Communication-Tracking Demonstration Submittal

Tab 1 – Transmittal Letter & PE Certification

Tab 2 – Description of Product

A description of the product(s) sufficient to provide a context for understanding the subsequent material

Tab 3 – W. Va. Requirements Satisfied

A description of all portions of the W. Va. Rule §56-4 that can be satisfied by the product's performance and the mine conditions in which that performance has been demonstrated and verified

Tab 4 – Status of Product

A summary of the product's commercial history and a table describing all issued or pending MSHA approvals with supporting documentation appended to the table

Tab 5 – Technical Specification

A detailed description of the product in sufficient detail for a qualified person to understand the operations and maintenance of the product

Tab 6 – Demonstration Results

Results of testing done in a W. Va. Mine and certified by a P.E. using the summary and individual demonstration formats provided by OMHS&T

Tab 7 – Interoperability

Description of provision for interoperability with other communication-tracking systems

Tab 8 – Capability

A description of preparations made to ensure sufficient manufacturing, installation, and support capability to allow rapid deployment of these systems in W. Va. mines.

Tab 9 – Training

Description of recommended training for miners, mine management, communication center operators, mine rescue teams, and maintenance staff with drafts of materials, if available, and plans for supporting operator training efforts

Miner to Reader Test Data (Each end-user device can be tracked via the WLAN network including Messenger cap lamp, WiFi tags internal to cap lamps, WiFi tags carried by miners, WiFi tags on assets, VoIP handsets and other third-party WiFi devices. Wherever coverage existed, the devices were identified and tracked.)

Equipment	Test Site	Comm Type	Number of Miners	Distance to Reader or Coverage Area	Rate of Travel	Describe Ride	Entry/Crosscut Conditions			
							Height	Width	Scenario	Notes
NetPort V1.0 Messenger V1.0 SpectraLink VoIP handset i650 AeroScout WiFi Tag T2	NLT-060225-A	VoIP WiFi (802.11g) Messaging	5	2400 ft. front 350 ft. back 250 ft. side	5.1	On foot	6 ft.	35 ft.	2, 7	Entry declined for 65% of the distance then inclined for the balance. Non-line-of-sight. Access point antennas located at cross-cut
NetPort V1.0 Messenger V1.0 SpectraLink VoIP handset i650 AeroScout WiFi Tag T2	NLT-060225-A	VoIP WiFi (802.11g) Messaging	5	2400 ft. front 350 ft. back 250 ft. side	5.1	On foot	6 ft.	35 ft.	2, 3	Entry declined for 65% of the distance then inclined for the balance. Non-line-of-sight. Access point antennas located at cross-cut. Conveyor located middle of entry (40 in. width).
NetPort V1.0 Messenger V1.0 SpectraLink VoIP handset i650 AeroScout WiFi Tag T2	NLT-060225-A	VoIP WiFi (802.11g) Messaging	5	Coverage extended into 2 adjacent parallel entries 200 ft. front	5.1	On foot	6 ft.	35 ft.	2, 3	Non-line-of-sight. Access point antennas located at cross-cut.
NetPort V1.0 Messenger V1.0 SpectraLink VoIP handset i650 AeroScout WiFi Tag T2	NLT-060815-B	VoIP WiFi (802.11g) Messaging	5	Maximum 2580 ft. Typical 1500 ft.	15.4	Truck	10 ft.	35 ft.	5	See site arrangement. Wireless access points are placed to provide seamless coverage in the test area.
NetPort V1.0 AeroScout WiFi Tag T2	NLT-060712-C	WiFi tracking	30	2500 ft.	31.9	Rail car	20 ft.	25 ft.	1, 10	Speed-related test to determine tag readings for large numbers of personnel.

NetPort IS V1.0 Messenger V1.0 SpectraLink VoIP handset i650 AeroScout WiFi Tag T2	NLT-070531-D	VoIP WiFi (802.11g) Messaging	5	Maximum 3000 ft. Average 1700 ft.	5.1	On foot, open rail trolley	8 ft.	20 ft.	1, 7	Generally line-of-sight with modest elevation changes. Line-of-sight often obstructed.

Legend

- **Equipment** – The make and model of the device(s) whose function is being demonstrated
- **Test Site** – provide a unique reference code to the attached diagram (unique select three letters that will be unique to your company insert hyphen then 6 digit date insert hyphen then a unique letter for that test example ABC-051607-A)
- **Comm Type** – what type of wireless communications used between the miner and the reader
- **Number of miners** – how many miners passed reader at same time
- **Distance to reader or coverage area** – provide the distance between the miners and the reader or coverage area (in the case of wifi coverage cloud)
- **Rate of Travel** – how fast were the miners moving in feet per minute
- **Describe Ride** –- describe the means of travel (on foot or in vehicle with description of vehicle)
- **Height** – what is the height of the entry or crosscut noting
- **Width** – what is the width of the entry or crosscut
- **Scenario** – relevant demonstration scenario number from list below (if not one of the standardized scenarios a description is required
- **Notes** – any thing you feel are relevant for understanding

Process Notes:

Miner-to-reader testing is to be done with the tag on miners situated in realistic scenarios not with loose tags

1. **An entry or crosscut with an axis that allows for uninterrupted line-of-sight**
2. **An entry or crosscut with an axis that has a curvature which precludes line-of-sight**
3. **An entry or crosscut with an axis that contains a belt noting belt width & placement**
4. **An entry or crosscut with an axis that contains a metal overcast**
5. **An entry or crosscut with an axis that contains a wire-mesh roof**
6. **An entry or crosscut with an axis that is blocked by stopping noting type**
7. **An entry or crosscut with an axis that has a power line parallel to path of transmission**
8. **The effectiveness to transverse one or more coal pillars**
9. **Miners simultaneously passing a reader in opposite directions**
10. **Miners in a mantrip passing a reader at the maximum speed typical for the mine**

Equipment	Test Site	Comm Type	Number of Miners	Distance to Reader or Coverage Area	Rate of Travel	Describe Ride	Entry/Crosscut Conditions			
							Height	Width	Scenario	Notes
See Part 2										

Top View

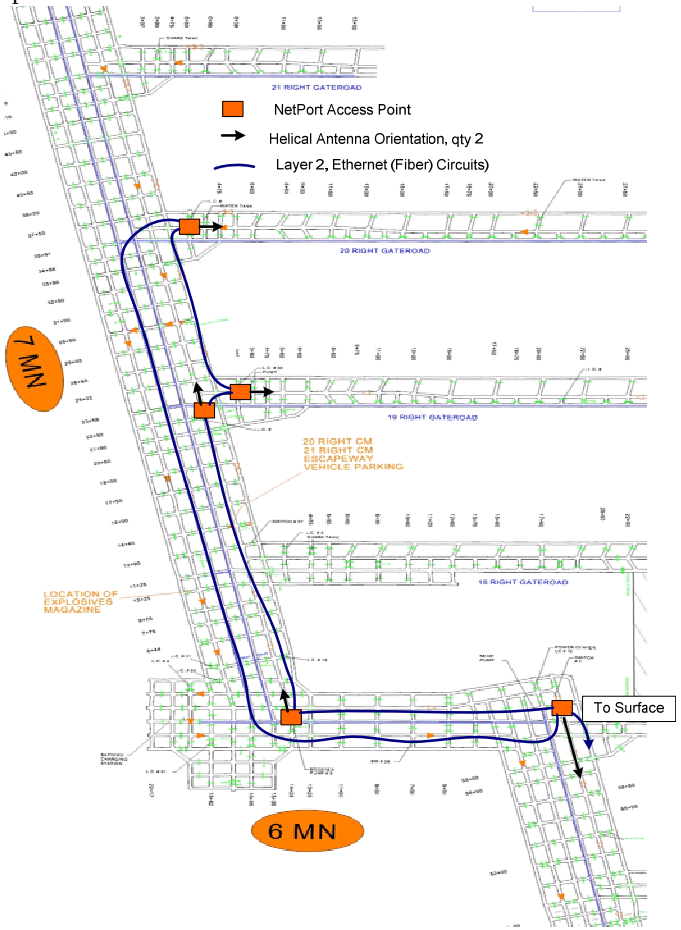
Relative Mine Location

Side Elevation
Belt entry declined for 65% of the distance then inclined for the balance. Non-line-of-sight.

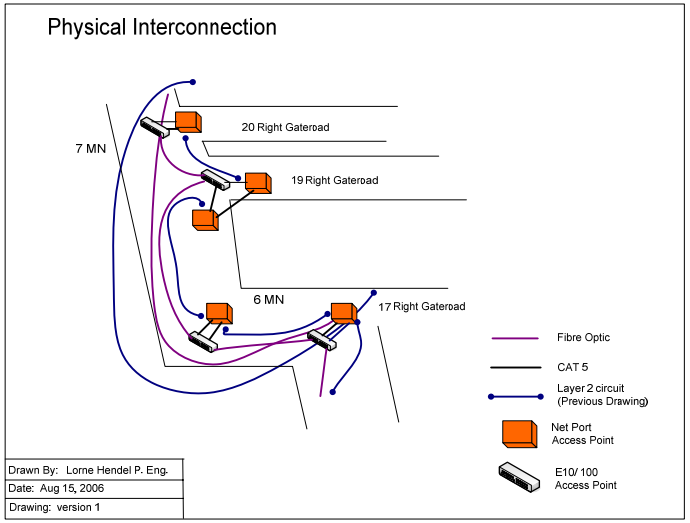
Name of Mine	Date of Testing	Certifying Engineer
Trinity Coal Logan Fork Mine	NLT-20060225-A	

Equipment	Test Site	Comm Type	Number of Miners	Distance to Reader or Coverage Area	Rate of Travel	Describe Ride	Entry/Crosscut Conditions			
							Height	Width	Scenario	Notes
See Part 2										**Generally line-of-site between access points.**

Top View



Relative Mine Location

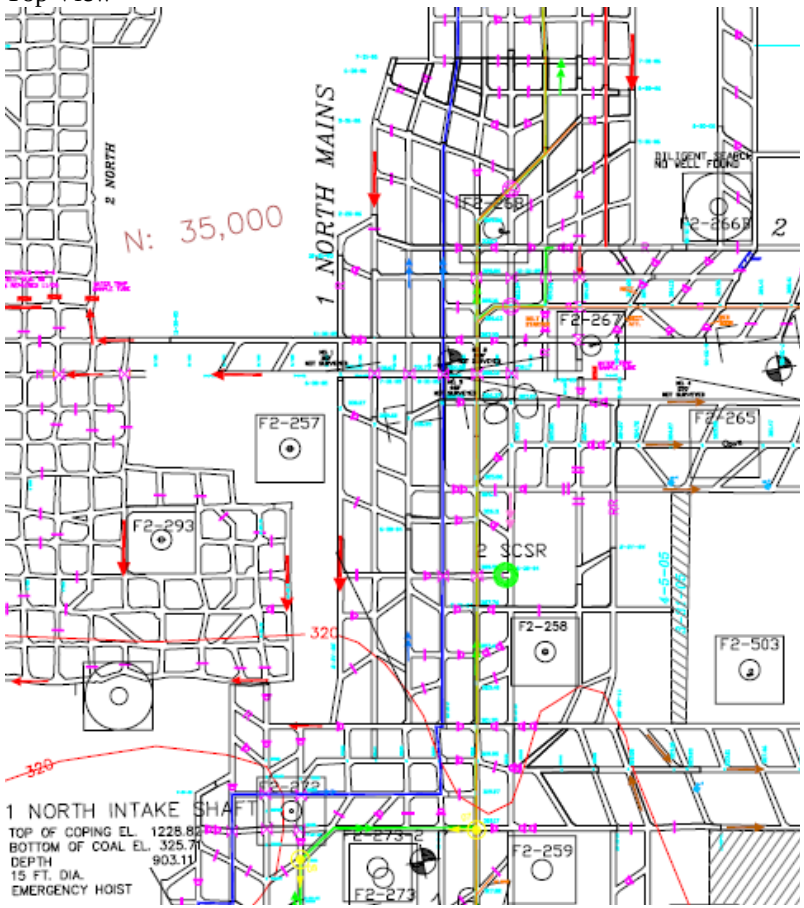


Side Elevation

Name of Mine	Date of Testing	Certifying Engineer
Peabody Twentymile Coal	NLT-20060815-B	

Equipment	Test Site	Comm Type	Number of Miners	Distance to Reader or Coverage Area	Rate of Travel	Describe Ride	Entry/Crosscut Conditions			
							Height	Width	Scenario	Notes
See Part 2										**Coverage located in yellow primary entry.**

Top View



Relative Mine Location

Side Elevation

Name of Mine	Date of Testing	Certifying Engineer
Peabody Federal No. 2 Mine	NLT-20060815-D	John Rinehart, PE WV #5014

Reader to Surface Test Data (For WiFi tracking, each access node on the fiber-optic cable becomes a reader. In each case below the nodes located underground were connected to surface via fiber-optic cable that was already in place.)

Equipment System/Miner	Test Site	Comm Type	Distance Reader to Surface Comm-Center	Entry/Crosscut Conditions				Number Amps/Nodes to Surface Comm- Center
				Height inches	Width feet	Scenario	Notes	
NetPort V1.0 access node	NLT-20060815-B	Ethernet (802.3) over fiber-optic cable	<6500 ft.	10 ft.	35 ft.	5, 7	Nodes were daisy-chained together using multi-mode fiber-optic cable.	0
NetPort IS V1.0	NLT-20070531-D	Ethernet (802.3) over fiber-optic cable	<6500 ft.	8 ft.	20 ft.	1, 7	Nodes were daisy-chained together using multi-mode fiber-optic cable.	0

Legend

- **Equipment** – The make and model of the device(s) whose function is being demonstrated
- **Test Site** – provide a unique reference code to the attached diagram (unique select three letters that will be unique to your company insert hyphen then 6 digit date insert hyphen then a unique letter for that test example ABC-051607-A)
- **Comm Type** – what type of communications used between the reader and the surface
- **Distance to reader or coverage area to surface communication** – provide the distance between the reader or coverage area (in the case of wifi coverage cloud) and the surface
- **Height** – what is the height of the entry or crosscut noting
- **Width** – what is the width of the entry or crosscut
- **Scenario** – relevant demonstration scenario number from list below (if not one of the standardized scenarios a description is required) (not all may be relevant to all technologies)
- **Notes** – any thing you feel are relevant for understanding
- **Number pf Amps/Nodes to Surface Comm**-Center – provide the number of powered components required between the device reading the tag and signal tracking device and the surface

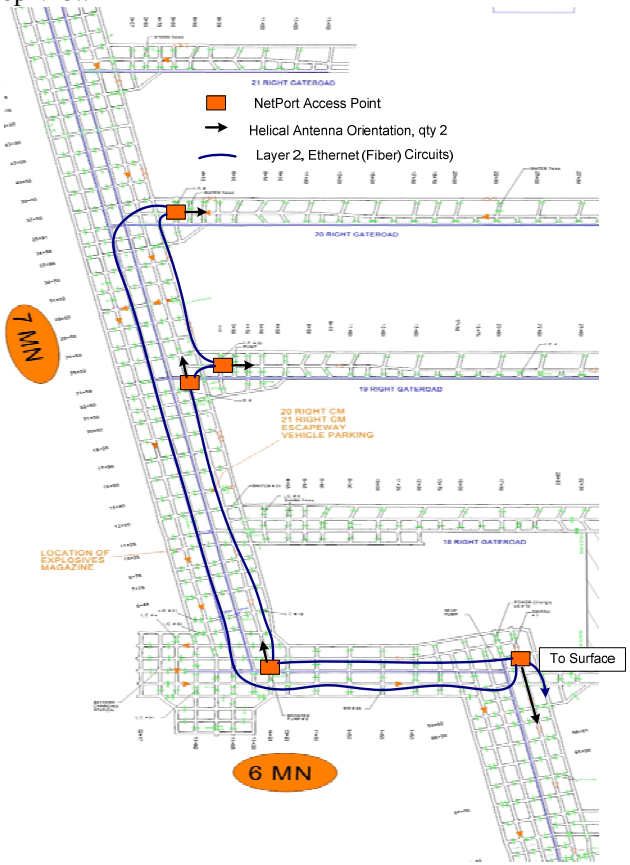
Process Notes:

Miner-to-reader testing is to be done with the tag on miners situated in realistic scenarios not with loose tags

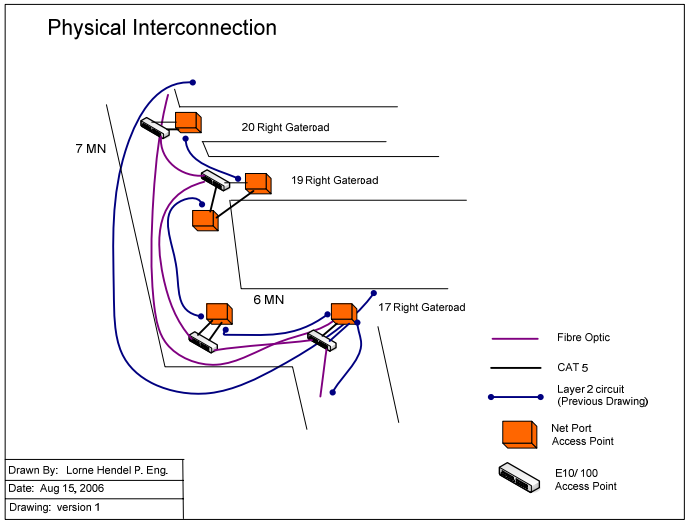
1. **An entry or crosscut with an axis that allows for uninterrupted line-of-sight**
2. **An entry or crosscut with an axis that has a curvature which precludes line-of-sight**
3. **An entry or crosscut with an axis that contains a belt noting belt width & placement**
4. **An entry or crosscut with an axis that contains a metal overcast**
5. **An entry or crosscut with an axis that contains a wire-mesh roof**
6. **An entry or crosscut with an axis that is blocked by stopping noting type**
7. **An entry or crosscut with an axis that has a power line parallel to path of transmission**
8. **The effectiveness to transverse one or more coal pillars**

Equipment System/Miner	Test Site	Comm Type	Distance Reader to Surface Comm-Center	Entry/Crosscut Conditions				Number Amps/Nodes to Surface Comm- Center
				Height inches	Width feet	Scenario	Notes	
								0

Top View



Relative Mine Location

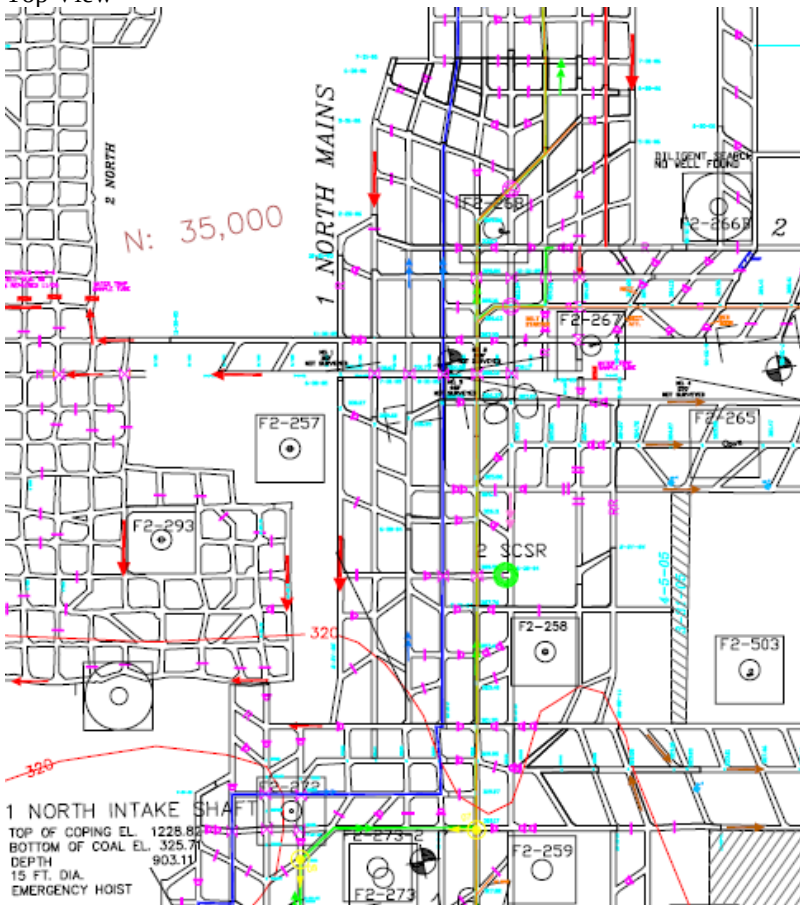


Side Elevation

Name of Mine	Date of Testing	Certifying Engineer
Peabody Twentymile Coal	NLT-20060815-B	

Equipment System/Miner	Test Site	Comm Type	Distance Reader to Surface Comm-Center	Entry/Crosscut Conditions				Number Amps/Nodes to Surface Comm- Center
				Height inches	Width feet	Scenario	Notes	
								0

Top View



Relative Mine Location
Fiber-optic cable extends from first node to surface via shaft.

Side Elevation

Name of Mine	Date of Testing	Certifying Engineer
Peabody Federal No. 2 Mine	NLT-20070531-D	John Rinehart, PE WV #5014

Miner to Miner Test Data: (Assuming that the network is restored via the redundant loop, the following is observed. Note that by the very nature of digital communications and coverage patterns in underground mines, VoIP communications is characterized as Excellent, Fair or Unusable quality. For example, if the handset is connected to the network voice quality would typically be Excellent. Upon moving out of coverage area; hence no network connection, voice quality would be unusable. NLT proposes the carrying of portable mesh nodes when the network is not functioning. This would be similar to a rescue team establishing an ad-hoc wireless mesh network as they progress into the mine.)

Equipment	Test Site	Comm Type	Distance Between Miners	Entry/Crosscut Conditions				SIO Score
				Height	Width	Scenario	Notes	
NetPort V1.0 SpectraLink VoIP handset i650	NLT-060815-B	VoIP WiFi (802.11g)	Surface to underground (>10,000 ft.)	10 ft.	35 ft.	5	Wireless handsets to wireless handsets.	S5, I5, O5 S2, I5, O4 S1, I5, O1
NetPort V1.0 SpectraLink VoIP handset i650	NLT-070531-D	VoIP WiFi (802.11g)	Surface to underground (>10,000 ft.)	8 ft.	20 ft.	1, 7	Wireless handsets to wireless handsets and wireless handsets to surface fixed telephone (POTS).	S5, I5, O5 S2, I5, O4 S1, I5, O1

Legend

- **Equipment** – The make and model of the device(s) whose function is being demonstrated
- **Test Site** – provide a unique reference code to the attached diagram (unique select three letters that will be unique to your company insert hyphen then 6 digit date insert hyphen then a unique letter for that test example ABC-051607-A)
- **Comm Type** – what type of communications used between the miners
- **Distance between the miners** – provide the demonstrated distance between the miners
- **Height** – what is the height of the entry or crosscut noting
- **Width** – what is the width of the entry or crosscut
- **Scenario** – relevant demonstration scenario number from list below (if not one of the standardized scenarios a description is required) (not all may be relevant to all technologies)
- **Notes** – any thing you feel are relevant for understanding
- **SIO Score –** this is a relative communication quality score (displayed as S#, I#, O#) (see "Reporting the Quality of Communications in Underground Mines" on the WV OMHS&T web site for further explanation)

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

Process Notes:

This demonstration assumes that all backbone equipment has ceased to function. It can not require the function of any devices other than the ones the miners carry with them.

1. An entry or crosscut with an axis that allows for uninterrupted line-of-sight
2. An entry or crosscut with an axis that has a curvature which precludes line-of-sight
3. An entry or crosscut with an axis that contains a belt noting belt width & placement
4. An entry or crosscut with an axis that contains a metal overcast
5. An entry or crosscut with an axis that contains a wire-mesh roof
6. An entry or crosscut with an axis that is blocked by stopping noting type
7. An entry or crosscut with an axis that has a power line parallel to path of transmission
8. The effectiveness to transverse one or more coal pillars

Equipment	Test Site	Comm Type	Distance Between Miners	Entry/Crosscut Conditions				SIO Score
				Height	Width	Scenario	Notes	

Top View **See Parts 3 and 5 for test area.** **Currently, miner to miner voice requires at least one access point or a portable mesh node.**	Relative Mine Location
	Side Elevation

Name of Mine	Date of Testing	Certifying Engineer

Miner to Surface Test Data: (See note regarding quality and network connectivity in Part 6.)

Equipment System/Miner	Test Site	Comm Type	Distance from Backbone or Node	Entry/Crosscut Conditions				SIO Score	Distance from Surface Comm-Center	Number Amps/Nodes to Surface Comm-Center
				Height inches	Width feet	Scenario	Notes			
NetPort V1.0 Messenger V1.0 cap lamp SpectraLink VoIP handset i650	NLT-060815-B	VoIP WiFi (802.11g)	2400 ft. front 350 ft. back 250 ft. side	10 ft.	35 ft.	5	Wireless handsets to wireless handset on surface. There are no active components between the underground and surface control room. This demo had five nodes.	S5, I5, O5 S2, I5, O4 S1, I5, O1	>10,000 ft.	0
NetPort V1.0 Messenger V1.0 cap lamp SpectraLink VoIP handset i650	NLT-070531-D	VoIP WiFi (802.11g)	3000 ft. front 350 ft. back 250 ft. side	8 ft.	20 ft.	1, 7	Wireless handsets to wireless handset on surface and wireless handsets to surface fixed telephone (POTS) in Waynesburg. There are no active components between the underground and surface control room. This demo has 9 nodes.	S5, I5, O5 S2, I5, O4 S1, I5, O1	>10,000 ft.	0

Legend

- **Equipment** – The make and model of the device(s) whose function is being demonstrated
- **Test Site** – provide a unique reference code to the attached diagram (unique select three letters that will be unique to your company insert hyphen then 6 digit date insert hyphen then a unique letter for that test example ABC-051607-A)
- **Comm Type** – what type of communications used between the miner and the system that allows communications to the surface
- **Distance from backbone** – provide the demonstrated distance between the miners and the first component of any system that allows the two-way communication with the surface communication center
- **Height** – what is the height of the entry or crosscut noting
- **Width** – what is the width of the entry or crosscut
- **Scenario** – relevant demonstration scenario number from list below (if not one of the standardized scenarios a description is required) (not all may be relevant to all technologies)
- **Notes** – any thing you feel are relevant for understanding

- **SIO Score –** this is a relative communication quality score (displayed as S#, I#, O#) (see "Reporting the Quality of Communications in Underground Mines" on the WV OMHS&T web site for further explanation)

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

- **Distance from comm**.-Center – provide the total distance from the point where the miner's communication entered any backbone systems and the communication center on the surface
- **Number of Amps/Nodes Comm-Center** – provide the number of powered components required between the device reading the tag and signal tracking device and the surface

Process Notes:

This demonstration assumes that all backbone equipment has ceased to function. It can not require the function of any devices other than the ones the miners carry with them.

1. An entry or crosscut with an axis that allows for uninterrupted line-of-sight
2. An entry or crosscut with an axis that has a curvature which precludes line-of-sight
3. An entry or crosscut with an axis that contains a belt noting belt width & placement
4. An entry or crosscut with an axis that contains a metal overcast
5. An entry or crosscut with an axis that contains a wire-mesh roof
6. An entry or crosscut with an axis that is blocked by stopping noting type
7. An entry or crosscut with an axis that has a power line parallel to path of transmission
8. The effectiveness to transverse one or more coal pillars

Equipment System/Miner	Test Site	Comm Type	Distance from Backbone or Node	Entry/Crosscut Conditions				SIO Score	Distance from Surface Comm-Center	Number Amps/Nodes to Surface Comm-Center
				Height inches	Width feet	Scenario	Notes			

Top View **See Parts 3 and 5 for test areas.**	Relative Mine Location
	Side Elevation

Name of Mine	Date of Testing	Certifying Engineer

Survivability/Re-Establish

Element(s)	Dynamic Impact	Fire	Static Pressure	Power Interruption
Fiber-optic cable.	Sever the cable.	Sever the cable.	Possible sever cable.	No affect on cable.
	Nodes automatically sense disruption in signal and re-establish connection via redundant ring cable installation. Temporary bridging nodes may be used to bridge fiber break. Tested by removing the fiber-optic connection from a node, re-establish voice service and observing nodes on central computer indicating no connection, then re-connecting.	Nodes automatically sense disruption in signal and re-establish connection via redundant ring cable installation. Temporary bridging node may be used to bridge fiber break. Tested by removing the fiber-optic connection from a node, re-establish voice service and observing nodes on central computer indicating no connection, then re-connecting.	Nodes automatically sense disruption in signal and re-establish connection via redundant ring cable installation. Temporary bridging node may be used to bridge fiber break. Tested by removing the fiber-optic connection from a node, re-establish voice service and observing nodes on central computer indicating no connection, then re-connecting.	
NetPort IS access point	Mechanical damage to enclosure and electronics. Wireless coverage and network connection ceases in the coverage area of the damaged node.	Mechanical damage to enclosure and electronics. Wireless coverage and network connection ceases.	Mechanical damage to enclosure and electronics. Wireless coverage and network connection ceases.	Node automatically switches to battery power and status changes in network diagnostics software.
	Nodes automatically sense disruption in signal and re-establish connection via redundant ring cable installation. Bridging nodes may be used to quickly bridge coverage into the affected area. Tested by removing the fiber-optic connection from a node, re-establish voice service and observing nodes on central computer indicating no connection, then re-connecting.	Nodes automatically sense disruption in signal and re-establish connection via redundant ring cable installation. Bridging nodes may be used to quickly bridge coverage into the affected area. Tested by removing the fiber-optic connection from a node, re-establish voice service and observing nodes on central computer indicating no connection, then re-connecting.	Nodes automatically sense disruption in signal and re-establish connection via redundant ring cable installation. Bridging nodes may be used to quickly bridge coverage into the affected area. Tested by removing the fiber-optic connection from a node, re-establish voice service and observing nodes on central computer indicating no connection, then re-connecting.	Node will run on battery for approximately 8 hours keeping the system operational. Larger battery capacity can improve life. The network diagnostics displays status change and mine personnel can be dispatched to re-establish power. Testing was performed by removing AC power input and verifying voice functionality.

Legend

- **Element** – provide the name and description of each element of the product/system
- **Dynamic Impact** – in the top cell describe what is likely to happen if the Element is in the path of explosion moving down an entry and in the lower cell describe what options there are for re-establishing the system in the case the element is rendered non-functional and what testing was done to verify performance
- **Fire** – in the top cell describe what is likely to happen if the Element is subjected to a fire and in the lower cell describe what options there are for re-establishing the system in the case the element is rendered non-functional and what testing was done to verify performance
- **Static Pressure** – the top cell describe what is likely to happen if the Element is subject to a static pressure as the result of an explosion and in the lower cell describe what options there are for re-establishing the system in the case the element is rendered non-functional and what testing was done to verify performance
- **Power Interruption** – in the top cell describe what is likely to happen if power to the Element is interrupted and in the lower cell describe what options there are for re-establishing the system in the case the element is rendered non-functional and what testing was done to verify performance

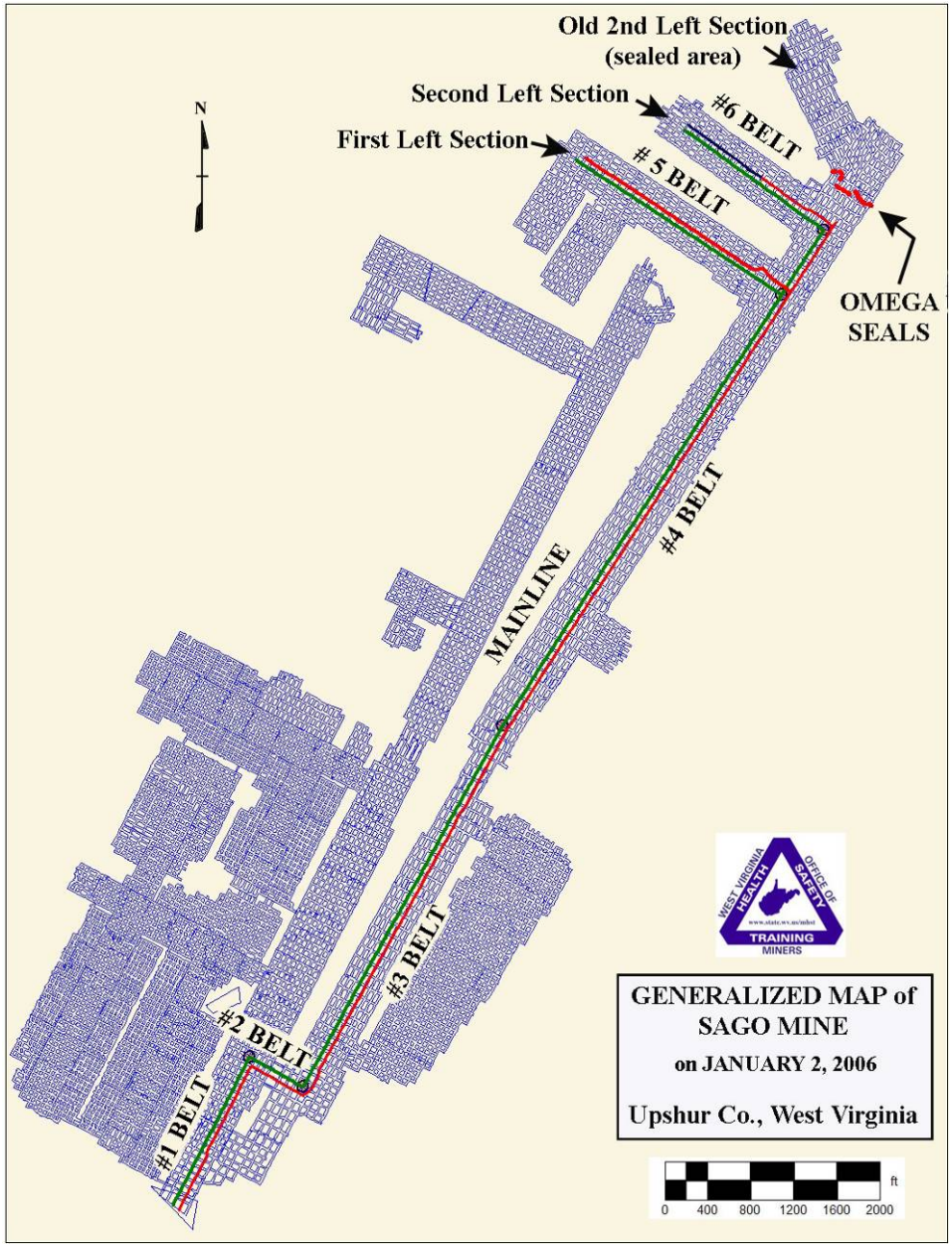
Process Notes:

For purposes of comparison, manufacturers should reference the Sago Reports on the WV OMHS&T web page. The reference scenario is that event.

It is difficult to predict specific impacts on each technology because of the variety means of placing specific elements of the communication-tracking systems within the entry or cross section. Generally most likely worst case event is an explosion which will destroy all devices protruding from the rib, roof or floor for a distance of 2000 feet. The second most likely worst case event is a fire or extreme heat that has propagated though out an area of 500 feet of entry or cross cut and has destroyed all man-made devices protruding from the rib, roof or floor. Manufacture may assume their devices will survive these events if they have demonstrated survival and are able to document such. In all other cases the response should assume that all elements of their product have been rendered non-functional and should discuss means for re-establishing functionality.

Redundant signal pathways and hardening options provided by the technology may be described in addressing survivability.

Provisions for rapid reconnection unique to the technology should be described.

Representative Mine Layout (Noting Proposed Element Locations)	Survivability Options Provided Assuming Explosion in Old 2nd Left	
	**Individual System Element(s)**	**Fiber-optic cable, connected nodes and power.**
	Damage by Dynamic Impact	Severed fiber-optic cable and possible node damage rendering the network in the area inoperable. Nodes in other parts of the network continue to function and redundant fiber cable re-establishes connectivity. Diagnostics in control room, identifies network fault immediately. Messages can be automatically or manually sent via VoIP or messaging cap lamps. Miners can deploy portable nodes to re-establish connectivity.
	Damage by Fire/Heat	Severed fiber-optic cable and possible node damage rendering the network in the area inoperable. Nodes in other parts of the network continue to function and redundant fiber cable re-establishes connectivity. Diagnostics in control room, identifies network fault immediately. Messages can be automatically or manually sent via VoIP or messaging cap lamps. Miners can deploy portable nodes to re-establish connectivity.
	Damage by Static Pressure	Severed fiber-optic cable and possible node damage rendering the network in the area inoperable. Nodes in other parts of the network continue to function and redundant fiber cable re-establishes connectivity. Diagnostics in control room, identifies network fault immediately. Messages can be automatically or manually sent via VoIP or messaging cap lamps. Miners can deploy portable nodes to re-establish connectivity.
	Function in Power Interruption	Nodes automatically switch to battery power when AC power is interrupted.