



# THE COMMUNICATIONS BREAKTHROUGH BOOSTING SAFETY AND PRODUCTIVITY IN UNDERGROUND COAL MINING





# COAL PRODUCTION ON THE RISE

As our global population continues to grow, so too is the need for energy fuels to meet the insatiable demand for electricity supply across the world. And, as it has been for hundreds of years, coal remains the fuel of choice for power generation because of its reliability, affordability and plentiful supply. It is also an essential ingredient in the manufacture of steel, itself a necessary component in infrastructure development and in many of the tools and products of everyday modern day life.

According to the World Coal Association, there are more than 860 billion tonnes of proven coal reserves worldwide – enough to meet global consumption for at least the next 100 years. Global production has now exceeded 7 billion tonnes a year, and estimates by the World Coal Institute are that production will reach 13 billion tonnes a year by 2030. Data from the Australian Bureau of Statistics shows around 460 million tonnes of coal was extracted from Australian coal operations in 2013-14. That number will continue to grow, and so will the number of domestic coal operations.

Australia, having the fourth-largest share of proven coal reserves, is extremely well positioned to meet the growing global appetite for coal. But, beyond having the actual coal reserves, Australia is also a world leader in the development of new mining technologies that are contributing to substantial improvements in output, operational productivity and, very importantly, operational safety. In particular, the deployment of cutting-edge communications technologies developed in Australia is rapidly taking underground coal mining to a whole new level.

This white paper details the advancements in technologies that are revolutionising the communications systems and processes in Australian underground coal mining by improving connectivity, information flows, workplace safety and mine productivity overall. The future of underground coal mining has arrived.

## THE COAL HARD FACTS:

**Provides**

**30.1%**

of global  
energy needs

**Generates**

**40%**

of global  
electricity

**Used in**

**70%**

of global  
steel

**Australia  
produces**

**460Mt**

of coal  
per year



# FINDING BETTER COMMUNICATIONS SOLUTIONS

## CHANGES AT THE COMMUNICATIONS COAL FACE

Underground mining accounts for close to 60% of the world's total coal production and, over the years, there have been many advancements in operational processes and mining equipment that have led to significant improvements in both productivity and workplace safety.

Yet, despite all the developments that have helped to substantially increase underground mine outputs, principally through the introduction of new mining methods and coal extraction techniques, and through the inventions of sophisticated mining machinery, robust and reliable communications systems have been a key missing link for the industry.

In today's world, strong communications systems are part and parcel of everyday life. Through an ever-increasing array of connected or Wi-Fi enabled mobile devices, we can make voice and video calls, send data, monitor and even control equipment remotely, from anywhere at any time. But, while that all works well above the Earth's surface, the communications story is very different in underground environments. Due to lack of connectivity, limited or non-existent communications is commonplace.

However, available new technologies are now effectively solving this connectivity issue. For the very first time, underground coal mines can enjoy the same level of connectivity as surface mining operations, and at the same time improve their productivity and safety.

## THE UNDERGROUND SAFETY LANDSCAPE

Deep below the surface, mine workers across Australia's underground coal industry operate around the clock, seven days a week. It's an unforgiving environment and unfortunately, over the years, multiple fatalities and injuries have occurred at various mine sites. Fortunately, they are few and far between, and a large part of that comes down to having stringent processes and good systems.

The health and safety of mine workers is the highest priority, and Australian underground coal mine operators have invested enormously over time, in their mining methods, their equipment and other processes, and in training and education, to minimise worker risk.

Part of their investment has been focussed on the installation of different communications systems in a bid to overcome the inherent problems associated with underground areas, specifically lack of connectivity. Lack of connectivity not only restricts underground communications, but also the ability to communicate vital information to and from the surface to the mine. In a critical situation the ability to communicate quickly and efficiently across an operation, including the ability to locate underground workers, is vital.



## THE BENEFITS OF IMPROVED UNDERGROUND COMMUNICATIONS

The safety of workers, as outlined, is a core benefit from improved communications systems. Using better systems, the logistics and locations of people can be known at all times, and leads to improved safety and emergency notifications. But there are other major operational benefits too. They include:

- Contractor monitoring;
- Fleet optimisation;
- Machine performance (monitoring);
- Autonomous mining; and
- Efficiency and productivity improvements.

## THE SYSTEMS CURRENTLY IN PLACE

At present, most Australian underground coal mines employ a range of systems to maintain their lines of communication. The systems are generally based on two types of technology.

The first is the “Wired” variety, which consists of twisted pair coaxial cable, CAT5 or CAT6 fibre optic cabling, or trailing cables. The second is the “Wireless” variety, encompassing point-to-point and mesh radios, Wi-Fi systems, and “leaky feeders” – coaxial cable that has small sections of its copper shielding stripped away to allow radio frequency signals to escape.

The typical product technologies that are available are wide ranging, and include:

- Two-way radios;
- Voice over IP telephones;
- DAC speaker set systems, commonly used on conveyor belts;
- Cap lamps, which can be used to send and receive short, pre set text messages;
- Nodes/access points;
- Serial Power Line Modems;
- Broadband Power Line Modems; and
- Radio Frequency tracking tags.

However, although these existing product technologies are proven and well supported, none effectively resolve the numerous connectivity issues that are presented by the underground environment. The current standard practice for roadway developments is to have access points along the mine wall to boost the Wi-Fi signal and to lay fibre optic cabling. Yet, both of these practices are prone to failure due to the Wi-Fi signal being lost or weak, while fibre optic cabling can easily be cut during mining operations.



IS **Wi-Fi** bubble



# A NEW GENERATION OF UNDERGROUND COMMUNICATIONS

## ENGINEERING A HIGH-POWERED COMMUNICATIONS SOLUTION

The ideal solution to enhanced underground communications is a system with a high bandwidth and coverage that can reach areas currently with no coverage at all, or those with low coverage. Until now, no system has existed that can meet all the complex needs of underground coal mining companies. To find a world-leading solution, Nautitech has collaborated with Northern Light Technologies (NLT).

Nautitech designs and manufactures industry leading technologies for hazardous areas, and has developed many products that were “first to market”. This includes the Spitfire BPLM (broadband power line modem), a powerful device able to transmit up to 200 megabits of data per second. Reliable data transmission is ensured by adaptation to channel (cable) conditions, error correction and error detection.

As well as being able to analyse data to identify losses in machine productivity, mobile equipment such as continuous miners, shearers, shuttle cars and their real-time data can be remotely accessed and controlled through the use of the Spitfire BPLM.

NLT is a global leader in cap lamps, tracking and communications with a particular niche in underground coal mines. Wi-Fi communication system deployment in remote and difficult locations is a specialty of NLT Australia.

The system transparently carries all types of Ethernet-based data, including machine data, video and voice. A custom range of couplers combine high-speed communications performance with protection against high working voltages. The SuperSpitfire acts as a repeater to extend range over multiple sections of trailing cable.

## Power Line Comms - Power Cores

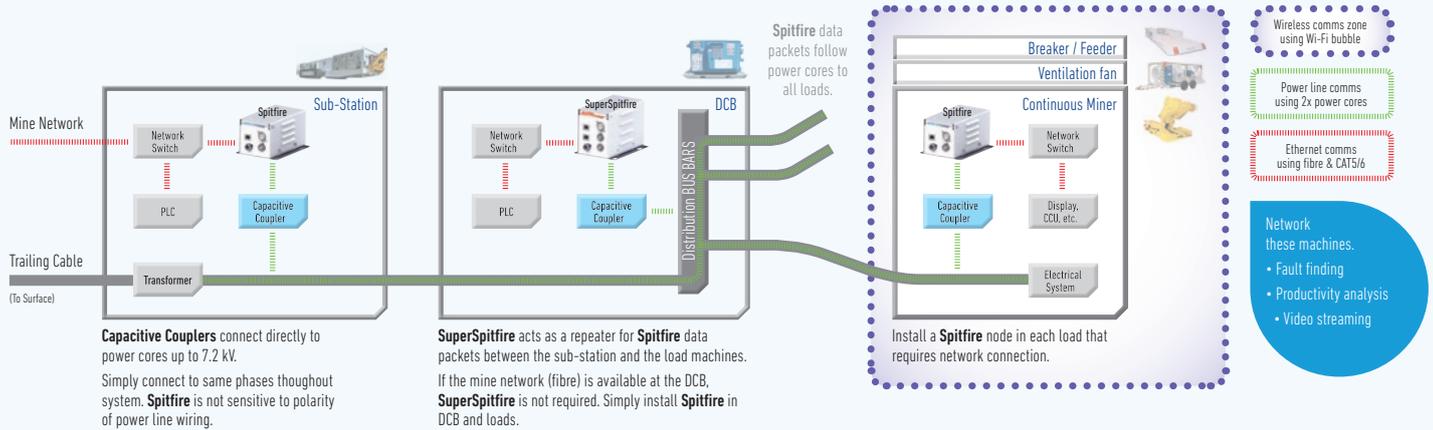
Use Nautitech's **Spitfire** and **Capacitive Coupler** to extend the mine network to other enclosures by sending data on the power cores of the existing trailing cables.

## Power Core Performance

Continuous miner with 400 metre trailing cable in NSW Australia.  
PHY data rate 43 Mbps  
Ping time, typical 6 ms

## IS Wi-Fi bubble

Use Nautitech's **Wi-Fi bubble** to extend wired comms from the inside of any enclosure to a wireless zone around the outside.



# HOW A QUEENSLAND MINE SITE IS LEADING THE WAY

## ENSHAM RESOURCES CASE STUDY

Central Queensland-based coalminer Ensham Resources became the first company in the world to reap the benefits of the advanced underground communications technologies jointly developed by Nautitech and NLT. In doing so, it has effectively paved the way for the rest of the coalmining industry.

### Ensham's Mine Site Requirements

The company identified a range of communications needs around its underground operations. These included:

- Sound network connections, using wired equipment;
- Sound network connections using Wi-Fi equipment;
- The reliable provision of network access;
- A system that supported all its existing product technologies; and
- One that involved simple and reliable installation and operation.

## AN ALL-IN-ONE SOLUTION

Fulfilling Ensham's core requirements involved developing a solution with two functional requirements, being surface communications to its continuous miner using its existing power lines, and the creation of a Wi-Fi hotspot, or "bubble", around the continuous miner.

The Nautitech-NLT combination of different but existing and proven communications technologies has taken advantage of Nautitech's best-in-class power line modems, with their reliable and high bandwidth, and Ensham's existing trailing cable for communications. At the same time, the communications signal has been protected from the harsh mining environment by utilising NLT's Wi-Fi solution to create hotspots around the continuous miner and other pieces of equipment. By using portable equipment without wires, Ensham has gained vital coverage in areas where it's most needed.

Meeting all communications requirements involved using two separate sub-systems; the Spitfire BPLM kit with an I.S. Access Point for the Wi-Fi. This proposed, tested and validated solution is now well proven, and is a bolt on solution, meaning no new approvals were required as it involved using existing and readily available, and extensively used, equipment in combination.

Initially starting with the standard Spitfire BPLM, the Ensham mine site is now considering using the use of the long-range SuperSpitfire system to extend its range throughout the operation.

# Power Line Comms - Pilot Cores

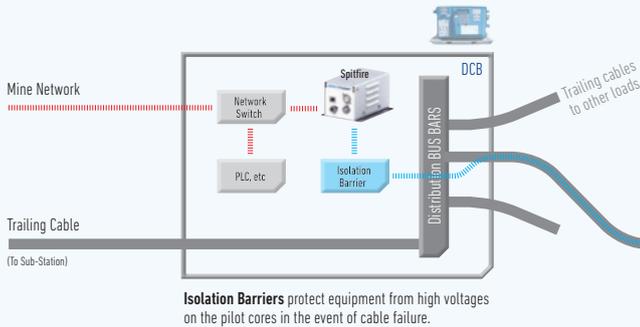
Use Nautitech's **Spitfire** and **Isolation Barrier** to extend the mine network to other enclosures by sending data on the pilot cores of the existing trailing cable.

## Pilot Core Performance

Longwall shearer with 440 metre trailing cable in NSW Australia.  
PHY data rate 115 Mbps  
Ping time, typical 5 ms

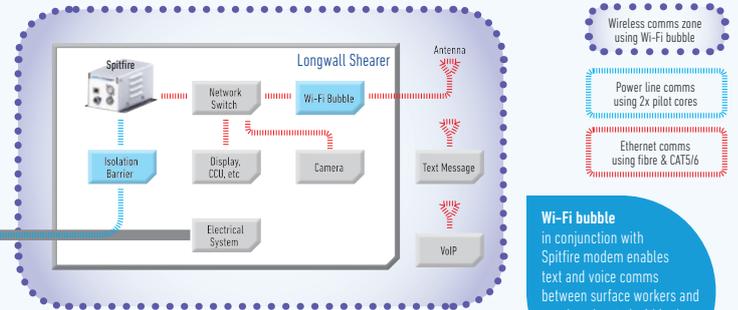
## Remote Display

Provides colour LED indication of speed/activity for EtherNet and Power Line network ports.  
Connects to **Spitfire** and **SuperSpitfire**.



# IS Wi-Fi bubble

Use Nautitech's **Wi-Fi bubble** to extend wired comms from the inside of any enclosure to a wireless zone around the outside.



**Wi-Fi bubble** in conjunction with Spitfire modem enables text and voice comms between surface workers and workers located within the bubble

## HOW THE SYSTEM HAS PAID OFF

Ensham Electrical Engineering Superintendent Brad Price says the new underground communications system is a world first for underground coal, and since being installed has been faultless.

"People can be seen if cameras are available, or heard at any given point including people around the continuous miner because they have access to the Wi-Fi bubble. Previously this was not possible due to a lack of communications.

"The simplicity of the component kit and installation requirements was also a major advantage to us. There were no issues with the Spitfire Wi-Fi bubble at all, even when machines were powered up for the first time. Everything just worked, and is rock solid. There were no drop-outs at all from when it was first installed.

"The mine is running equipment at production capacity and the communications have been consistently at a high bandwidth. Due to the high bandwidth, we can now have multiple people and many calls on our VoIP phones and communications at the same time."

- Nautitech Power Line Modem Kit Components**
- Spitfire BPLM
  - Remote display assembly
  - Capacitive couplers
  - Power cable
  - Power-line bus cable

- NLT Wireless Kit Components**
- I.S. PSU
  - I.S. Net Port Access Point
  - Media converter
  - Antenna
  - FRAS LMR 400 coax cable 5m M-M

## KEY BENEFITS

- Reduces the cost of communications infrastructure;
- No need for Wi-Fi infrastructure all along roadways between Distribution Control Box and continuous miners;
- The set-up brings connectivity to the coal face with the continuous miner;
- The system significantly increases data bandwidth; and
- Consistent and reliable connections with no drop-outs in coverage around the continuous miner.

The Spitfire BPLM Wi-Fi solution installed at Ensham is the first system of its kind, and has been an outstanding success. The physical layer data rate has consistently been above 50 Mbps, with no drop-outs. Subsequently, a second system has been installed into another continuous miner, with Ensham looking to extend the use of the BPLM Wi-Fi system into its other applications.





# CONCLUSION

Robust, reliable and fast communications are critical in underground coal mining operations. Without the right systems, including the ability to track and talk with employees, to send and receive vital data, and to monitor and control equipment, mining companies are severely disadvantaged. Until now, the systems available have not been able to provide a seamless solution to the industry's complex needs. Indeed, quite often, underground coal mining operators have simply not been able to have total communications coverage across their operations. As well as having a detrimental impact on productivity, there is a much bigger risk to the safety of their workers, particularly in a crisis scenario requiring effective communications and an immediate response.

The combination of communications technologies by Nautitech and NLT has up opened up a compelling new communications channel for the underground coal mining industry that takes connectivity to a whole new level. Companies now have the capability to send and receive data, communicate with their workers, control their equipment, and monitor their operations and performance like never before. As underground coal production, and the number of underground coal mines, invariably increases in line with the expected sharp increase in global demand over the next 15 years, so too will the need for world-class underground communications systems. Fortunately, the solution is already available.

For further information, contact Nautitech on 02 9899 6857.

**NAUTITECH**  
INTELLIGENT IDEAS FOR HAZARDOUS AREAS

Unit 3, 9 Packard Ave    **T +61 2 9899 6857**  
Castle Hill, NSW        **F +61 2 8456 6004**  
AUSTRALIA 2154        **nautitech.com.au**