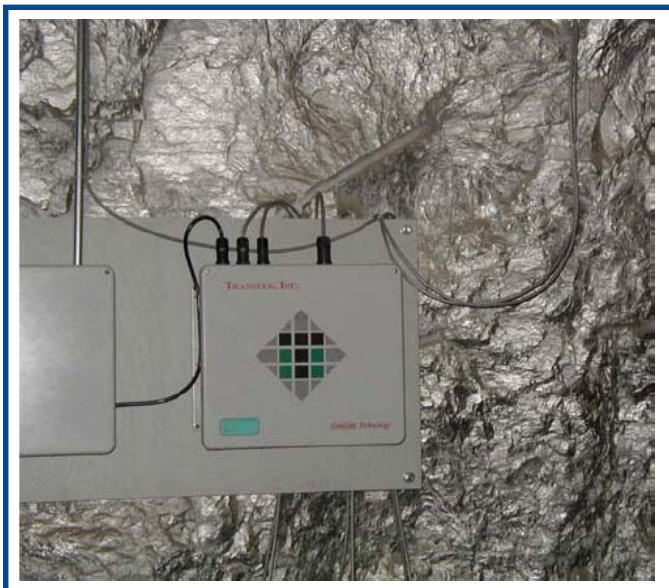
Wireless Telecommunications Eliminates the Need for a Dedicated Hard-Wired Network

A comprehensive mine-wide, two-way wireless voice and data communication system for the underground mining industry was developed. The system achieves increased productivity, energy efficiency, and safety within the mines. The mine-wide system permits two-way communication among underground personnel and between underground and surface personnel. The mine-wide system comprises of two interfaced subsystems: a through-the-earth communications system and an in-mine communications system. The system was designed, built, and commercialized by Transtek, Inc. Currently, several in-mine systems are in operation in underground mines in the United States. The system is not currently approved by MSHA for coal operations, but the approval is expected shortly. The use of these systems has proven a 70% increase in operations productivity leading to considerable energy savings.

This project also resulted in a spin-off rescue team lifeline and communications system. Transtek's systems are being used by the National Institute of Occupational Safety and Health (NIOSH) in their underground mine rescue team training program.

Furthermore, a system for tracking the location of vehicles and people within the mine was also developed, built and tested successfully. The project points the way to further developments that can lead to a GPS-like system for underground mines allowing the use of autonomous machines in underground mining operations, greatly reducing the amount of energy used in these operations.

Some products developed under this program are transferable to applications in fields other than mining. The rescue team system is applicable for use by first responders to natural, accidental, or terrorist-based building collapses. The in-mine communications system can be installed in high-rise buildings providing in-building communications to security and maintenance personnel, as well as to first responders.



In-Mine (IM) communication - Trademark ComCell Control Module installed inside underground mine.



Benefits for Our Industry and Our Nation

- *Increases practicality of fully autonomous equipment*
- *Increases underground mine safety*
- *Increases underground mine operations productivity by 70%*
- *Reduces construction needs in underground mines*

Applications in Our Nation's Industry

Wireless mine-wide telecommunications throughout the mine will allow underground personnel and surface personnel to communicate through voice and data transmissions. This technology will increase safety and operations productivity in underground mines. The in-mine communications technology can also be used advantageously in fields other than mining such as high-rise buildings and other steel-reinforced structures where two-way radios do not function well. Security and maintenance people cannot reach each other in many locations in high-rise buildings and other structures. The same problem exists for first responders in disaster situations in these environments.

Project Description

The objective of this project was to reduce the amount of energy usage in the mining industry by increasing operations productivity and safety through the introduction of a comprehensive wireless mine-wide voice and data communications system to operate underground and between the mine and the surface. Productivity and safety were to be increased further by developing a vehicle and people tracking system compatible with the communications system. Instant communication enables immediate reaction to changing circumstances preventing waste and allowing people and vehicles to be where they are needed and when they are needed, reducing energy waste from idling machinery.

Barriers

- Underground mines have proven to be resistant to wireless communication due to environmental conditions that limit the transmission of radio waves. Radio waves can only propagate a few feet before they are absorbed, diffracted, or reflected from rocks, walls, and other objects in the mine.
- Many mines still use traditional hard-wired, wallmounted telephones and a paging system to communicate underground. The time lapse between a page and its response is typically 50 minutes.

Pathways

The communication system was built by developing two subsystems: a through-the-earth wireless communications system, and an in-mine communications system. The two subsystems were interfaced resulting in the mine-wide communications system. The system for tracking the location of vehicles and people within the mine was designed through the development of beacons and transponders. This tracking system, in turn, was interfaced with the in-mine system to allow the information from the tracking system to be transmitted to a control room, displaying the information on a monitor.

Results

Transtek built a system that transmits voice wirelessly down- and up-link up to 600 feet from a given antenna through the earth within permissible energy limits. This is done through proprietary signal processing, filtering, and judicial physical

design parameters. No previous technologies were able to do this. This mine-wide system now allows for “instantaneous” communication.

Commercialization

Transtek collaborated with its partners from government, academia, and mining communities. These partnerships assisted in design, field tests, and implementation.

In-mine communications systems was implemented in limestone and sand mines, and tested in coal mines in Pennsylvania and Wisconsin. Experience gained from the installation and use of the system in these mines led to the development of several design improvements. The customers expressed full satisfaction with the installed system, and reported substantial productivity increase directly related to the use of wireless instant communication. As a result of the success at these mines, additional mines purchased and installed the system in their mines. As of December 2004, there were 10 customers using 30 to 40 units in operation in the United States.

As a spin-off from this project, Transtek developed, designed, and built a portable battery-operated communication system for rescue teams. The system offers four modes of operation that meet rescue teams’ specifications. The system is used by NIOSH in training programs that they conduct for mining companies.

The results of this project highlighted several mining needs that point the way to additional research and development requirements. Further development can lead to a GPS-like system for use in underground mines. Such a system will make the use of autonomous equipment in underground mining a reality, resulting in increased safety, productivity and large energy savings in mining operations.

Intellectual property coverage of the technology was obtained with the issuance of a US Patent to Transtek by the Trademark and Patent Office. An international patent is pending. The preparation for additional patent applications is in progress. The technologies received recognition in national and international journals that published articles describing Transtek’s systems.

Some of the technologies developed for the mining industry are transferable to other fields, including Homeland Security first responders in natural or man-made disasters, as well as security and maintenance personnel in high-rise commercial and residential buildings.

Project Partners

Transtek, Inc.
Pittsburgh, PA

University of Pittsburgh
Pittsburgh, PA

Victor Products USA
Cranberry Twp, PA

National Institute for Occupational
Safety and Health
Pittsburgh, PA

CONSOL, Inc.
Library, PA

Gateway Commerce Center
Wampum, PA

A Strong Energy Portfolio for a Strong America

Energy efficiency and clean, renewable energy will mean a stronger economy, a cleaner environment, and greater energy independence for America. Working with a wide array of state, community, industry, and university partners, the U.S. Department of Energy’s Office of Energy Efficiency and Renewable Energy invests in a diverse portfolio of energy technologies.

May 2006