

Mine Emergency Communication: Options, Issues & Status

West Virginia
Coal Forum

Charleston,
West Virginia



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Bowl of Many Cooks



Since February of 2006 hundreds for people and dozen of companies have dedicated themselves to providing better safety options for miners.

The electronics and communications giants left the field once they realized the enormity of the challenge and the diminutive nature of the coal industry. Its the small businesses that remained.

Seldom have such varied disciplines been focused on a single problem without the attraction of massive funding. Few resources have been provided those that persevered except the desire to provide a solution.



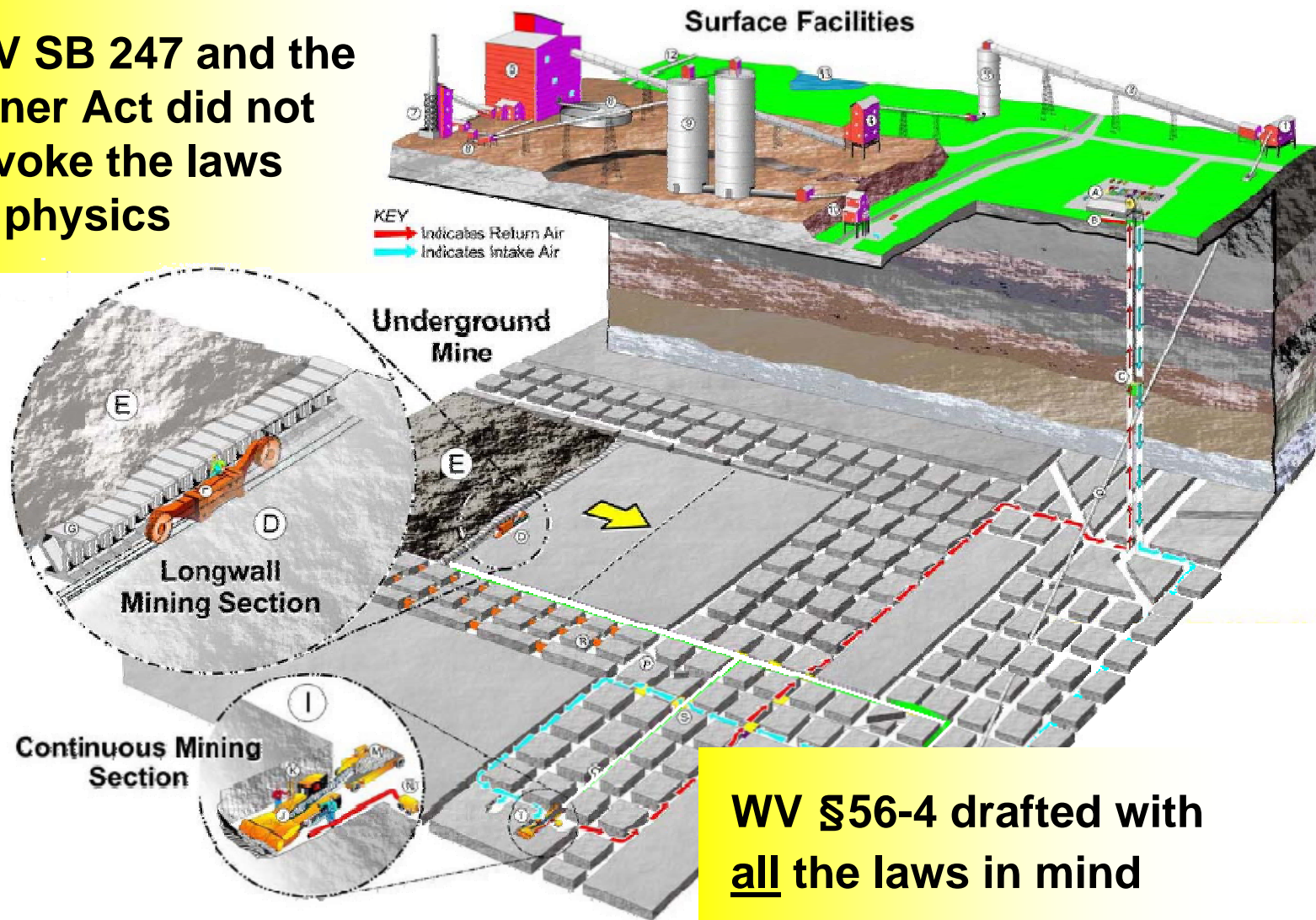
We all owe a resounding thanks to those that have given of themselves and their time to allow our industry to reach this point and all our encouragement to them as they push on toward all our goal...

Everybody gets to go home!

Communication Reality



WV SB 247 and the Miner Act did not revoke the laws of physics



WV §56-4 drafted with all the laws in mind

WV §56-4

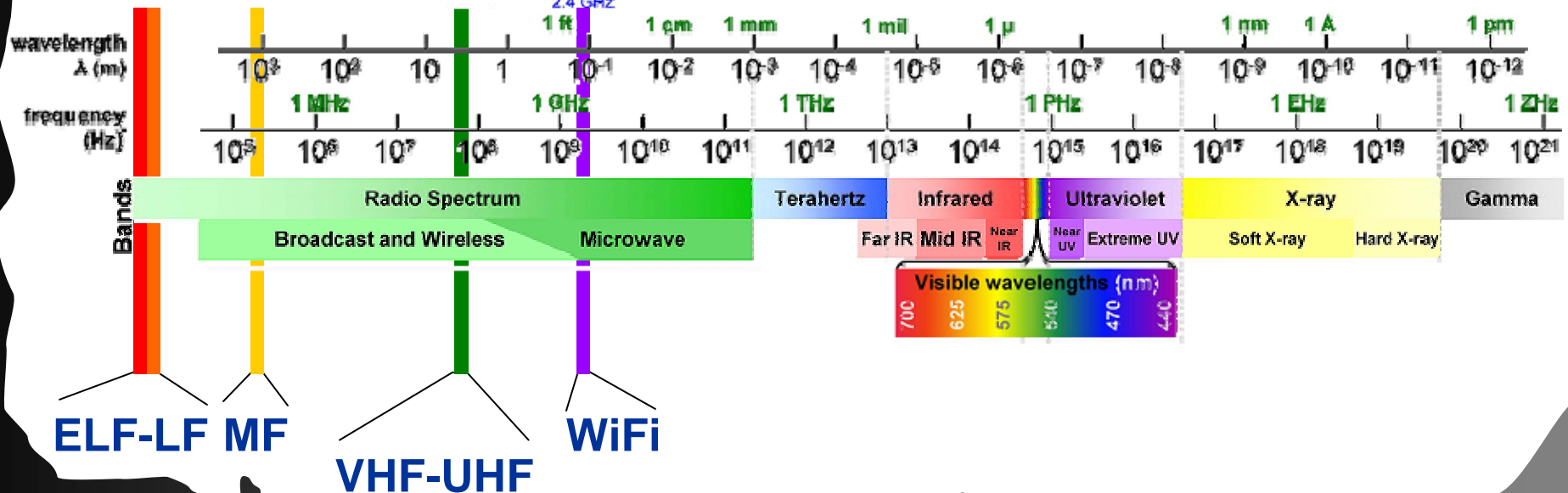


- **Wireless – miner not connected by wire**
- **Two-way communications to each miner in at least two separate airways**
- **Tracking each miner in relation to known points prior and in escapeways after**
- **Operators submit Communication/Tracking Plan by July 31, 2007**
 - **Understand needs and thought through risks**
 - **Survive accident or be quickly repairable**
 - **Communication center operator min. red-hat**

Talking Where Cell Phones Won't Go

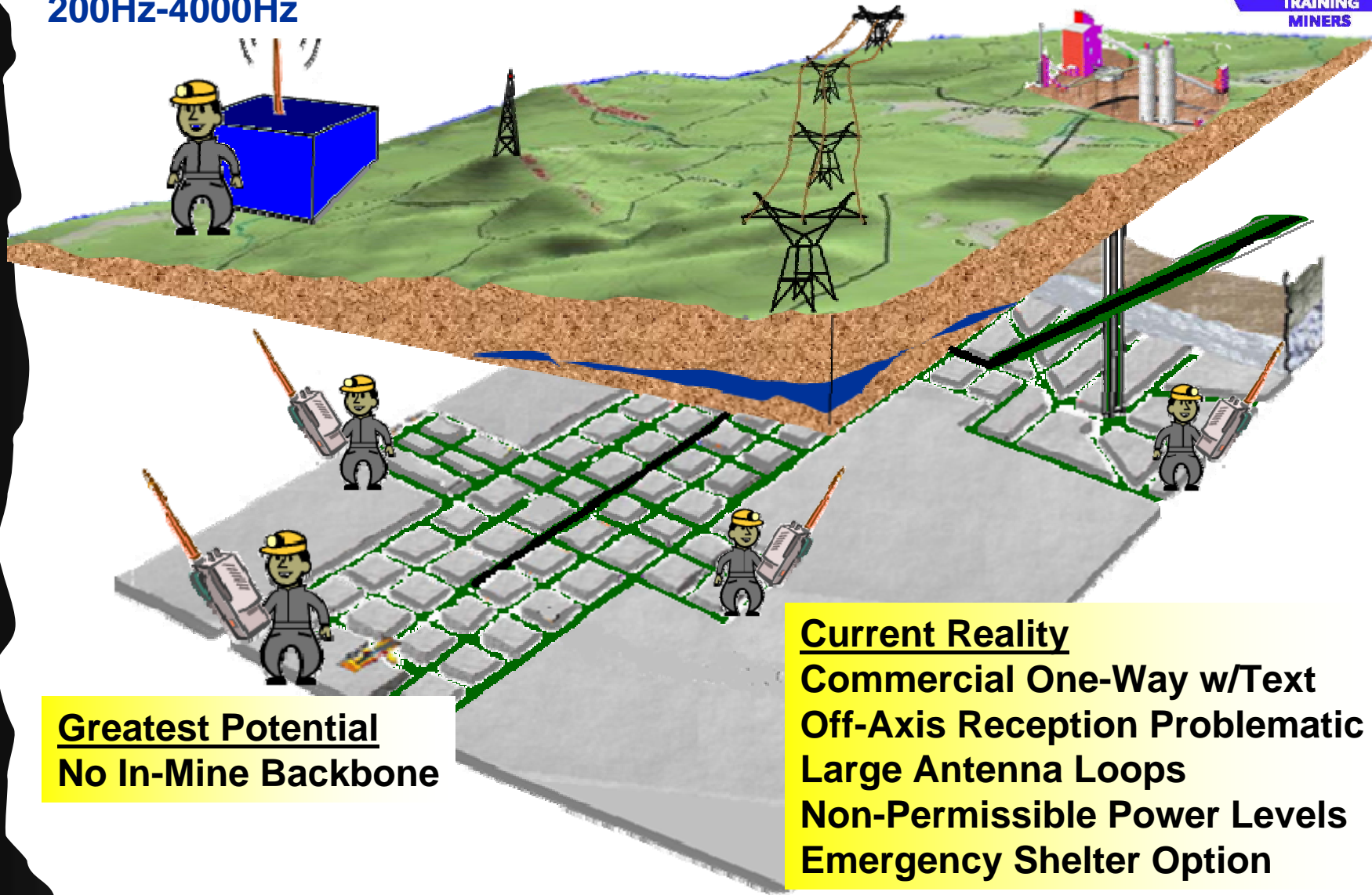


Practical options are limited by physics and existing uses



Through The Earth (TTE)

200Hz-4000Hz

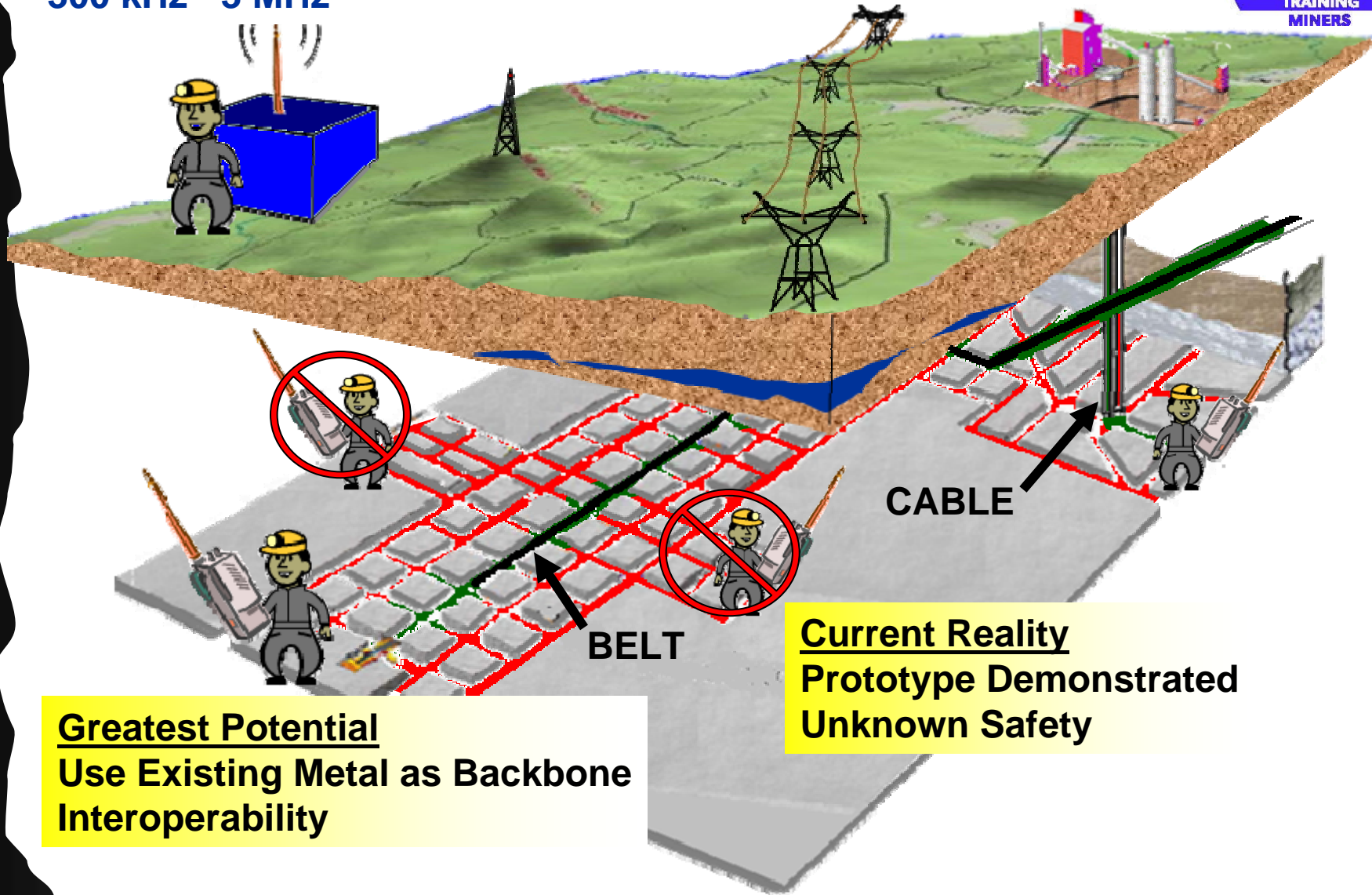


Greatest Potential
No In-Mine Backbone

Current Reality
Commercial One-Way w/Text
Off-Axis Reception Problematic
Large Antenna Loops
Non-Permissible Power Levels
Emergency Shelter Option

Medium Frequency (MF)

300 kHz - 3 MHz

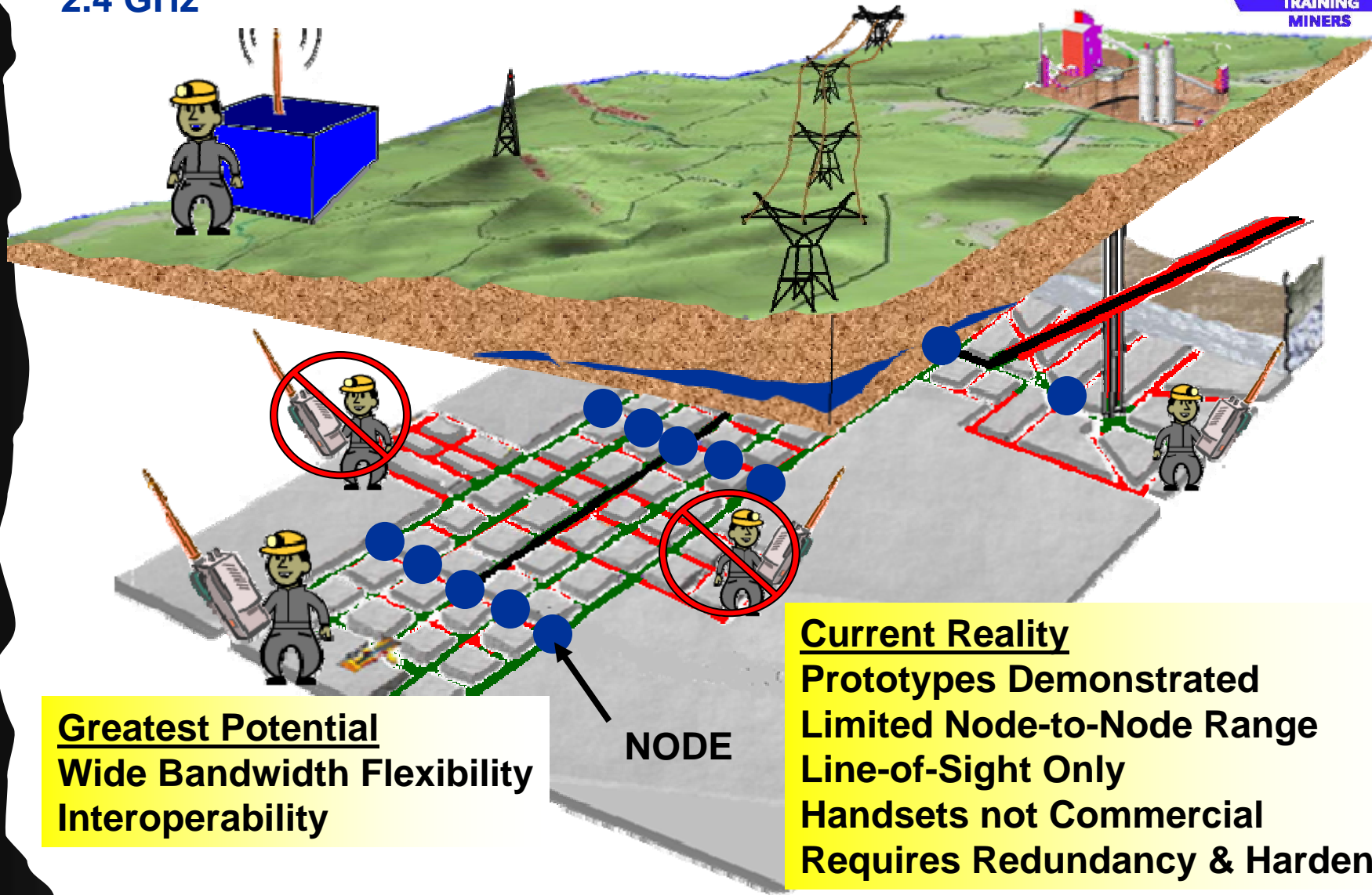


Greatest Potential
Use Existing Metal as Backbone
Interoperability

Current Reality
Prototype Demonstrated
Unknown Safety

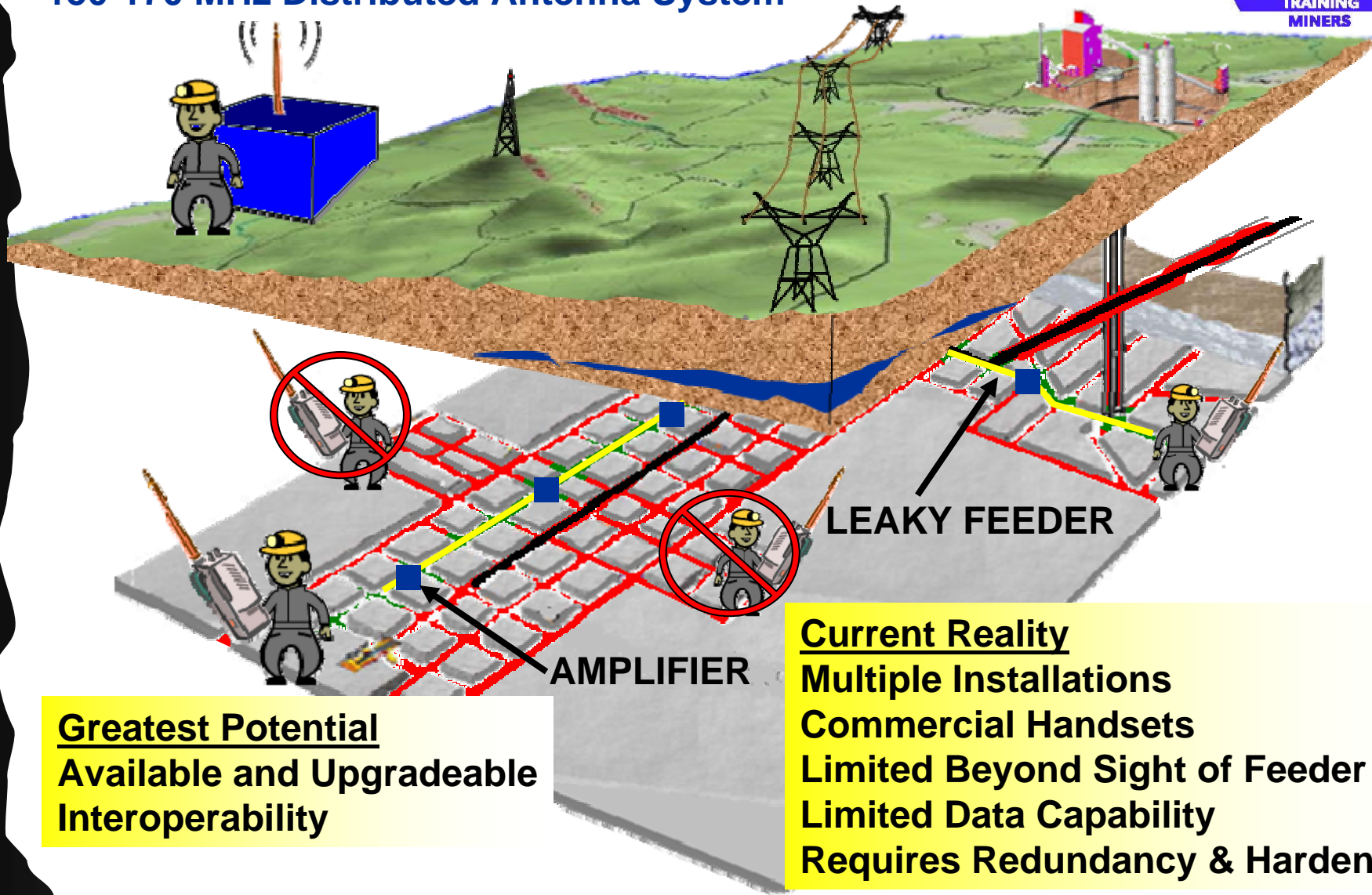
Wi-Fi Mesh Nodes

2.4 GHz



Leaky Feeder (VHF)

150-170 MHz Distributed Antenna System

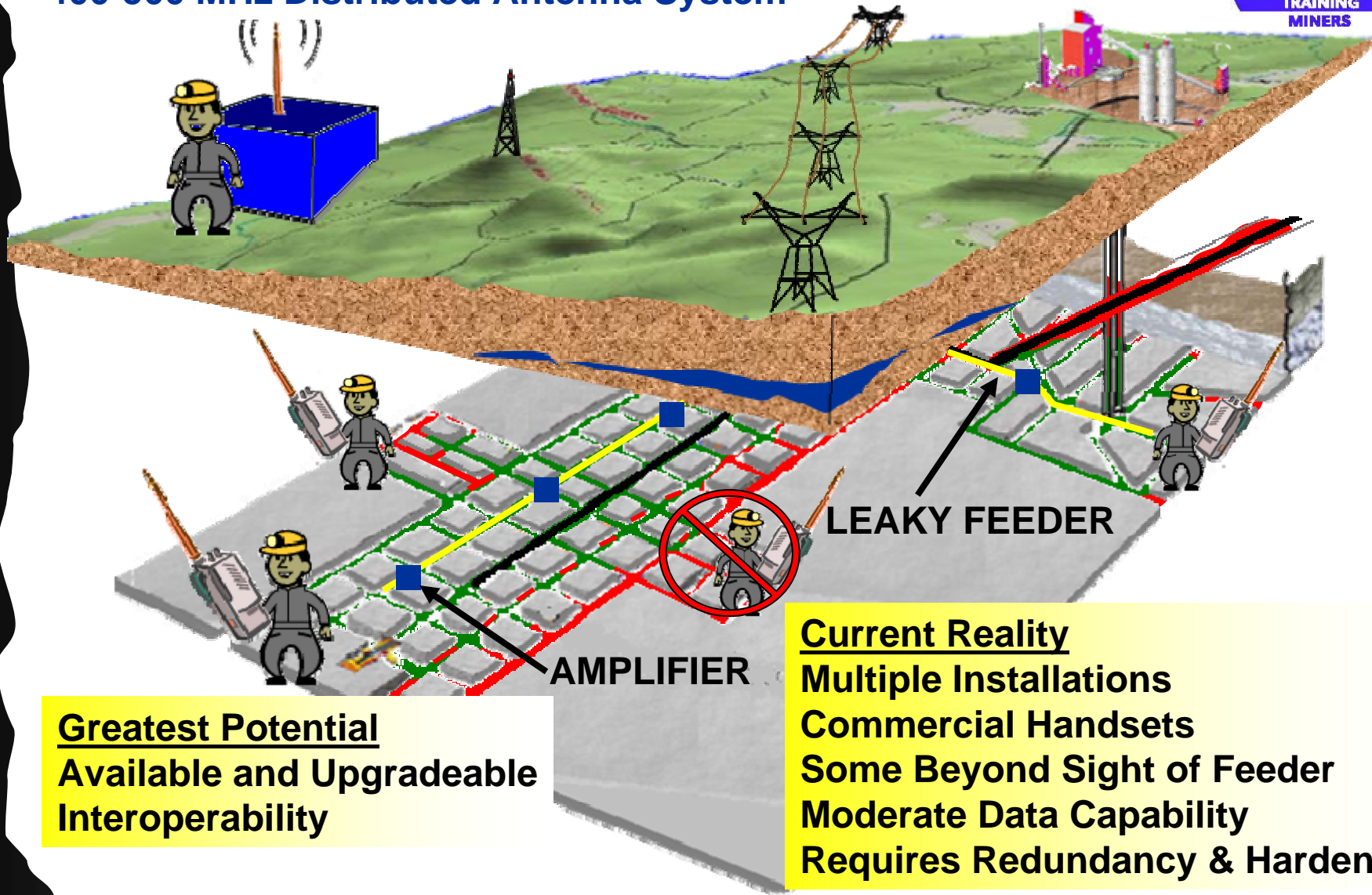


Greatest Potential
Available and Upgradeable
Interoperability

Current Reality
Multiple Installations
Commercial Handsets
Limited Beyond Sight of Feeder
Limited Data Capability
Requires Redundancy & Hardening

Leaky Feeder (UHF)

400-500 MHz Distributed Antenna System

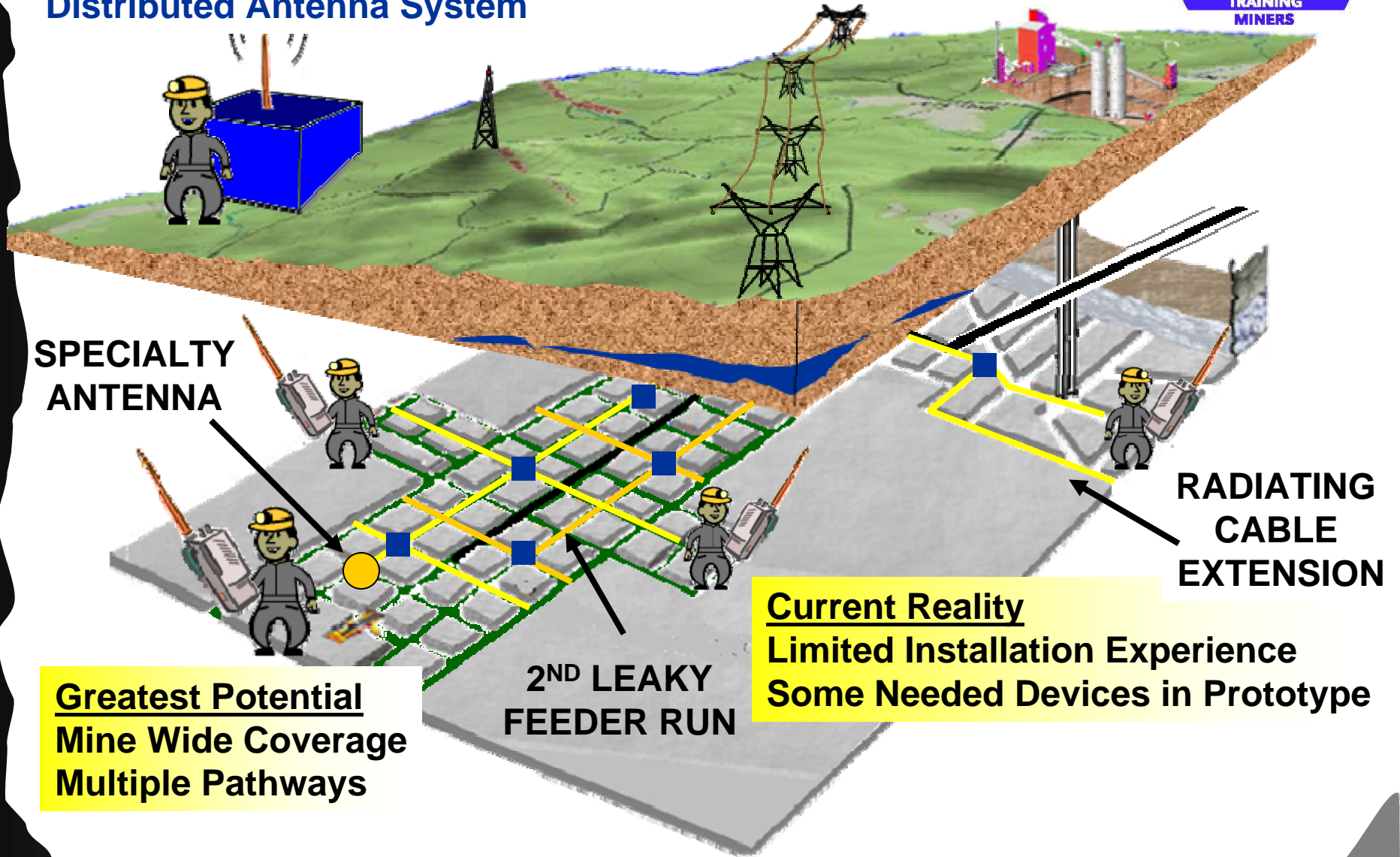


Greatest Potential
Available and Upgradeable
Interoperability

Current Reality
Multiple Installations
Commercial Handsets
Some Beyond Sight of Feeder
Moderate Data Capability
Requires Redundancy & Hardening

Leaky Feeder Enhancements

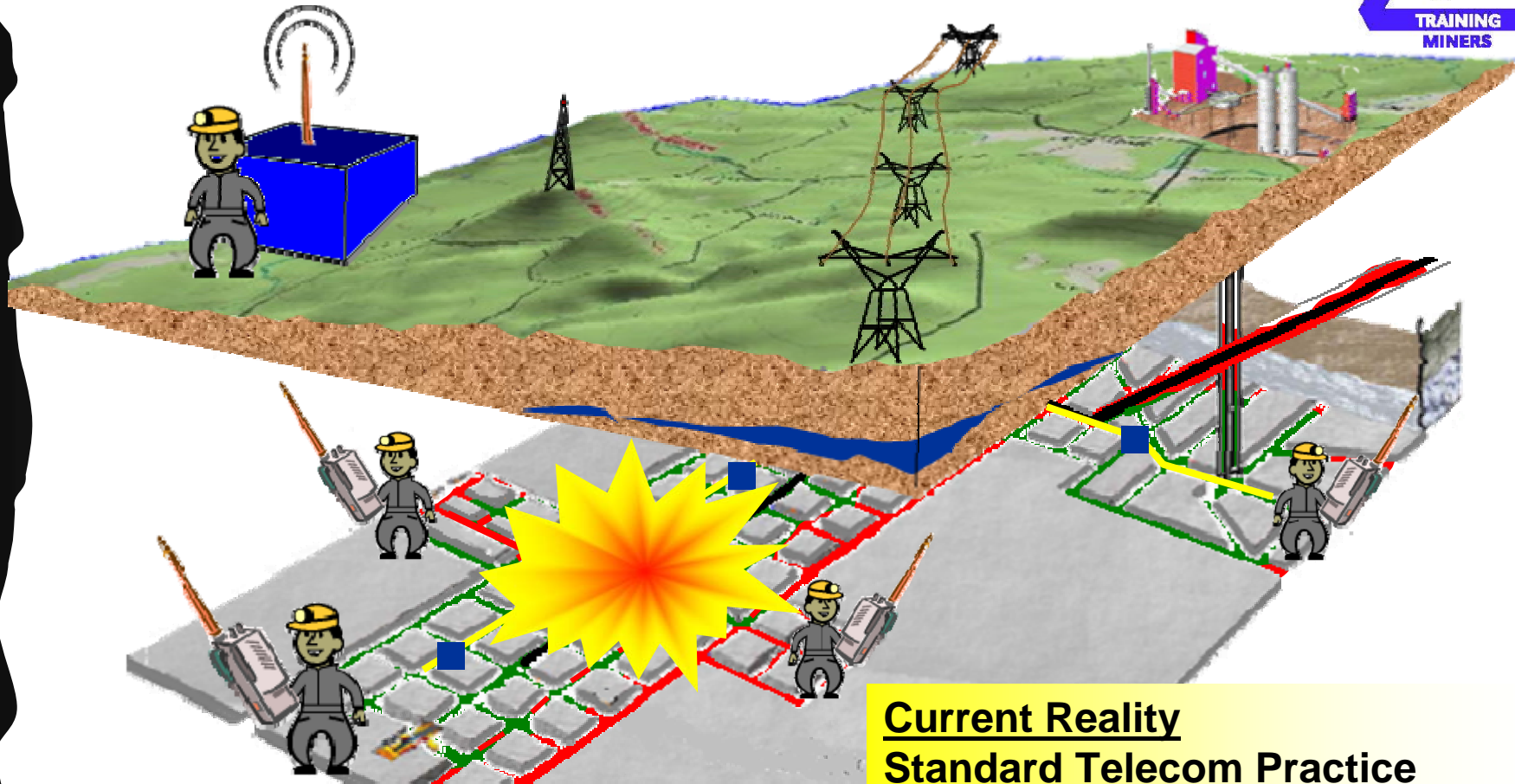
Distributed Antenna System



Greatest Potential
Mine Wide Coverage
Multiple Pathways

Current Reality
Limited Installation Experience
Some Needed Devices in Prototype

Future Technologies = Survivability



Greatest Potential
Multiple Pathways
System Integration
Signal Takes Whatever Survives

Current Reality
Standard Telecom Practice
Site Specific Best Solution
Interoperability Limited
Device Development Required
Adoptable to Current Technology

Tracking Where GPS Won't Go



Know the Location

Proximity signal strength
Acknowledgement

Communicate the Location

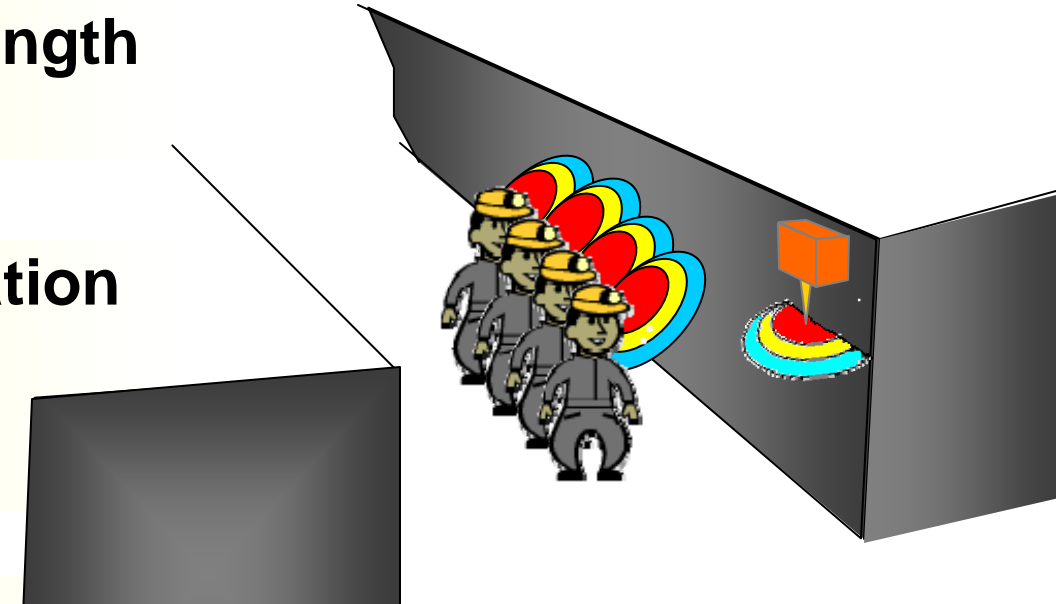
Dedicated backbone
Shared backbone

Show Information

Map display
Data analysis
Threshold alarms

Current Reality

Zone Systems
RFID Active Tag Systems
Ethernet Backbone and
Leaky Feeder Backbone
Signal Triangulation Near



WV §56-4 Functionality Reviews



*After the evaluation of the documentation submitted and with the recommendation of our technical reviewers the Office of Miner's Health Safety and Training verifies that _____ has **demonstrated functionality such as would allow W.Va. underground mining permit holders to meet all or part of their requirements for emergency communications and tracking** outlined in the West Virginia Emergency Rule Governing Protective Clothing And Equipment, §56-4-8 and will be included in the listing of reviewed devices.*



Pre-Application Meeting



Application Received



Reviewed



Data Augmentation Requested



Re-Reviewed



Functionality Determination Letter



MSHA IS Approval

Active Applications



Varis Communications

150-170MHz Leaky Feeder
Kenwood Radios
Digital – 56kbs



Hughes Supply

150-170MHz Leaky Feeder
400-500Mhz Leaky Feeder
Kenwood Radios
Digital – 56kbps



Marco North-America

900MHz RFID Tracking
Leaky Feeder or Ethernet



Hannah Engineering

2.4GHz 802.11 Nodes
VoIP Phones and WiFi Tags
Digital – 11mbps



Matrix Design Group

433 MHz Tag Tracking
Fiberoptic Ethernet Backbone
Leaky Feeder Backbone



Helicomm, Inc (Venture Development)

2.4GHz 802.15.4 Nodes
RS485 Ring of Subnet Controllers
Digital 250kbs
Text Messaging
400-500Mhz RFID Tracking



Active Control Technology

2.4GHz 802.11 Nodes
VoIP Phones and WiFi Tags
Digital 11mbps
2.4Ghz Signal Strength Tracking



MineComm (Pyott Boone Electronics)

150-170MHz Leaky Feeder
400-500Mhz Leaky Feeder
Kenwood Radios
Digital – 56kbps



Mine Site Technology (CSE)

150-170MHz Leaky Feeder
LF Through the Earth
2.4GHz 802.11 Tag Tracking



Mine Radio System

150-170MHz Leaky Feeder
Kenwood Radios
Digital – 56kbps



Becker Communications

400-500MHz Leaky Feeder
Kenwood Radios
Digital – 56kbps



Northern Lights

2.4GHz 802.11 Nodes
Fiber or CAT5 Ethernet Backbone
WiFi Tags and VoIP Phones

Quality of Communications



Copyright Verizon

“Can you hear me now?”

Turns out not to be a trivial question

Adapted a standard reporting format from ARRL

Accepted Reception Reporting Systems

Signal Strength	Interference of any type	Overall Quality
5-Excellent	5-No interference	5-Excellent
4-Good	4-Very slight	4-Good
3-Fair	3-Moderate	3-Fair
2-Poor	2-Heavy	2-Poor
1-Useless	1-Extreme	1-Unusable

Quality of Reporting



Reporting has been done in distances

Provides limited information

Adopted minimal information requirements for reporting

Miner to Miner Test Data

Equipment	Test Site	Comm Type	Distance Between Miners	Entry/Crosscut Conditions				SIO Score
				Height	Width	Scenario	Notes	
TK-390	5-10	UHF	1000 FT	6FT	20FT	1 5 & 7	LINE OF SITE IN #5 ENTRY	5,5,5
TK-390	5-10	UHF	210 FT	6FT	20FT	6 & 7 CONCRETE BLOCK	LINE OF SITE IN CROSS CUT 10 THROUGH STOPPING	5,5,5
TK-390	5-10/11	UHF	70FT	6FT	20FT	8	LINE AROUND BLOCK	5,5,5

Example of tabular reporting

Ability to Relate



Still need more information to make design decisions

Equipment	Test Site	Comm Type	Distance Between Miners	Entry/Crosscut Conditions				SIO Score
				Height	Width	Scenario	Notes	
TK-390	5-10	UHF	1000 FT	6FT	20FT	1 5 & 7	LINE OF SITE IN #5 ENTRY	5,5,5


<p>Top View</p> <p>ICG Imperial Mine</p> <p>1 2 3 4 5 6 7 8</p> <p>15</p> <p>10</p> <p>5</p> <p>3 4 5 6</p> <p>Primary Escape way Entry 8 Secondary Escape Way Entry 5</p> <p>— Leaky Feeder cable — Belt line — 5 rating on radios — 3-4 rating radios</p>		<p>Test performed at ICG Imperial mine on 1/18/07</p> <p>Witnessed by: John Rinehart, P.E.</p> <p>70 ft centers on blocks</p> <p>The communications center is approx. 100 feet from mine portal</p> <p>The test was performed approx 750 ft into the mine @ crosscut 10</p> <p>The stoppings are cinder block with metal man doors</p>	
<p>Name of Mine: ICG-Imperial</p>		<p>Date of Testing: 1/18/07</p>	<p>Certifying Engineer: John Rinehart, P.E.</p>

<p>Relative Mine Location</p> <p>ED, TM</p> <p>THIS IS A NATIONAL MINE AS USED IN THE CERTIFICATION DRAWINGS.</p> <p>INTAKE AIR IS IN ENTRIES 6,7 AND 8.</p> <p>BOLT (GREEN) IS IN ENTRY 4 LEAKY FEEDER IN 5.</p> <p>RETURN AIR IS ENTRIES 1,2, AND 3.</p> <p>TEST AREA</p>	<p>Side Elevation</p> <p>7 8 9 10 11 12 13</p>
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Results, Status and Guidance




Click on an area for Regional Information



State of West Virginia
Joe Manchin III, Governor

West Virginia Department of Commerce
Kelley M. Goes, Cabinet Secretary



Office of Miners' Health Safety & Training
Ronald L. Wooten, Director
C.A. Phillips, Deputy Director

Phone: 304-558-1425 Fax: 304-558-1282
1615 Washington St. E. Charleston, WV 25311-2126

Mine Emergency Notification Phone Number: 1-866-987-2338

STARTING POINTS:

The West Virginia Office of Miners' Health, Safety and Training is responsible for the enforcement of the West Virginia Mine Safety Laws and Regulations (Chapter 22A Code of WV). Learn more about our agency from our [Informational page](#) or from our [\(Agency Mission Statement\) page](#).

Search our Website using our [site search](#)

What's New?
(Featured Pages and Links)

[Communications and Tracking Device Certification Guidelines](#)

[Applications for Surface Mine Inspector and Coal Mine Electrical Inspector Examinations are now being accepted.](#)

[Qualified Diesel Instructor Certification Class - Schedule](#)


Industry Notifications:

[Mine Communications & Related Technologies Workshop 6-7-2007](#)

[Emergency Rules For Alternative Training Programs for Apprentice Electricians, and Notice of Comment Period](#)

[Senate Bill 68 on Mine Safety](#)

Featured Photograph:



Go to:

wvminesafety.org

Click on:

[Emergency Communications and Tracking](#)

Time Line



**August
OMHST
Markups**

**September –
October
Approvals**

> WV Communication Plan Approvals >

**July 31
Mine Submittal**

**August –
September
Re-writing**

**October +
Order-Installation**



> MSHA Electrical Approvals >

OMHS&T Communications Plan Team

One inspector from each Regional office +
Member(s) of the Approval Review Team

Summary



- **W. Va. functionality reviews continues**
- **NIOSH study group interaction continues**
- **MSHA electrical approval process continues**
- **WV Communication Plan submittal July 31**
- **Installation dates subject to manufacturers receiving MSHA electrical approvals**

Thank You

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