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The underground lifeline

Innovative Wireless Technologies' SENTINEL system keeps underground communications and critical data moving when mine infrastructure is placed under its greatest pressure.

Innovative Wireless Technologies (IWT) doesn't believe in losing connection.

The communications technology company has dedicated its entire product range to reinforce that belief.

Maintaining that connection and connectivity underground, however, is no simple task.

Below the surface, communications infrastructure must contend with distance, complex layouts and the possibilities of a damaged device, interrupted pathway or loss of power isolating parts of the operation.

IWT developed its SENTINEL system with those conditions in mind.

Rather than treating voice communications, personnel tracking, atmospheric monitoring and operational data as separate functions supported by independent infrastructure, SENTINEL brings them together in a single wireless mesh platform.

The technical principle behind the SENTINEL platform is to ensure 'information' is given more than one way to reach its destination.

"Unlike traditional systems that rely on a single communication path, the SENTINEL System creates a web of interconnected wireless nodes," IWT SENTINEL product manager Chad Barnett told *Australian Mining*.

"If one path is blocked or a device fails, the network automatically reroutes communications through another path, keeping miners connected without manual intervention."

This "self-healing architecture" is designed to remove a single point of failure from the communications chain. When one available route is disrupted, traffic can be redirected through another part of the mesh, helping maintain contact without requiring someone to first enter the affected area and repair the failed pathway.

This is a level of technological resilience that IWT said becomes especially important during an emergency, when damage, disrupted power and changing atmospheric conditions can make an already difficult underground environment more uncertain.

According to IWT, the SENTINEL system was used during a major emergency at a large underground metallurgical-coal operation, employing more than 400 people in the Northern Appalachian Coal Basin in the US.

During the event, the system supported evacuation, rescue coordination and mine re-entering efforts, with communications and personnel-tracking information combined with atmospheric monitoring and ventilation analysis – giving responders a continuing picture of conditions underground.

Crucially, elements of the network remained available.

"Line-powered mesh nodes with battery backup, battery-powered wireless devices and gas monitors continued operating days, preserving critical situational awareness," Barnett said.

The continuity allowed information from underground to keep reaching the people responsible for making decisions above ground.

Rather than relying on a single form of communication or an isolated data source, responders could draw on the broader system.

The installed network also worked with IWT's Mine Rescue System, extending communications and tracking into the rescue effort. IWT said the flow of real-time information helped personnel assess underground conditions and limit unnecessary exposure while the response progressed.

"Seamless compatibility between the installed SENTINEL network and the IWT Mine Rescue System allowed communications and tracking to extend into rescue operations," Barnett said.

While an emergency is the most acute test of an underground communications system, it is not the only time connectivity matters.

The Mine Rescue System's compatibility with the existing SENTINEL network allowed communications and tracking coverage to be extended.

Images: Innovative Wireless Technologies

The SENTINEL Wireless Gas Monitor was instrumental in providing real-time visibility of atmospheric.

On an ordinary shift, the same information can support a far wider group of personnel than the safety team alone.

Dispatchers can use location data to coordinate people and equipment, while supervisors can see where crews are working and assign tasks accordingly.

Ventilation engineers can use atmospheric information to help manage airflow and maintenance teams can more quickly identify the location and operating context of equipment requiring attention.

Managers and safety personnel, meanwhile, can use the same operational picture to monitor performance and compliance.

Bringing those data streams together can reduce the time spent searching for an asset, waiting for information or working across several disconnected systems.

It can also help production and maintenance teams coordinate their activities, so an equipment issue is identified and acted on with less disruption to the wider operation.

"Together, these data streams provide a real-time operational picture that enhances safety, productivity, regulatory compliance and overall mine efficiency," Barnett said.

Equipment utilisation is one area in which IWT sees that visibility providing practical value. Knowing where production assets and personnel are located can help dispatchers reduce delays, refine task assignments and respond quicker when equipment requires attention.

The benefit is not the tracking point alone, but the decisions that can be made when location, communications and operating information are available through the same platform.

The integrated approach is also intended to reduce the amount of standalone infrastructure a mine must install and maintain.

A single network supporting communications, tracking, atmospheric monitoring and operational data can limit duplicated equipment, while wireless deployment can reduce reliance on cabling vulnerable to damage as the mine develops.

Battery-powered and battery-backed devices provide another layer of resilience during an outage, as demonstrated in the US emergency.

"The scalable architecture allows mines to add new applications without replacing existing infrastructure, protecting long-term investments," Barnett said.

Although every underground mine presents different conditions, IWT uses the same mesh principle across coal, hard-rock and salt operations.

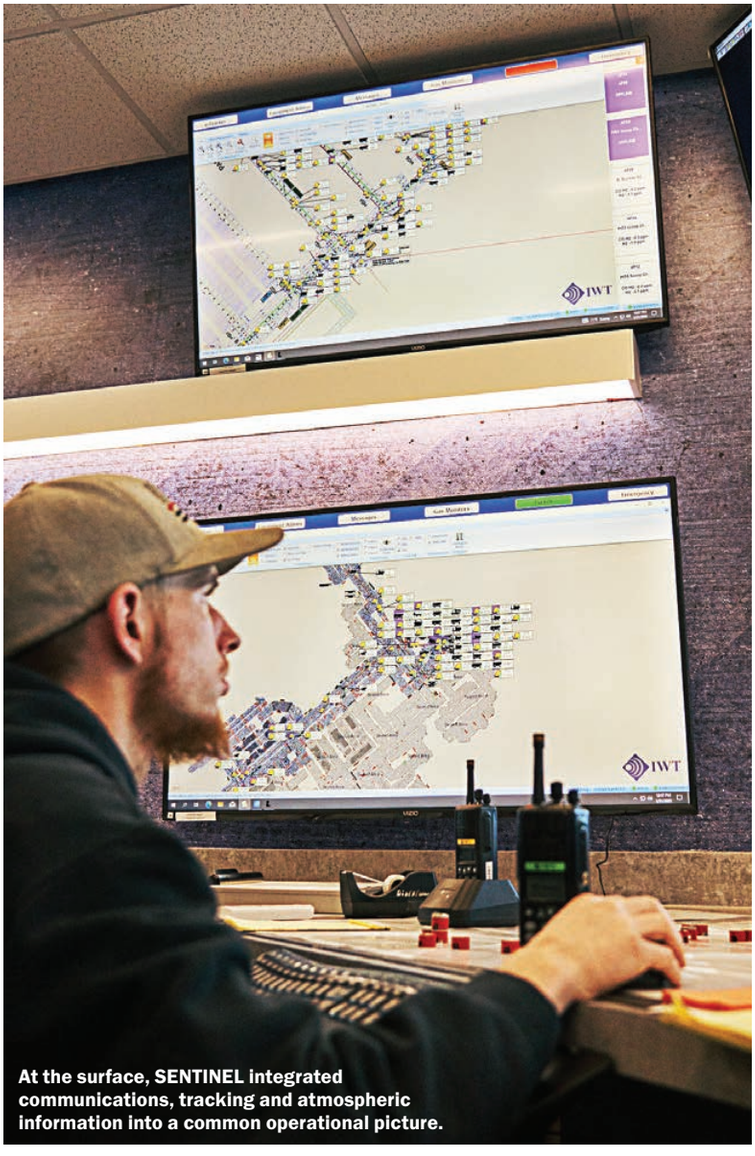
The deployment itself can then be tailored through node placement, sensor selection and software configuration to suit the mine's layout, equipment and operating priorities.

When it comes to IWT's work, resilience underground cannot be achieved simply by placing technology into a mine and assuming that it will work everywhere in the same way.

Its coverage must follow the operation as it changes and the information being collected must remain useful to the people expected to act on it.

Inside Australian underground mines, the Northern Appalachian example exemplifies that communications infrastructure is not merely a convenience for routine coordination, nor is it something that becomes relevant only after an incident begins.

It is instead, according to Barnett, part of a mine site's safety and operating backbone. AM



At the surface, SENTINEL integrated communications, tracking and atmospheric information into a common operational picture.