

**DEMONSTRATION SYSTEM TESTING AND PERFORMANCE ASSESSMENT  
FOR ACTIVE CONTROL TECHNOLOGIES ACTIVEMINE SYSTEM**

**PERFORMED BY  
WIRELESS MINING TECHNOLOGIES LTD.**

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## 1.0 INTRODUCTION

Validation of the Active Control Technologies wireless network for communication and tracking in coal mines following the West Virginia OMHS&T protocol was undertaken by myself, Malcolm K. Buck, P.Eng. of Oakville, Ontario, Canada. I have 15 years of experience and expertise in underground communications, equipment control and information management systems. I visited the test site on May 14, 2007 and tested the system following the OMHS&T performance testing protocol. This report presents my observations, tests and testing results matching as closely as possible to the OMHS&T protocol provided to me.

## 2.0 TEST SITE

The test site is located at the Viper Mine, near Springfield Illinois and owned by International Coal Group. It employs room and pillar mining approximately 300 feet below surface. Pillars are on 70 feet centres and the entryways and crosscuts between the pillars are 20 feet wide. The average roof height is approximately 6 feet. Figure 1 shows the mine plan drawing of the test area.

## 3.0 TEST SITE CONFIGURATION

The wireless network is set up covering 4 parallel entryways, with individual lengths of 3,360 feet. At the end of this distance 5 crosscuts at 90 degrees to the entryways are covered for a further 700 feet in length in each crosscut. The crosscut coverage originally provided network coverage to a mining area which has now advanced past the network setup.

Figure 2 shows the overall test site configuration. The wireless nodes locations are indicated on the figure. Six nodes provide network coverage in the entryways used to access the working faces area and the remaining 5 nodes provide full network coverage to the equivalent of a mining area. The communication centre for convenience is located underground at the entry end of the test facility. There is essentially no backbone between the communication centre and the network except for CAT 5 cables of 5 feet length. To move the communication centre to surface would only require a connection via fibre optic cabling.

Within the test area there are the following installations:

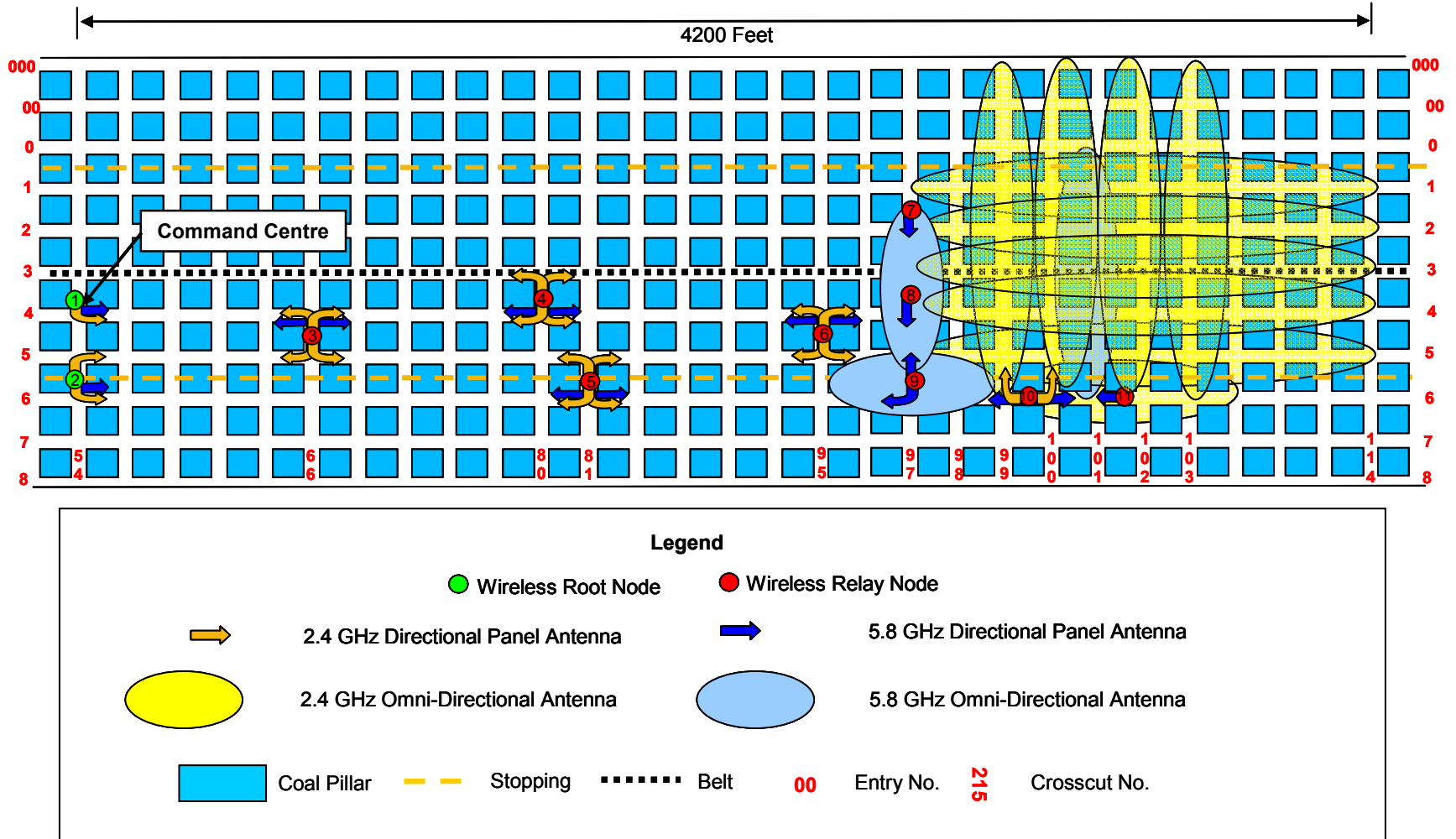
- 2 sets of stoppings
- A 24 inch wide conveyor in an entryway hung from the back
- High voltage electrical substations

There is no screen installed on the roof though there are roof bolts with metal plates on an approximate 8 feet centres pattern. There is also no metal overcast in this area.

The test equipment currently consists of NEMA 67 enclosures for the nodes, ruggedized antennae and standard surface ethernet networking equipment. The nodes are powered using power over ethernet adapters plugged into 120 volt power supply. One node is powered by a battery backup. Voice communication is provided by a handheld mobile telephone and tracking uses a small tag attached, for the test, to the lamp belt.



Figure 2 Wireless Test Site Network Schematic.



## 4.0 TESTING PARAMETERS

The demonstration system testing assessed the wireless system capabilities for the following functionality:

- a. Communication - Miner to Surface
- b. Communication - Miner to Miner
- c. Tracking – Miner to Reader
- d. Tracking Reader to Surface

For each of these components the transmission capabilities were assessed to the limit of the distance between the wireless nodes under the following required test site scenarios:

1. An entry or crosscut with an axis that allows for uninterrupted line-of-sight.
2. An entry or crosscut with an axis having curvature which precludes line-of-sight.
3. An entry or crosscut with an axis that contains a belt between transceivers.
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.
7. An entry or crosscut with a high voltage power line parallel to the axis of transmission.
8. The effectiveness of the signal to penetrate one or more coal pillars.

Scenarios 4 and 5 were not tested with this test system. Conditions for scenarios 4 and 5 do not exist at the Viper Mine in the test area. A similar Active Control Technology test system at the Blacksville Number 2, West Virginia owned by Consol Energy, has mesh on the back and a metal overcast (though not observed by myself) and there these have no effect on the voice or tracking functionality. I have observed no effect from screen, straps or other metal plating installed on the floor, walls and roofs of the openings on wireless network setups at other mines as well.

In Scenario 7 the test was conducted across a high voltage line as well as a high voltage substation located in the crosscut 20 feet from Node 6.

The test sites for above remained the same for the communication and tracking scenarios. Physical conditions within the mine for each test area and scenario were recorded and evaluated.

The OMHS&T criteria used to assess the physical conditions were as follows:

- The distance between miners.
- Height of entry or crosscut noting undulations limiting line-of-sight.
- Width of the entry or crosscut noting any undulations limiting line-of-sight.
- Slope or grade of the entry or crosscut noting any undulations limiting line-of-sight.
- Roof Condition (smooth rough jagged, etc.) noting frequency of roof bolts and existence of wire mesh.
- Describing obstructions such as stoppings, pillars, belts, overcasts, etc between the miner and the backbone in sufficient detail to understand any impacts on propagation.

And for tracking the additional conditions:

- Number of miners passing a reader at same time.
- Mode and rate of travel for miners moving past the reader and rate of travel.

- If miners were transported describe the unit and the location of the miners in the unit in relationship to the position of the tag reader.

Additionally an SIO Score was determined for the communication scenarios based on the criteria below:

<b>Signal Strength</b>	<b>Interference</b>	<b>Overall Quality</b>
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

For all scenarios the ability of the communication center to talk to everyone in the network and track the location of people within the mine were evaluated.

## **5.0 TEST RESULTS**

For all testing presented below, scenario 8 is not applicable or required with this wireless network as tracking and voice communication can be achieved at all points around all pillars and so no signal travel through pillars is required.