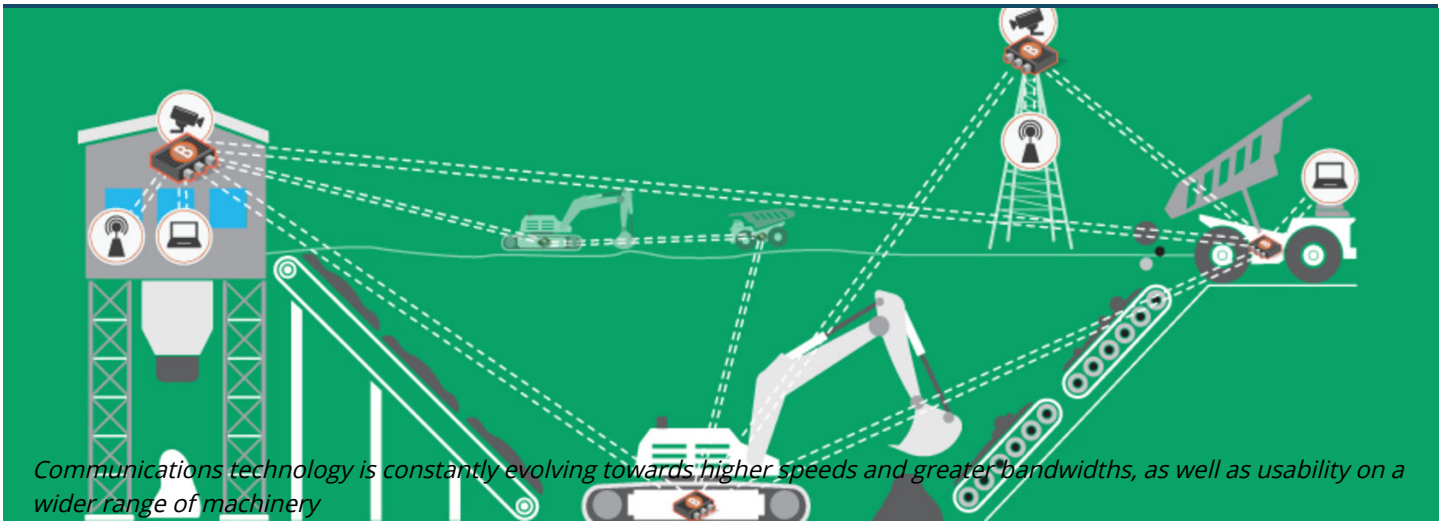
Mining Magazine

Connecting in the age of autonomy

Like many other tech companies, wireless network provider Rajant is grappling with how autonomous mining is affecting the communications market and its customers' needs



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Mining is just one of many industries looking for ways to improve the efficiency of operations and to keep workers out of harm's way, which often translates into taking people out of the equation.

Since autonomy has been a buzzword within mining for quite some time, it might seem like progress is fairly slow.

"You have to bear in mind that this is an industry, a bit like oil and gas, where technology will be tested so thoroughly before it's adopted, because if a 300t haul truck goes out of control on a slope, people can die very quickly," says Chris Mason, director of sales for the EMEA region for Rajant Corporation.

In fact, Mason believes there has been an accelerated uptake of autonomous technology within mining, with testing of fully autonomous trucks, shovels and drills ongoing.

At the same time, communications network installers and integrators are being asked to prove the claims they make in their promotional material in terms of connectivity, coverage, bandwidth and network capabilities.

"And I think that's a good thing," Mason says, "because historically, certainly in many heavy industries, they've relied on process control networks: it was small amounts of data, but sent quite frequently, and that's fundamentally changing; we're getting large amounts of data required all the time.

"It's no longer the case that, for example, a two-way radio provider can migrate into wireless networking and function without making some significant additions to its skill sets. So, a really important function of reaching the market and operating as a manufacturer is to make sure the integrators, who are actually deploying the equipment, are doing so in the manner the equipment and technology was intended and designed to perform."

A wireless network for a mine still has a link to a wired network, which means integrators require a combination of skill sets in-house, covering both the RF side of wireless capabilities and the integration with wired. "Often that is the point at which any organisation encounters difficulties because of the different characteristics of wired and wireless networks," he says.

Network demands

When it comes to autonomously or remotely controlled mining equipment, a wireless network needs to be able to offer 100% connectivity.

While autonomous devices are capable of functioning without external intervention, the machines still require monitoring. This means mining operations have to have access to high-bandwidth, high-quality CCTV footage across their network.

Latency is also an important factor. It means any delay in getting a signal of location, activity, condition or risk from the autonomous system to the control system that's operating the machinery, explains Mason.

The signal also needs to reach the system in time to stop the equipment immediately, rather than having a long delay in delivering the data packet. "And all of that in a mobile environment - and one that is dynamic, as it changes all the time," he adds.

Rajant is regularly delivering hundreds of megabits per second from mobile environments, spanning areas averaging 20km2, with hundreds of moving wireless network nodes.

Chris Mason

"Everything moves, and you have to support mobility extremely well," says Mason.

"The other thing you have to accept is that, if you're a miner, your own operations will build barriers to communication.

"You're digging holes and piling up rock, so you have to be able to go around that. You have to have alternative mechanisms and communication paths around that environment.

"You're also operating in harsh climatic and operational environments. These are some of the worst places to try and deploy technology in the world. We've got units operating in +50°C in Australia and also at -20-30°C north of the Arctic Circle. Your equipment has to cater for that."

High mean time between failures is crucial for mining operations, particularly in harsh, remote and dangerous conditions.

"You don't want to be constantly sending technicians - expensive technicians - in to replace or repair the technology.

"And then from a CIO's perspective, there's an additional thing to think about, which is how frequently do I have to replace this network that's operating 24 by 7 by 365. If I have to replace the whole lot, I have to suspend operations, and that just isn't acceptable. So, the future lifetime of the product and backwards compatibility with earlier versions are really important to keep your operations going."

Growing operations

In addition to having a network that is capable of delivering the right speed, bandwidth, latency and mobility - miners need one that's scalable.

"In other words, as your mine grows, as it inevitably does, you need to be able to add more equipment without adversely affecting the network," says Mason.

When expanding or adding new applications, miners need to work together with those in charge of network management.

"Because you know by just adding three or four cameras to a network may actually take it to the point that you haven't got the bandwidth overhead to be able to support them."

Rajant also works very closely in educating its integrators and resellers, as well as the end users, to get them to manage their wireless networks the same way they manage their wired ones.

"You wouldn't let somebody wander in to your server room and connect a laptop to your core network without certain forms of governance," notes Mason. "Well, contractors and people on the mine sites have a habit of bringing wireless communications equipment with them to run their operations. So, we work with our customers to make sure that not only is the network itself functioning as well as it possibly can, but to be alert to the fact that they need to manage their own frequencies and make sure they don't introduce interference from those people who are supposed to be supporting their operations."

Rajant's BC Enterprise product helps do just that by giving an ongoing illustration of critical performance indicators on the network, while allowing users to dynamically manage the network's performance.

The monitoring tool shows throughput capacity of each individual node and how it's performing as things change in the mine.

"One of the critical aspects of a scalable network is that when you add nodes it doesn't adversely affect the performance," says Mason.

"What we've managed to achieve with the InstaMesh protocol, a distributed network routing protocol, is that it only ever adds between 3-5% in total of the available bandwidth for network management. How that translates into reality is that in our largest network in an oil and gas field in the US, which now has 503 nodes, with each new area of production they just add a node.

"It's as simple as that, as long as the network node ... has three settings that are the same as its peer - so network, network code, correct channel frequency - as soon as you switch it on, it will work.

"That means that you can have, as either backups or for your future network expansion, devices sitting on the shelf with those three components configured within them, and then as soon you need to expand into an additional area of operation to get some more coverage, you simply turn one on. Within a minute or so they will start acting as part of the mesh and passing traffic."

Data security

The first user of Rajant's products was the US Department of Defense, and the company still has very strong links to the US military. It has its own in-house team of information assurance experts and cryptographers, who've come directly from that environment.

"Every item that we have ships out with five or six levels of security starting at AES-256 and increasing, and if necessary we can actually develop bespoke encryption," says Mason.

"And it's all about making that security usable as well as secure, because one thing inevitable of encryption to any data link is that that encryption, by its very nature, has to be processed, and therefore it slows down the traffic. So, you have to start with very good, strong high-speed data links in order to deliver secure packets in the bandwidth and the latency that are required to do autonomous operations."

Next step

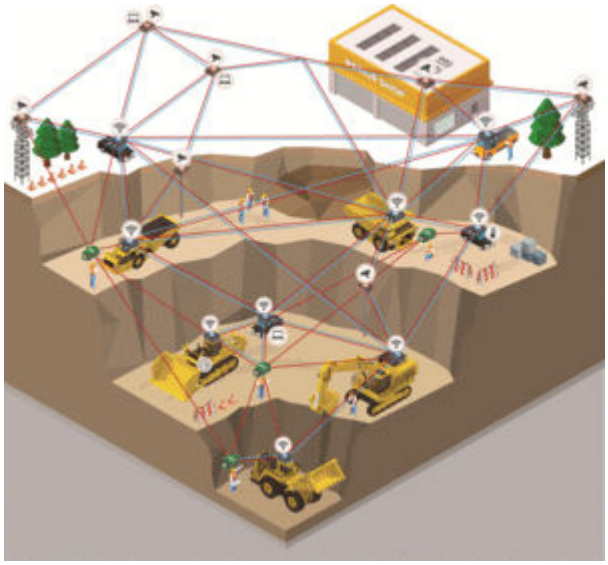
Communications technology is constantly evolving towards higher speeds and greater bandwidths, as well as usability on a wider range of machinery - including autonomous equipment underground.

"We have a large number of open-pit deployments; the bigger challenge is going underground, which we're just doing," says Mason.

"The thing about underground mining is that the type of rock and the shape of tunnels directly affect the radio signal propagation, so you get very different signal strengths, distances and usability in an underground mine."

Rajant has been working with a number of organisations that are looking to go autonomous underground.

> "There are some vast advantages in those environments; principally because, if you go autonomous, you no longer need to build a tunnel to have to transport people, so they can be very different shapes and you end up mining far more of the valuable ore than the overburden and the surrounding walls just to get access. So, it



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becomes a very different type of mining - highly efficient - and again it needs to be supported by transmitting real-time video from right at the rockface back to the control room," Mason explains.

"And, actually, more devices being connected are yielding insights into how to better manage the operations. We've seen a lot of progress on, what you might call, some fairly straightforward predictive maintenance. So, for example, where a machine begins to run hot, instead of it running hot and waiting for the next service to be able to be maintained, you automatically bump that to the front of the queue and make sure that it's treated before it becomes critical.

"When you start getting into much more detailed use of the data that you have, you can start to identify specific machine types or fuels or lubricants that give you a better yield in terms of longevity and parts wear. You can really analyse shift behaviours and look at where your machines are being abused, if they are by the drivers, or where the system, if you're looking at autonomy, needs to be tweaked such that a two or three mile per hour reduction going down a slope yields a 20% tyre life increase.

"It's real data, but only the sort of thing you can get if you can rely on the network."