

# Enhanced Mine Rescue Communications



**Innovative Wireless Technologies, Inc.**

Phil Carrier – VP Sales and Marketing

# Introduction

## 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 Mining Background

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

# IWT Mining Solutions

## 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



Protecting Miners' Safety and Health Since 1978



A large circle of yellow dots surrounds a digital clock display. The clock shows '00:00:00' in a yellow, 3D-style digital font.

00:00:00

**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*

# IWT Communications Solution

## Portable wireless communications for Mine Emergency Operations

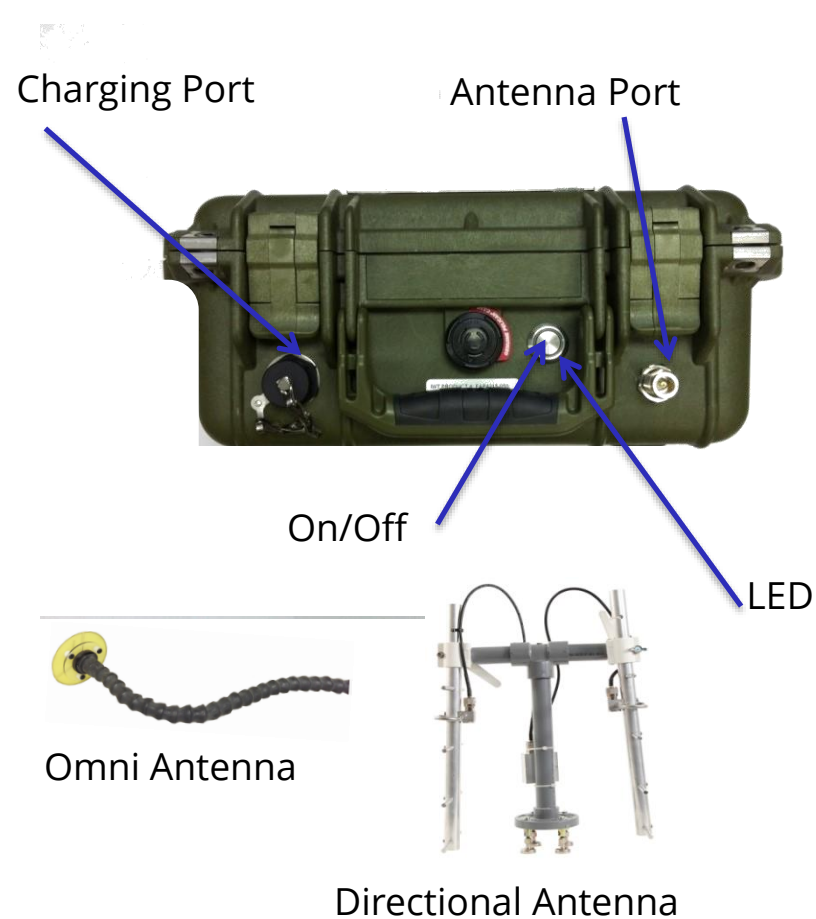
- Proven mesh technology already deployed in mines
- Adopted by MSHA

## 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



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



## Command Center

- Handsets
- Mine Rescue Dispatch Station



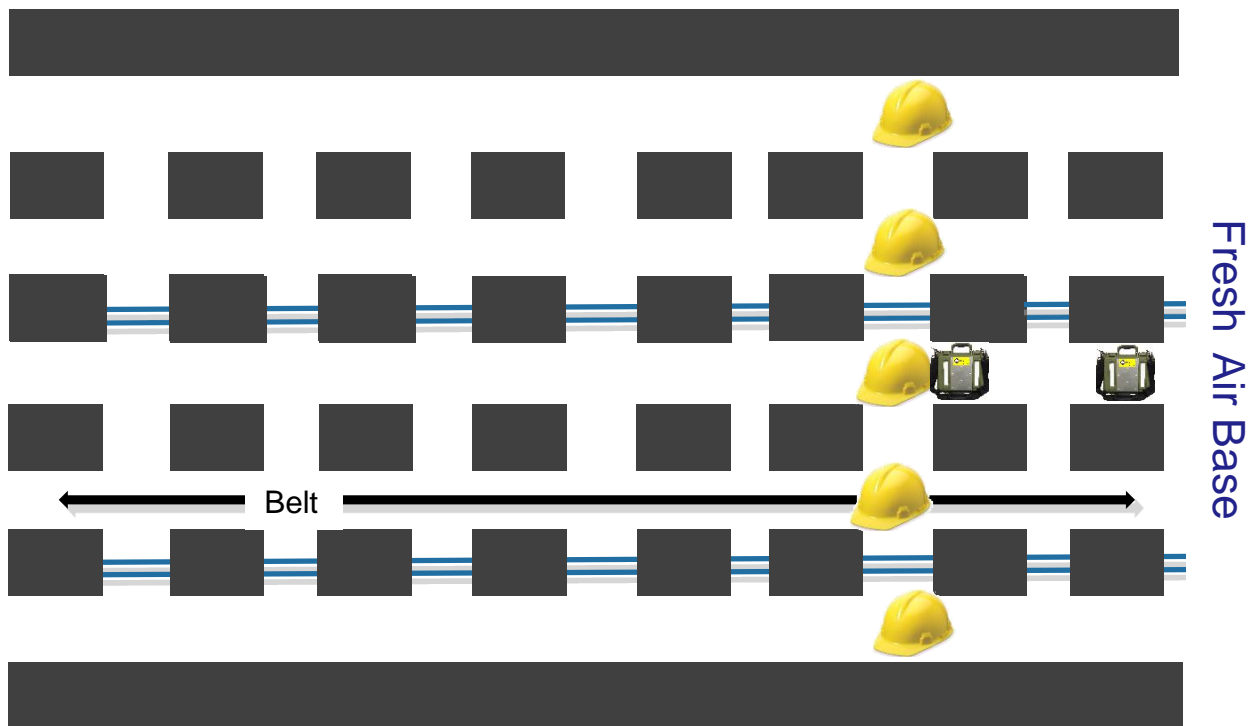
## Outby the Fresh Air Base

- Portable Mesh Nodes (PMN) with Directional antennas
- Communications network to Command Center



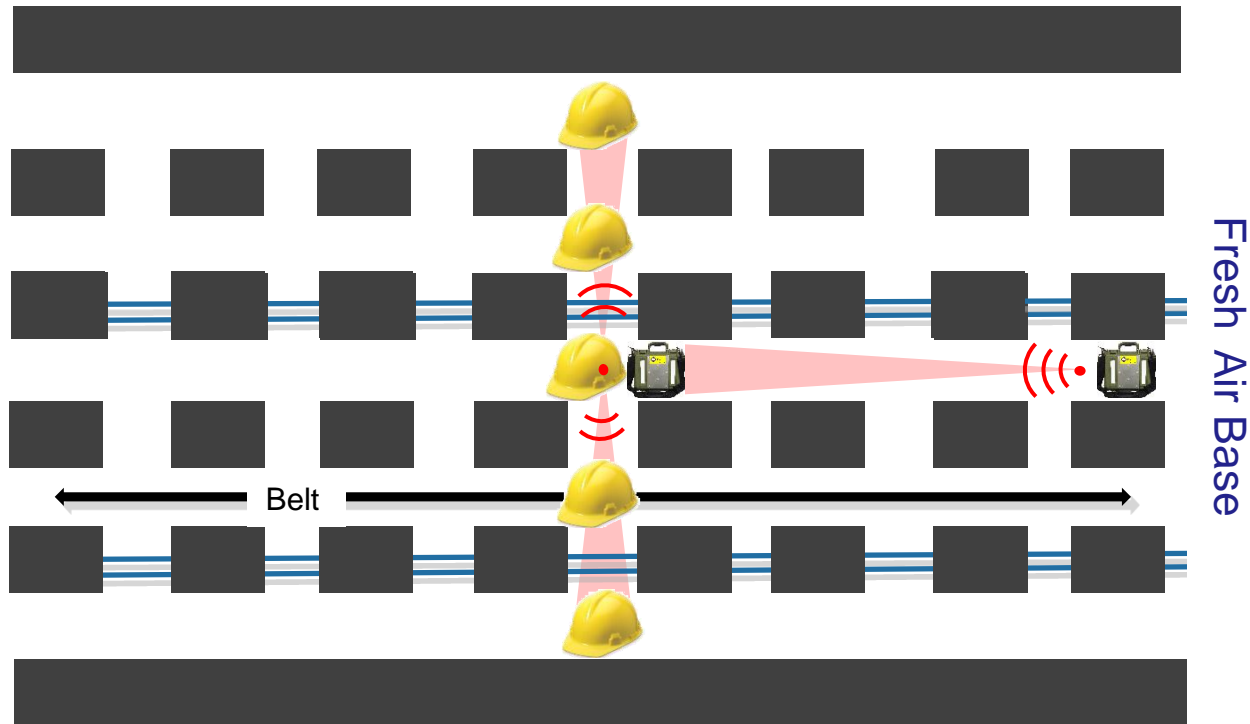
# Deployment Option A

PMN (  ) is carried by Tail Captain / Map Man



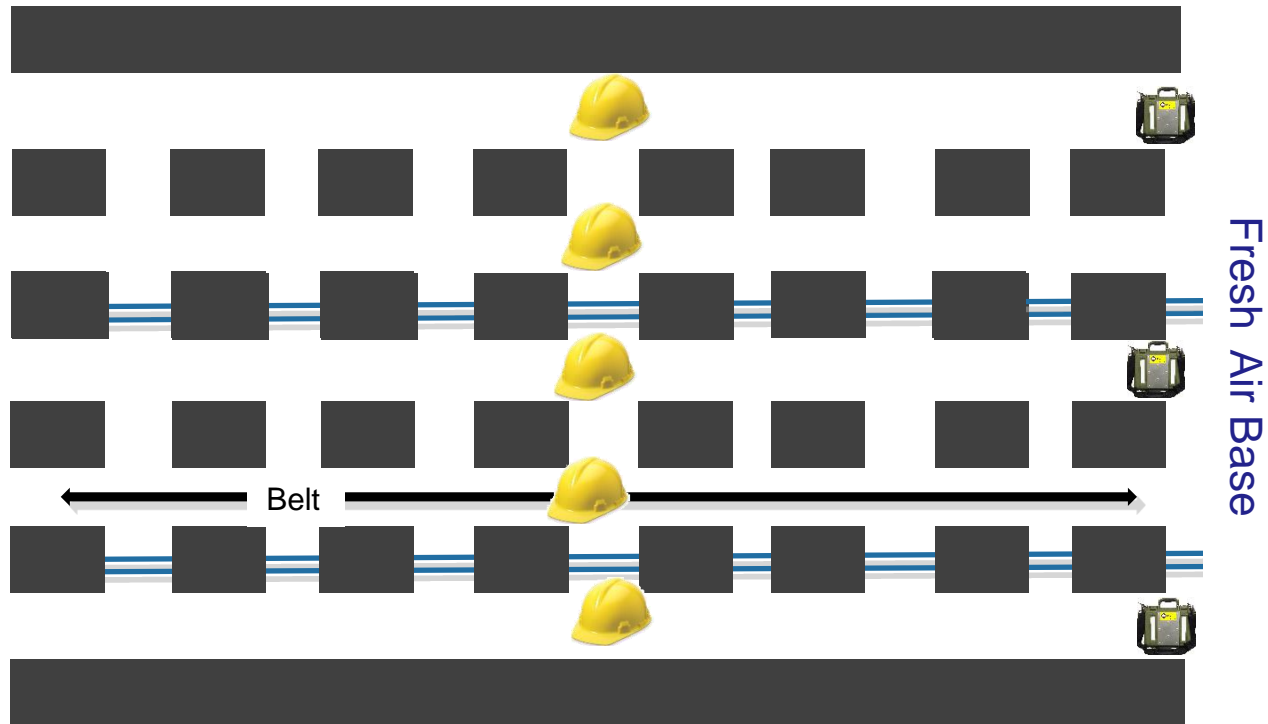
# Deployment Option A

All team members receive signal from PMN



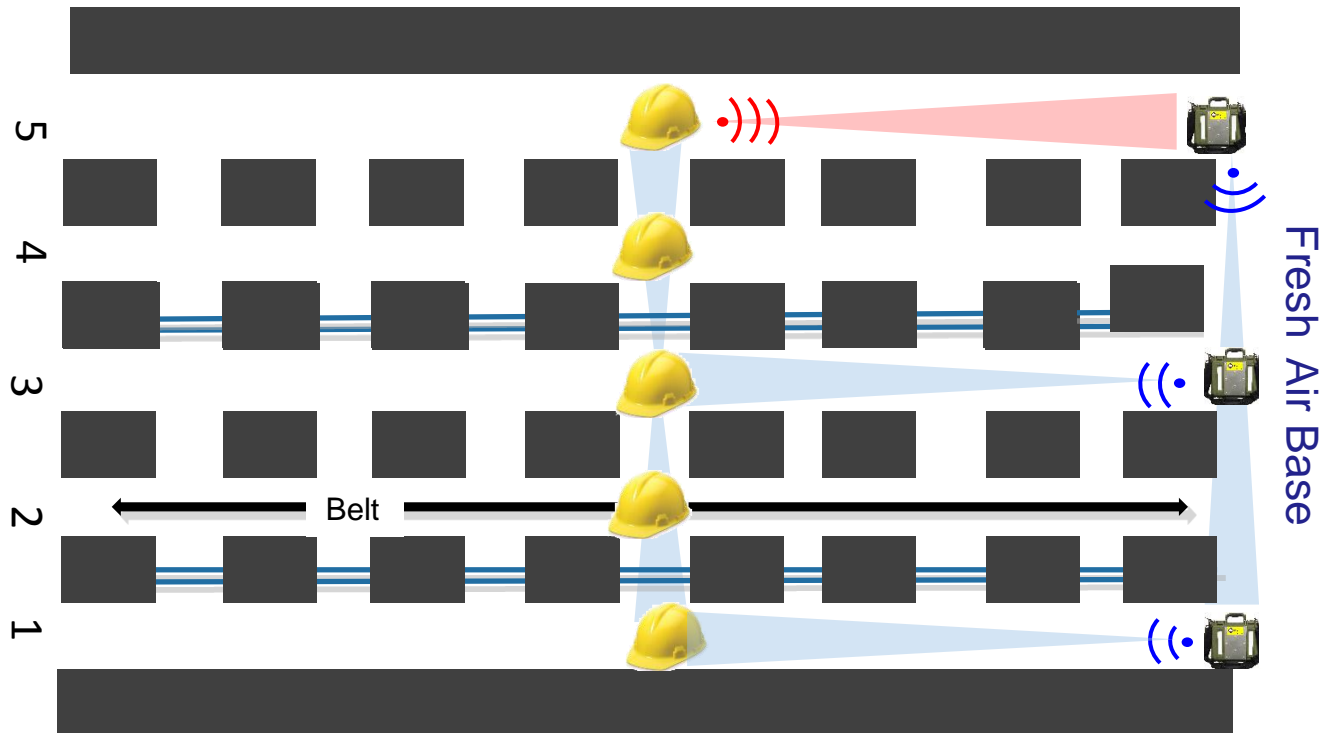
# Deployment Option B

PMNs are left at Fresh Air Base



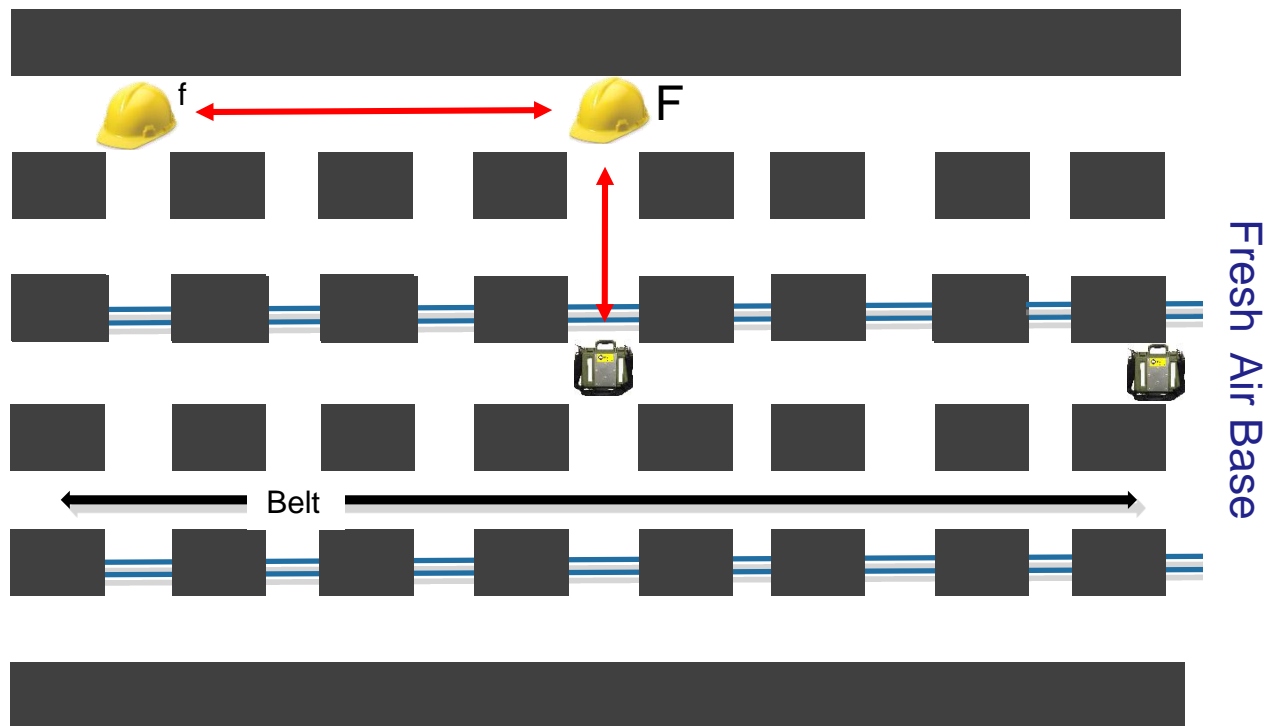
# Deployment Option B

Handset 5 transmits and other handsets receive voice transmission through PMNs



# Handset Relay Mode

Handset acts as Repeater



# Modular & Expandable

Inby Wireless Communications

Wireless Communications Outby

Tracking Outby

Communications redundancy via Fiber

Spotter readings transmitted wirelessly

“Leave Behind” gas readings

96 hour battery backup

IP Camera

Base functionality

FAB to CC

Display at FAB/CC

Broadband data

Faster, surer

Behind FAB

Outby devices

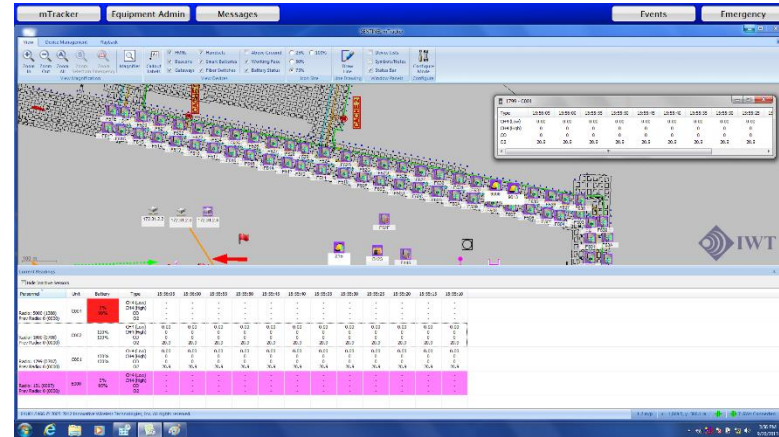
Picture >1000 words

# Gas Detection

MX-6 Gas Detector paired with mesh Handset

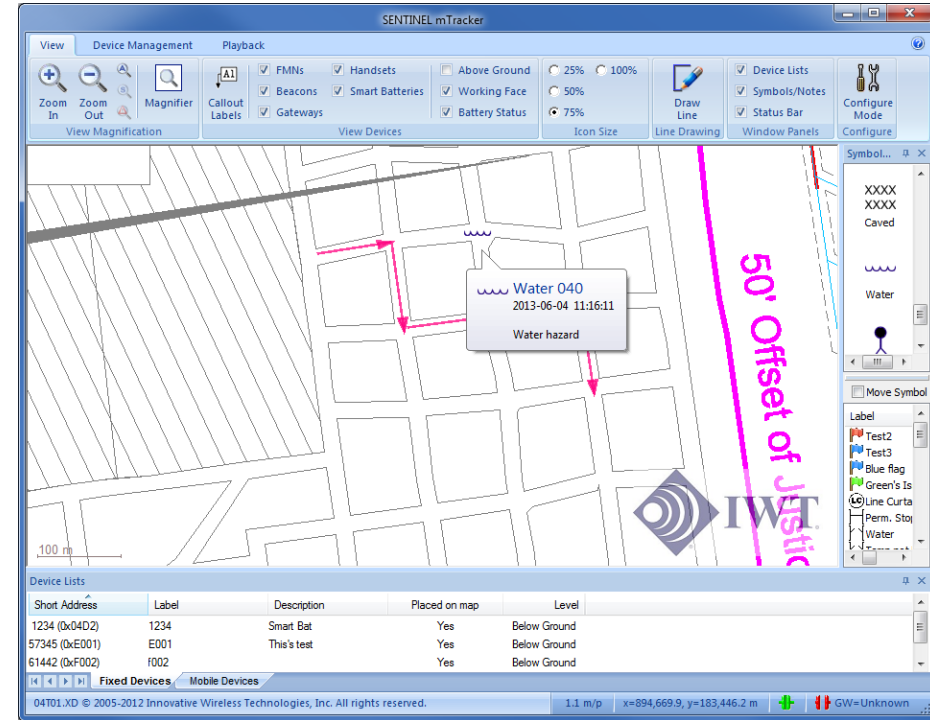
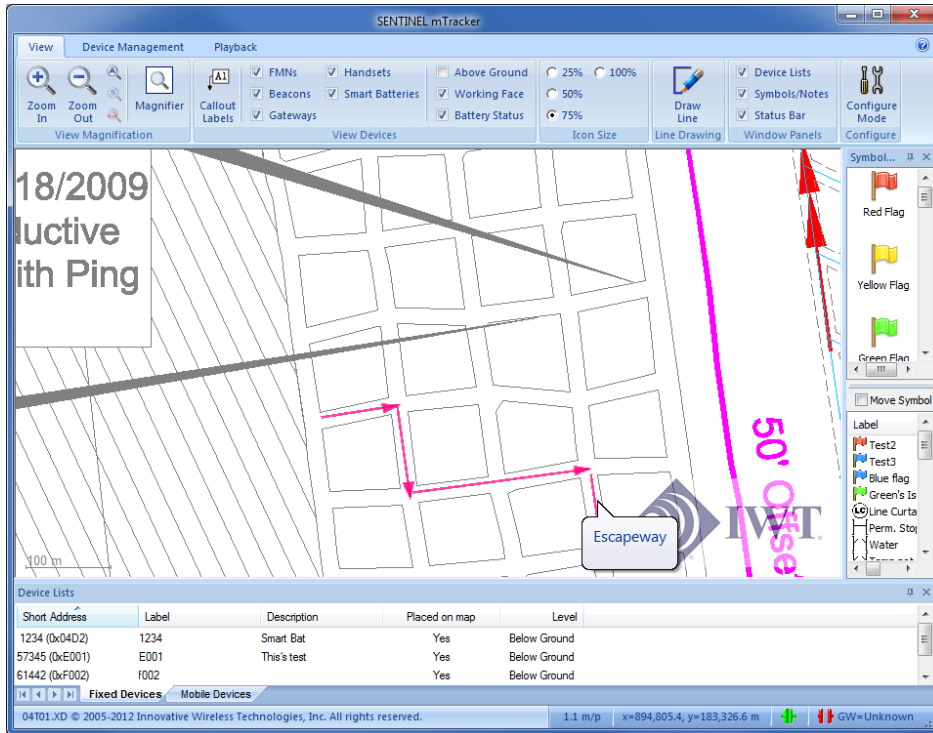
*Readings automatically transmitted over wireless mesh network*

Sensor readings, Battery status (MX-6 & Adapter)



# Drawing/Notes on Mine Map

Draw on map to note situation during exploration with time-stamp



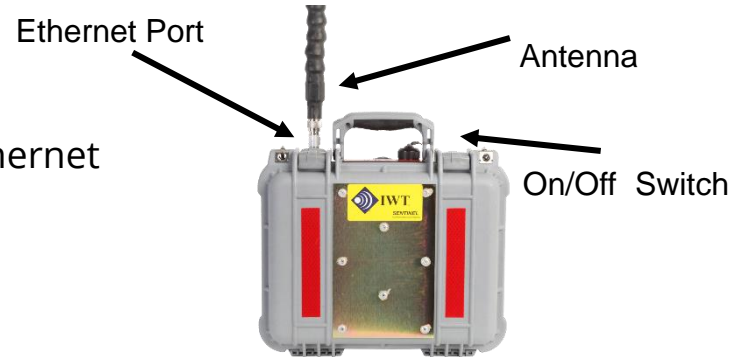
Command Center draws on map to provide direction to team underground

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

# Hi Bandwidth / Redundancy

## 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

# Additional Operating Time

## 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



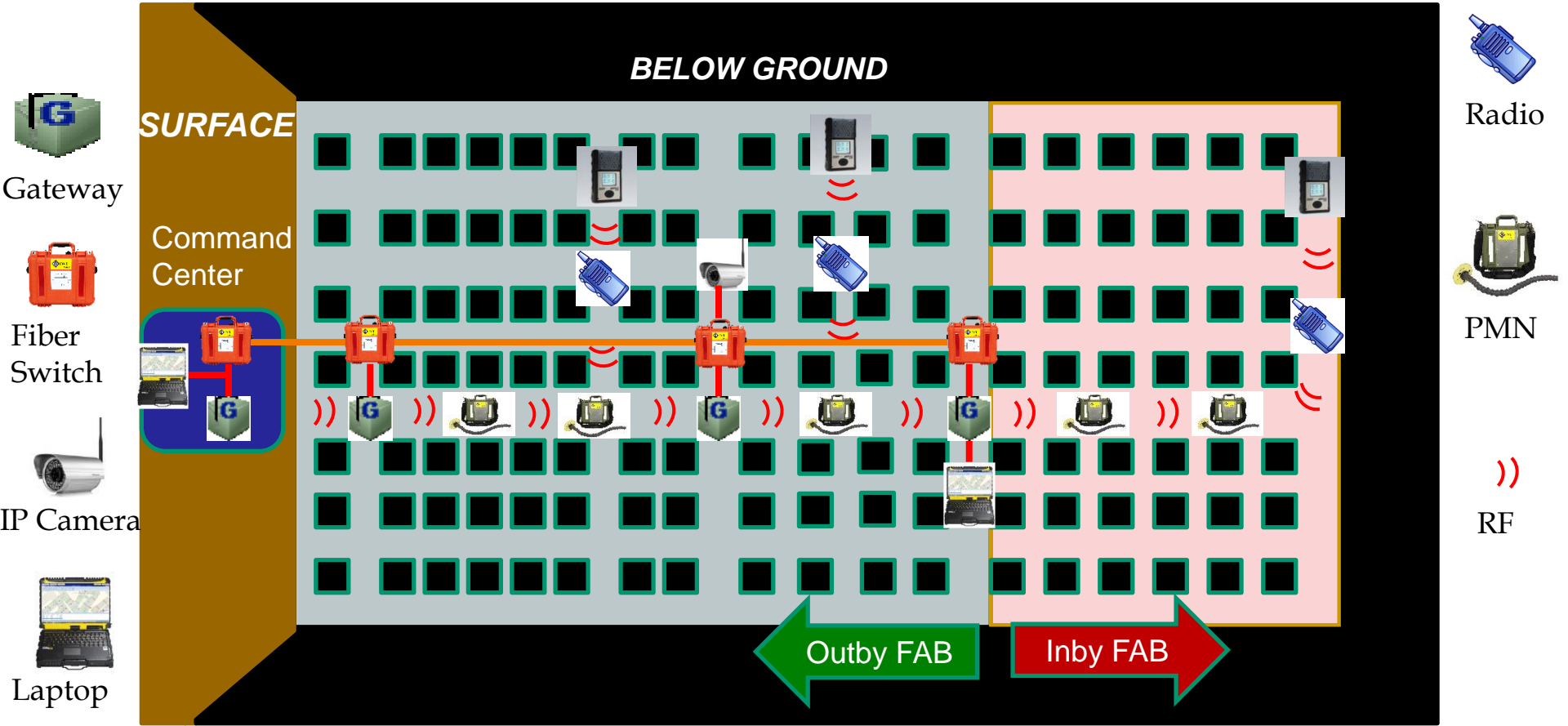
# Full System Deployment



MX-6 with Sensor Interface

Ethernet Cable

Fiber Cable



# 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”**

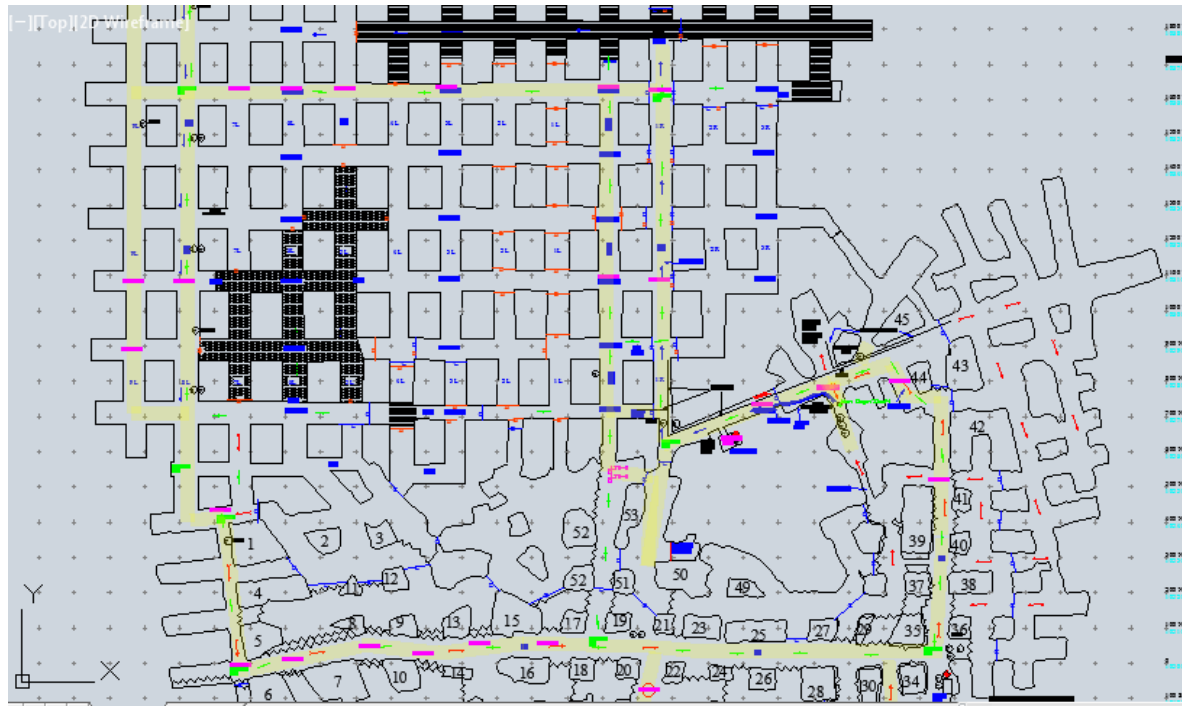


# Salt Mine Recovery

9 PMNs deployed underground

Mine Phone between the Fresh Air Base and the Command Center

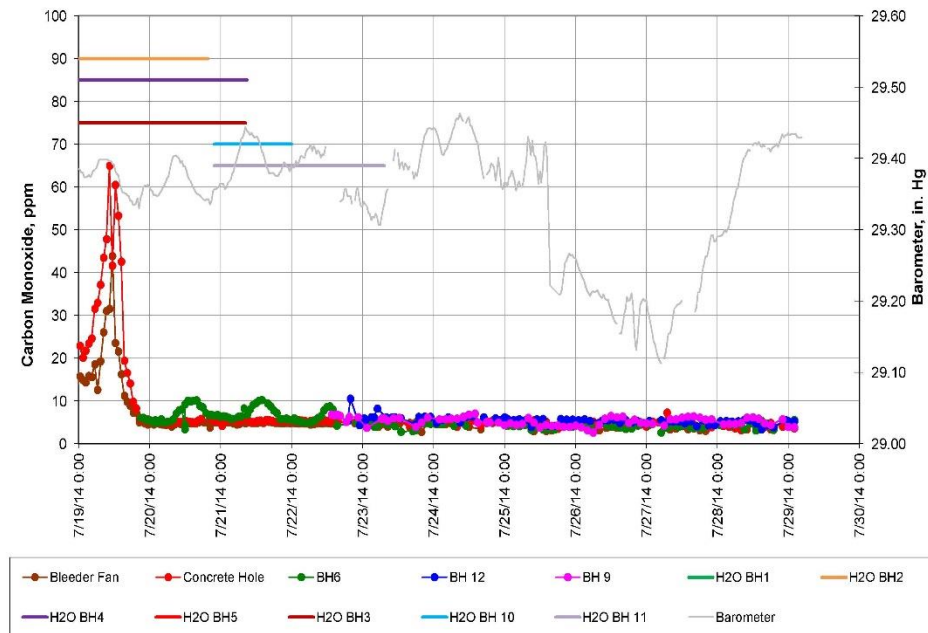
Covered approximately 7,800 ft (2,377 m) of entries



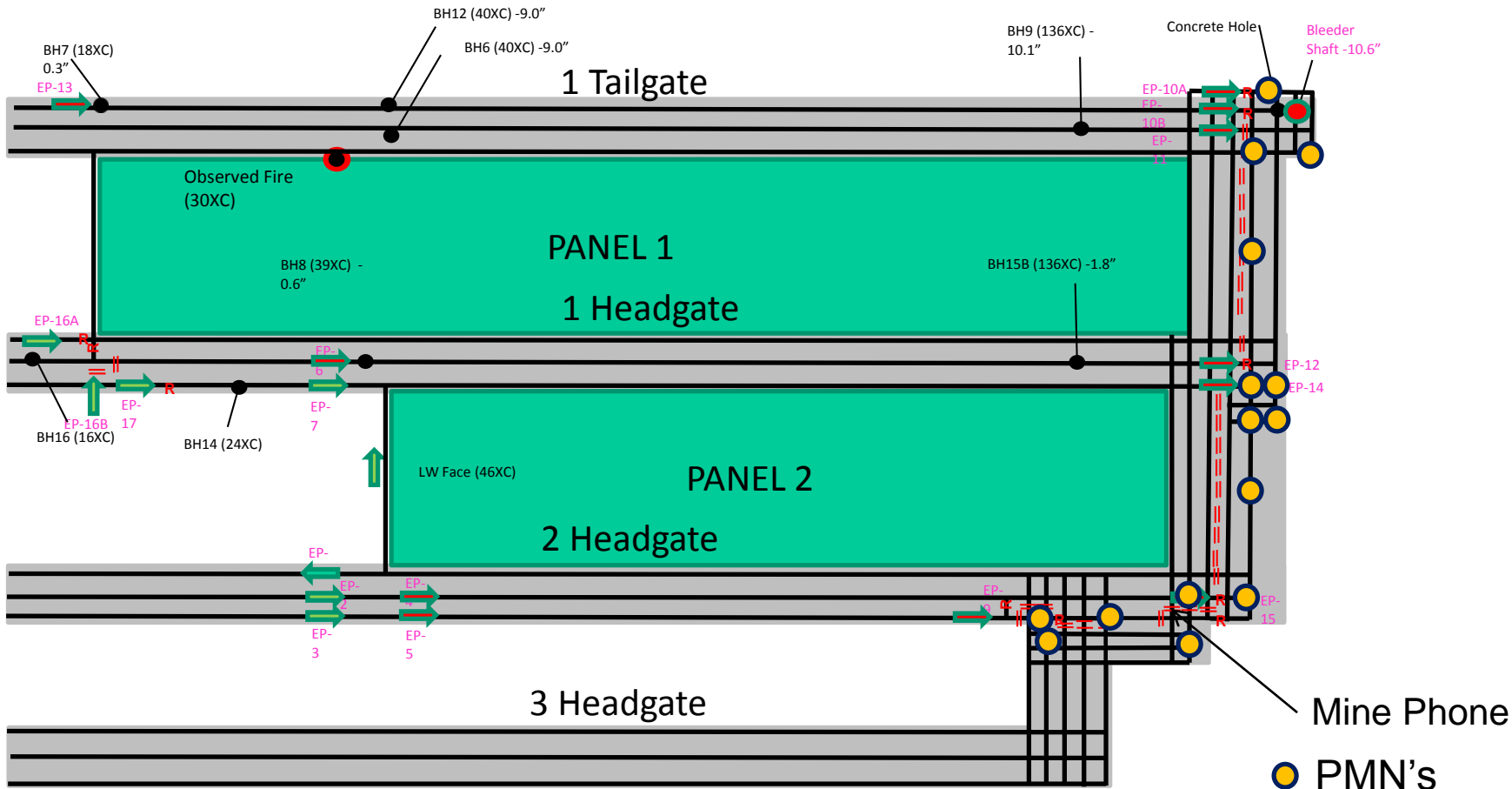
# Coal Mine Recovery #1

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

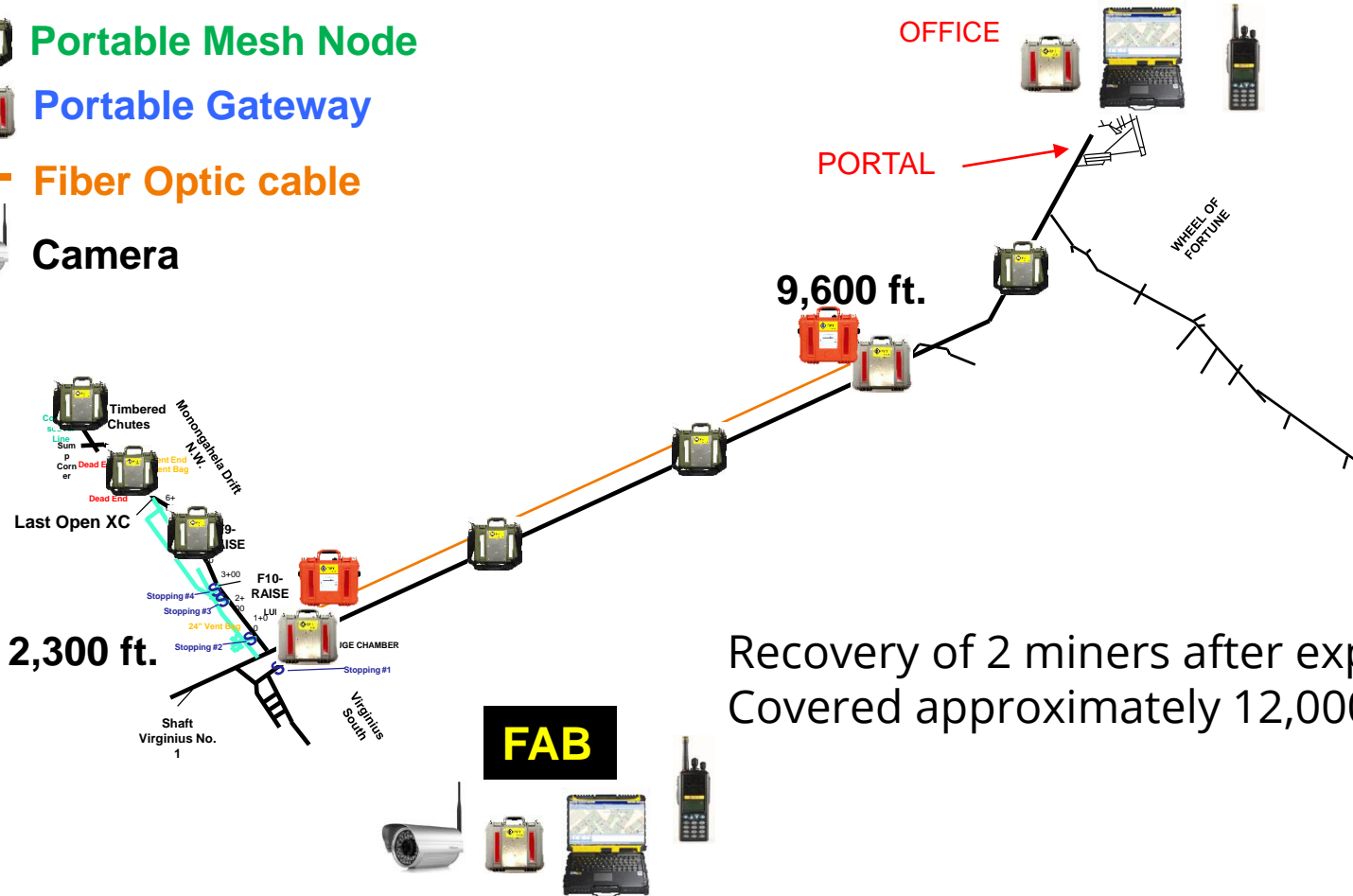
# Coal Recovery #2

 Portable Mesh Node

 Portable Gateway

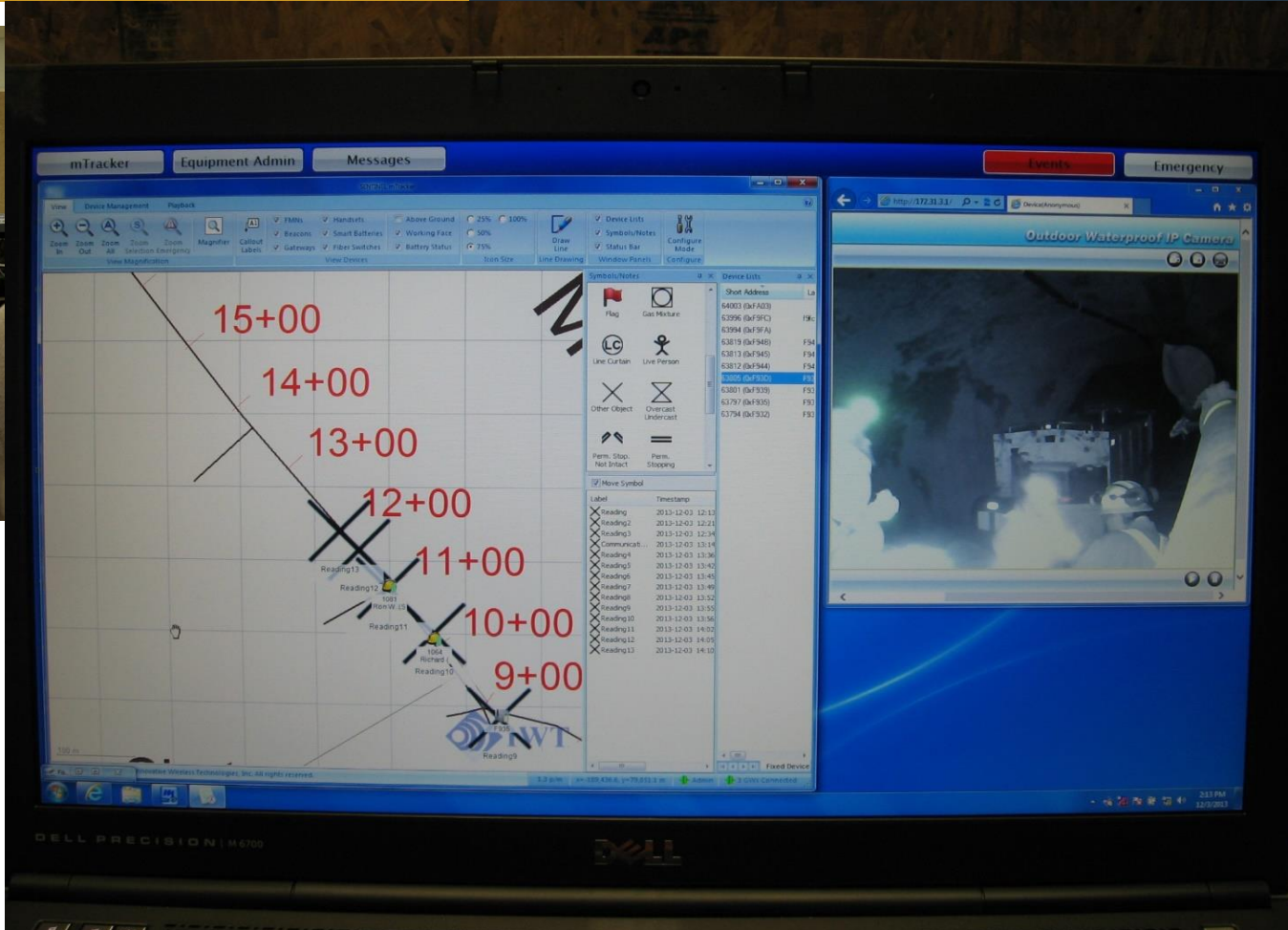
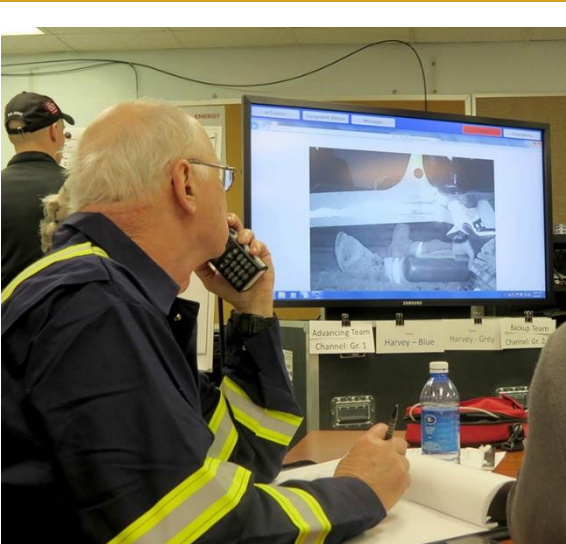
 Fiber Optic cable

 Camera









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

# Mine Map & Camera Feed



# Intrinsic Safety Approvals

PRODUCT	IS APPROVALS
Portable Mesh Node 	MSHA, ATEX pending
Handset, Speaker/Throat Mic 	MSHA, ATEX, DGMS pending
MX-6 Gas Detector Interface 	MSHA, ATEX pending
Portable Gateway 	NA
Smart Battery 	NA
Fiber Optic Switch 	NA

# 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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