Enhanced Mine Rescue Communications

Innovative Wireless Technologies, Inc.

Phil Carrier – VP Sales and Marketing
Innovative Wireless Technologies, Inc. (IWT)
  • Private company founded in 1997 – about 50 employees
  • Headquartered in Lynchburg, Virginia USA

Premier provider of wireless technology and solutions
  • Mesh Networks
  • Radio Geo-location
  • Wideband and Ultra-wideband communications
  • Wireless Protocols

Proven technology with solutions in diverse markets
  • Mining
  • Tunneling
  • Border and Perimeter Security Solutions
  • Emergency and First Responder Communications
IWT mesh technology adapted specifically for underground coal mining in response to MINER Act of 2006 (USA)

Deployed in 80+ US underground coal mines since mid-2009

The most widely deployed Wireless communications and tracking system in the world

- No cable/fiber between infrastructure nodes
- Improves miner safety
- Improves operator efficiency

Mine Rescue communications system used by MSHA
Fixed Deployment – Exceeds Compliance
• 2-way voice and text, exceeds MSHA requirements
• Tracking for personnel, vehicles
• Compliance during section moves

Portable Systems – Enhances Safety
• Mine Emergency Operations – used by MSHA Teams
• Through-the-Earth Communications System

New Products – Operational Improvement
• Integrated Atmospheric Monitoring and Communications systems
• Collision Avoidance Vision Enhancement System (CAVES)
• Data Analytics for Productivity
A few IWT customers
EVERY SECOND MATTERS
Communications History

Progression in the technologies and techniques used to share information

- **Lifeline**
  - Pulls – Stop (1), Advance(2), Retreat(3), Emergency(4)
    - *Limited information communicated*

- **Sound-powered/Mine Phone**
  - Doubles as a Lifeline
    - *Large cable reels; wire damage/wear; connection reliability*
    - *Point-to-point voice comms; no comms when moving FAB*

- **UHF/VHF Radios in Talkaround mode**
  - *Coverage/range limitations; people dropped to extend coverage area*
  - *People relay messages; Mine phone to Command Center*
  - *Voice only communication*
Desired Improvements

Prompted by evaluation of US Mine Disasters: Sago, Upper Big Branch

• Continuous communications from Command Center to the exploring Team
• Rapid deployment: lightweight, self configuring, no cables to carry in
• Reliable Information (No relayed messages)
• Reliable performance
• Scalable (small to big incidents)
• More than Voice (Sensor Data, Outby Tracking)
• Security

MSHA Request for Technology ➔ Request for Proposals
1. FASTER recovery
   through improved communications

2. SAFER for rescue teams
   through improved communications
Portable wireless communications for Mine Emergency Operations
- Proven mesh technology already deployed in mines
- Adopted by MSHA

Basic System Description
- Portable Mesh Nodes
  - Self-configuring network
  - Battery operated: >40 hours
  - Lightweight: <6.5 kg
  - Small: 30cm W x 13cm D x 23cm H
  - Communication range up to 750m

- Handsets
  - Encrypted Voice & Text
  - Emergency button
  - Speaker/Throat Mic or Direct-connect to Draeger face mask (future)
Basic System Components

- Charging Port
- Antenna Port
- LED
- On/Off
- Omni Antenna
- Directional Antenna
- Antenna
- Emergency
- Menu “Home”
- RSSI Value
- Push-to-Talk
- Keypad
- Group Select Knob
  - 1 = Broadcast
  - 2 - 8 = Groups 1 - 7
  - 9 - 16 = Talkaround Groups 1 - 7
- On/Off/Volume
- Speaker Mic Connector
- LCD Display
Communications Upgrade

IWT revolutionizes Mine Emergency Operations in 3 ways

1. Continuous Communications
   from Command Center to inby the Fresh Air Base

2. Rapid Deployment
   light weight, self configuring, no cables to carry in

3. Reliable Information
   relayed messages unnecessary
System Configuration

Inby the Fresh Air Base
- Portable Mesh Nodes (PMN)
- Handsets

Fresh Air Base
- Handsets
- **Optional** Mine Rescue Client Station

Outby the Fresh Air Base
- Portable Mesh Nodes (PMN) with Directional antennas
- Communications network to Command Center

Command Center
- Handsets
- Mine Rescue Dispatch Station
PMN ( ) is carried by Tail Captain / Map Man
Deployment Option A

All team members receive signal from PMN
PMNs are left at Fresh Air Base
Deployment Option B

Handset 5 transmits and other handsets receive voice transmission through PMNs.
Handset Relay Mode

Handset acts as Repeater

Fresh Air Base

Belt
<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inby Wireless Communications</td>
<td>Base functionality</td>
</tr>
<tr>
<td>Wireless Communications Outby</td>
<td>FAB to CC</td>
</tr>
<tr>
<td>Tracking Outby</td>
<td>Display at FAB/CC</td>
</tr>
<tr>
<td>Communications redundancy via Fiber</td>
<td>Broadband data</td>
</tr>
<tr>
<td>Spotter readings transmitted wirelessly</td>
<td>Faster, surer</td>
</tr>
<tr>
<td>“Leave Behind” gas readings</td>
<td>Behind FAB</td>
</tr>
<tr>
<td>96 hour battery backup</td>
<td>Outby devices</td>
</tr>
<tr>
<td>IP Camera</td>
<td>Picture &gt;1000 words</td>
</tr>
</tbody>
</table>
Gas Detection

MX-6 Gas Detector paired with mesh Handset

Readings automatically transmitted over wireless mesh network

Sensor readings, Battery status (MX-6 & Adapter)
Drawing/Notes on Mine Map

Command Center draws on map to provide direction to team underground

*Instantly seen by Fresh Air Base & Command Center – eliminates miscommunication*
**Portable Gateway**

- Gateway bridge between Wireless RF Mesh and IP via Ethernet
- 24 hour run-time with internal battery
- **NOT** intrinsically safe

**Fiber Optic Switch**

- Enables communications redundancy to wireless network
- Enables video transmission over fiber
- Enables linking of computers at Fresh Air Base and Command Center
- **NOT** intrinsically safe
96 Hour Extender Battery

• Provides 96 hour operation of Outby Portable Mesh Nodes

• Enables “remote shut-off” of Portable Mesh Nodes in case of evacuation

• NOT intrinsically safe
Full System Deployment

- MX-6 with Sensor Interface
- Ethernet Cable
- Fiber Cable

SURFACE

- Gateway
- Fiber Switch
- Command Center
- IP Camera
- Laptop

BELOW GROUND

- Outby FAB
- Inby FAB

Radio
PMN
RF
Case Studies

Sand Mine Recovery
- 6 PMNs deployed underground
- Direct communication to the Surface
- Covered approximately 1,500 ft (457 m)

Silver Mine Recovery
- 8 PMNs and 3 Gateways deployed
- 9,600 ft (2,926 m) of Fiber between Fresh Air Base and Command Center
- Covered approximately 4,000 ft (1,219 m) of drift wirelessly
- MSHA: “Accomplished in 6 hours what previously would have taken 2 days”
Salt Mine Recovery

9 PMNs deployed underground
Mine Phone between the Fresh Air Base and the Command Center
Covered approximately 7,800 ft (2,377 m) of entries
Coal Mine Recovery #1

Mine Fire ➔ high CO levels
15 PMNs deployed for exploration ~ 4,000 ft (1,200 m) of Gate & Bleeder
Mine phone at Fresh Air Base to communicate with Command Center
Recovery #1 Deployment

3,900 ft (1,200 m) from EP 15 to Bleeder Shaft
Coal Recovery #2

Recovery of 2 miners after explosion
Covered approximately 12,000 ft (3,657 m)
## Intrinsic Safety Approvals

<table>
<thead>
<tr>
<th>PRODUCT</th>
<th>IS APPROVALS</th>
</tr>
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<tbody>
<tr>
<td>Portable Mesh Node</td>
<td>MSHA, ATEX pending</td>
</tr>
<tr>
<td>Handset, Speaker/Throat Mic</td>
<td>MSHA, ATEX, DGMS pending</td>
</tr>
<tr>
<td>MX-6 Gas Detector Interface</td>
<td>MSHA, ATEX pending</td>
</tr>
<tr>
<td>Portable Gateway</td>
<td>NA</td>
</tr>
<tr>
<td>Smart Battery</td>
<td>NA</td>
</tr>
<tr>
<td>Fiber Optic Switch</td>
<td>NA</td>
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</tbody>
</table>
Summary

Speeds up the exploration

Increased Team Safety

Improves decisions with better/more information to everyone

Reduced chances of Communication Errors

In use and available today

Thank You
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