



Hytera Whitepaper
Intelligent Communications Solution for Mining



INTRODUCTION

The global mining industry faces a number of challenges today, but modern digital communications solutions can play a major role in helping to overcome some of these difficulties. The current situation is summed up by a report from the World Economic Forum (WEF) published in January 2017 entitled: Digital Transformation Initiative - Mining and Metals Industry¹.

“Five years after this century's commodity boom peaked in 2011, the global mining and metals industry is still adjusting to a set of strong headwinds. These include: anaemic global demand growth; massive excess capacity, weak pricing and increasing volatility; workforce skill gaps; increasing pressure from customer requirements; growing resource nationalism and regulation; declining resource access and quality; and mounting trade friction along all steps in the value chain.

Many existing mines are reaching the end of their life with the quality of ores reducing, meaning the production costs per ton of ore are increasing. For example, the WEF report noted that the average cost of producing copper has risen by more than 300% in the last 15 years, while the quality of grade has dropped by 30%.

The number of surface (open-cast) mines is decreasing, while more costly deep mine numbers are on the rise. New mineral resources are becoming scarcer and there are fewer high-quality ores left to exploit. This has forced mining companies to explore deposits in more remote and harder-to-access areas, which are often located in harsh environments. The risks, lead times and operational costs are therefore higher.



Mining companies are now subject to stricter and more expensive regulatory regimes including taxes, permit fees, export duties and social licenses to operate. They are also subject to tougher environmental monitoring and clean-up requirements. Mining is an inherently dangerous activity, so companies are under immense pressure to improve safety standards, which means more investment in safety processes and equipment.

The industry also suffers from an ageing workforce less adapted to new digital innovations. A shortage of skilled workers means existing staff have to do more with less, pushing up wages and reducing employee productivity.

Finally, mining has become increasingly complex and although the industry does exploit new technology, including automation of

machinery, haulage systems, trains and trucks, too often these technologies operate in isolation. Information technology, operational technology and other devices and systems are not integrated in a way that makes the most of them.

These conditions seem likely to persist, according to the World Economic Forum, whose report states: "There is no evidence to suggest that these trends will reverse any time soon. On the contrary, they are likely to persist indefinitely, defining the industry's "new normal". Moreover, across industries, the current value-chain structure with incumbent businesses is being challenged not only by macroeconomic conditions, but by increasingly fast-moving and pervasive digitalization."

HOW DIGITAL COMMUNICATIONS TECHNOLOGY CAN HELP THE MINING INDUSTRY



Automation

Given all the above challenges, it is no surprise that mining companies face enormous pressure to cut costs and to improve efficiency, productivity and safety. Digital communication technology is widely seen as having a major role to play here in helping to simplify processes, reduce risks, cut costs and improve margins.

The use of communications technology in the mining industry can be divided into three main areas: automation; in-pit mobility; and data-centric analytics. The list of features and processes that can benefit from communications technology and automation in mining is now impressively long.

Applications include: in-pit autonomous haulage systems; autonomous drill systems; push-to-talk voice and push-to-talk video and dispatch

systems; driverless freight train control; anti-collision systems; in-pit proximity detection; CCTV; high-precision GPS applications such as geofencing; slope monitoring and rockface/ground penetrating radar.

Other applications in use are: vehicle, machinery and drill/excavator fleet management and telemetry (e.g. scheduling/task assignments, guidance/positioning, equipment problem identification/avoidance, remote diagnostics, speed, tire pressure, temperature, fuel/oil/brake fluid levels, load measurement, GPS-based precision excavating); SCADA systems and sensors; dust suppression using automated sprinklers, control valves and a wireless control system; and applications for field force automation.



Data Analytics

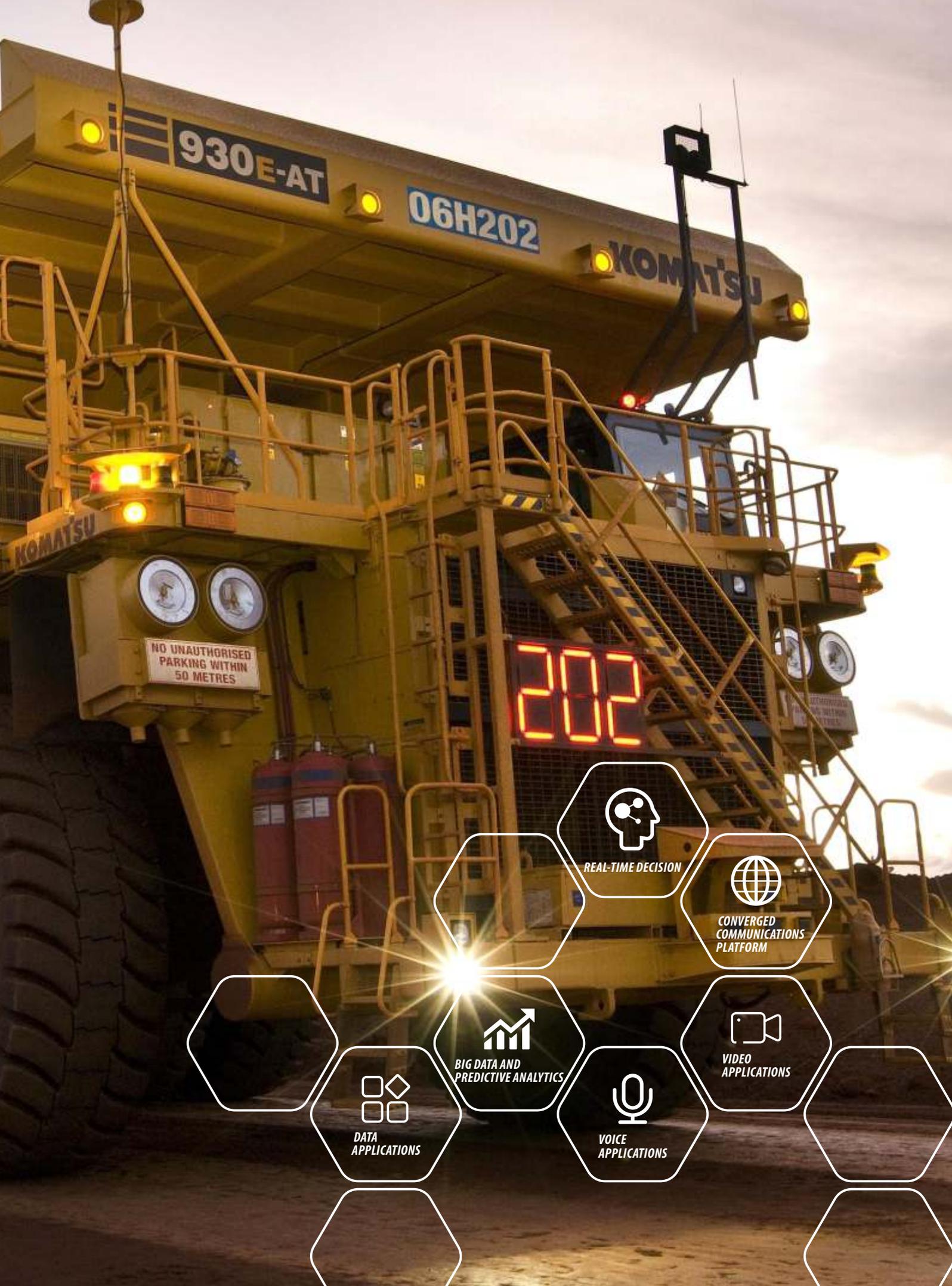
Mining companies also need to harness Big Data analytics to provide “real, applicable insights from data and sharing them clearly and effectively with the right levels of the organisation”, as this will help “provide real-time decision support and future projections”, argues the WEF report.

Big data and predictive analytics not only provide a competitive advantage by enabling faster and more accurate decision making, but they also help to minimise unplanned downtime by ensuring timely maintenance of vehicles, excavators, drills and other assets before a major machine failure that could hold up production.

As can be seen from all the above examples communications technology supports a very wide variety of applications within the mining industry.

These may use a variety of bearer technologies including Land Mobile Radio (LMR), Wi-Fi, Bluetooth, cellular GSM, 3G and 4G, wire and fibre optic cables and perhaps satellite in more remote regions or mining exploratory missions.

However, too often all these bearer technologies and applications work in isolation. If the mining industry is to really reduce its operating costs and improve efficiency it needs to invest in a converged communications platform that will bridge these islands of communication. To provide maximum efficiency the platform needs to be a single, cost-effective physical infrastructure capable of providing broadband speeds and flexible enough to support the multiple data (applications), voice (applications) and video applications cited above.



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NO UNAUTHORISED
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REAL-TIME DECISION



CONVERGED
COMMUNICATIONS
PLATFORM



BIG DATA AND
PREDICTIVE ANALYTICS



VIDEO
APPLICATIONS



DATA
APPLICATIONS



VOICE
APPLICATIONS



Safety is another area where communications technology can really improve accident rates and save lives. Poor safety compliance can lead to stoppages that directly impact operational production and profitability, while worker compensation packages and regulatory fines can end up being more expensive than the cost of prevention.

Investing in robust safety systems and equipment, including data capture from safety related systems and tools, can help managers optimise production and maintenance activities by reducing the cumulative risk and therefore minimising downtime.

A wide range of safety tools are now available for use in mining. Modern technology can support active, real-time surveillance of people, machinery and mine conditions, including air quality and tunnel, slope and rockface stability. Constant two-way communications systems are a must to enable miners, support teams and control rooms to be in continuous contact.

Video feeds and remote sensors can monitor conditions in real-time to provide increased situational awareness and safety, as well a faster response to any emergency including medical assistance. Real-time video streaming can also provide a link to enable medical experts in remote locations to give expert advice to less qualified medical staff at the scene of an accident.

Miners work long shifts in exacting environmental conditions, tiredness can be a problem that leads to accidents and mistakes. Continuous operator fatigue and

distraction detection technology using real-time in-cab cameras, sensors and detection equipment can proactively prevent accidents by sending an alert to the operator and to control rooms.

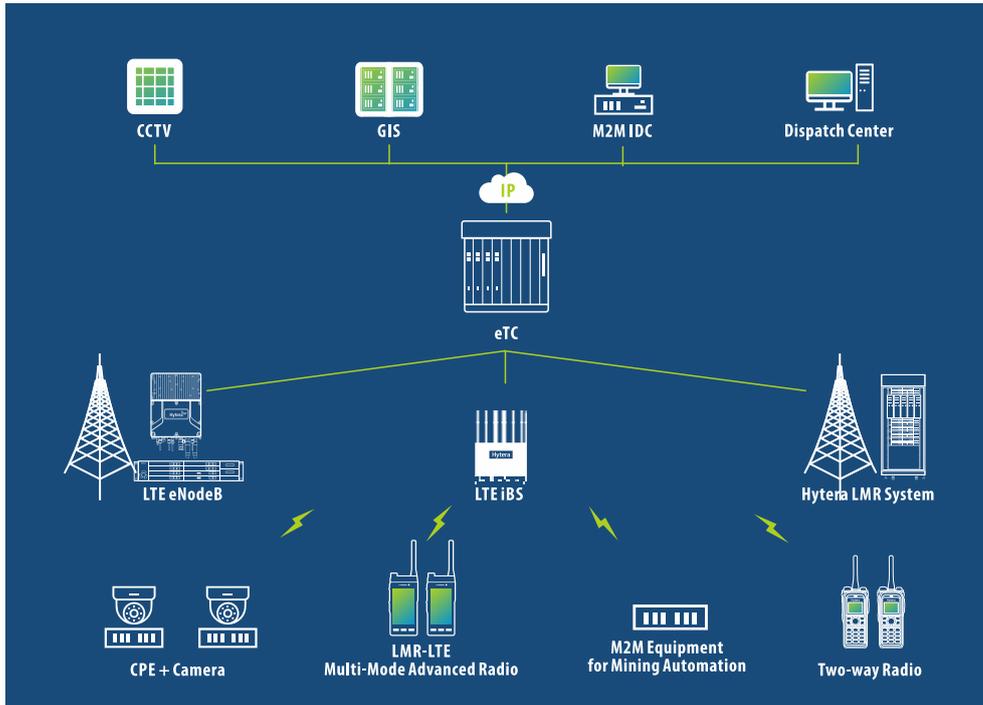
New technology in the form of artificial intelligence is allowing robots to be sent into areas of underground mines to assess any potential danger without humans having to enter the space. Falling rocks account for 40% of fatalities in mines, but ground penetrating radar technology can be used to monitor for small seismic activity, assess the stability of the rock face and send an early-warning if it detects any movement. New radar technologies are also being deployed to penetrate rock faces and see where reefs are located.

Personal safety systems include location and detection of people and assets (including last known location), Man Down and Lone Worker solutions and emergency call functionality, asset monitoring, collision prevention, personal warning technologies, air quality control and location of trapped miner search solutions, including information on the distance and direction of the trapped miners.

Video surveillance technology also enables operations managers to see what is happening at the excavation face and elsewhere. It can also be used in conjunction with movement sensors/alarms to remotely monitor mine facilities and perimeters and to provide visual situational awareness of emergency situations such as weather damage, fires or illegal entry.



HYTERA INTELLIGENT COMMUNICATIONS SOLUTION FOR MINING

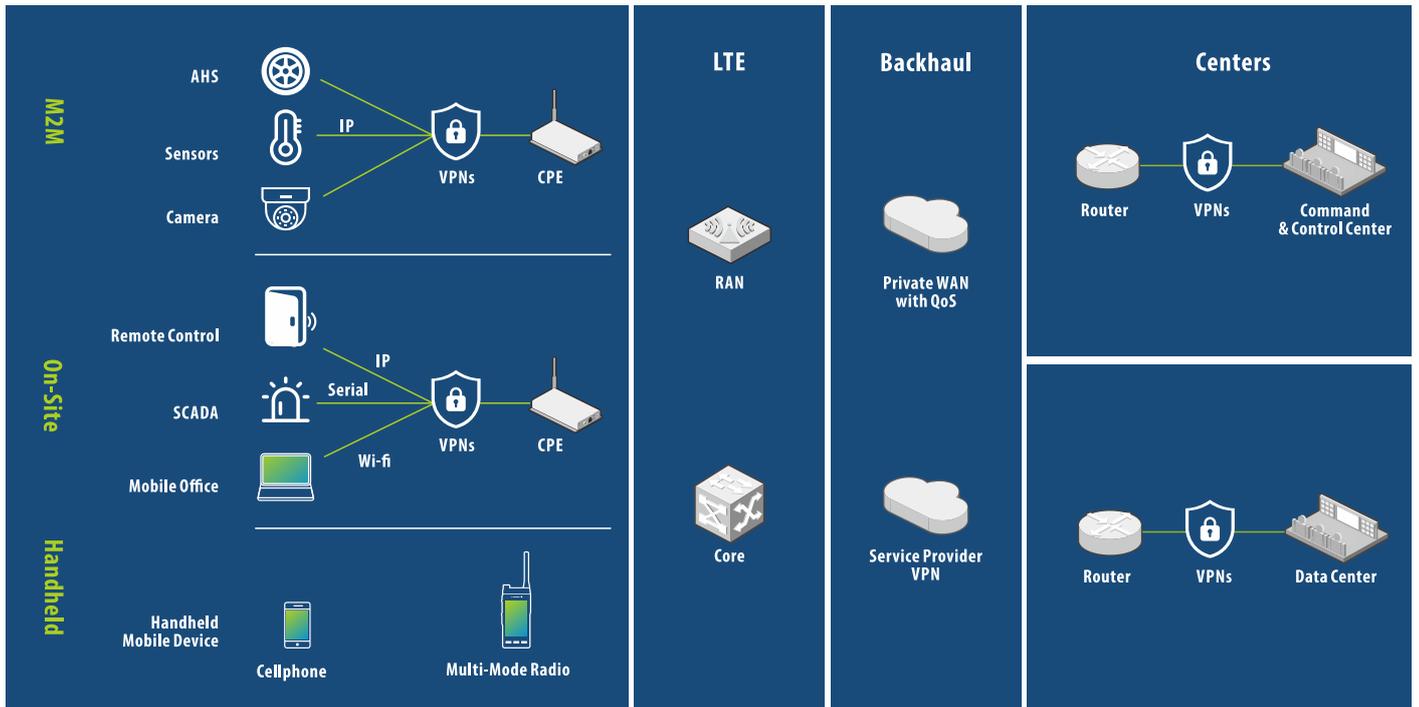


Mines typically use LMR networks such as TETRA or Digital Mobile Radio (DMR) for voice communications and Wi-Fi for data applications. This is because LMR is excellent for voice and messaging, but as a narrowband technology it is limited in the amount of data it can carry.

Wi-Fi is excellent at transmitting data indoors, but less good outdoors where its coverage range is limited. Wi-Fi also suffers more easily from interference and it does not support handover between access points. It does not work if the

terminal speed is more than 80km/h and is poor at handling voice calls. Wi-Fi is also relatively weak when it comes to cybersecurity, something that is becoming increasingly urgent as more mines rely on Internet connected data systems.

For these reasons LTE is the best solution of outdoor coverage. LTE is both extremely good at carrying fast broadband data transmissions, including a low latency of 10ms for mission critical applications, and voice calls. LTE can also provide mission critical trunking voice calls, which Wi-Fi cannot support.



LTE offers seamless roaming in one network, along with established Quality of Service (QoS) parameters for guaranteed bandwidth to ensure there is enough capacity to handle all the different applications used in mines. It is intrinsically resilient and has powerful cyber protection solutions available.

Hytera's new Intelligent Communications Solution for mining provides an complete end-to-end LTE wireless broadband network solution including, Radio Access Network (RAN), backhaul, LTE core, device and network management, and the ability to converge LTE and LMR networks.

The solution is based on fully interoperable 3GPP LTE industry standards to provide fast, secure, real-time audio, data and M2M/IoT communications. It meets LTE QoS requirements for carrier-grade network design with full consideration for redundancy and availability to

ensure a robust and reliable network. The solution is also fully transportable and can be set up in minutes, which makes it highly suitable for the mining industry.

At the heart of the network solution is the LTE Enhanced Trunking Core (eTC), which is linked to the Network Management System (NMS) and Application control system. LTE eNodeBs (base stations) and LTE integrated base stations are connected to the eTC to provide the RAN network.

Hytera LMR systems such as TETRA or DMR can also be linked to the eTC for a converged solution. Gateways can provide links to commercial cellular 2G/3G/4G networks and PABX/PSTN telephony systems. Applications for use in mines include video walls to display CCTV feeds, a data analysis platform to display information from M2M sensor readings, the NMS and dispatching solutions.

TRANSPORTABLE SOLUTION

LTE infrastructure is made up of the LTE eTC, the LTE baseband unit (BBU) and LTE remote radio unit (RRU). Hytera's innovative LTE transportable infrastructure solution integrates these three key components into one intelligent and reliable integrated base station (iBS) unit weighing just 26.5kg.

This provides a very affordable and very flexible broadband solution capable of supporting the multitude of voice, data and M2M applications used in the mining industry on a single, unified and cost-effective platform. The iBS is a less costly unit than a macro eNodeB, it saves space, power and reduces operational costs (OPEX).

The iBS can support up to 200 online users and has a typical coverage range of a few kilometres. It takes just five minutes to set up as it is a self-configuring, self-optimising 'plug and play' solution with optical and electrical (O&E) connections. Up to four iBS eNodeBs can be

interconnected. The units can be mounted on poles, vehicles or carried in a case. This makes it very easy for mining companies to relocate the LTE network infrastructure as the mine expands.

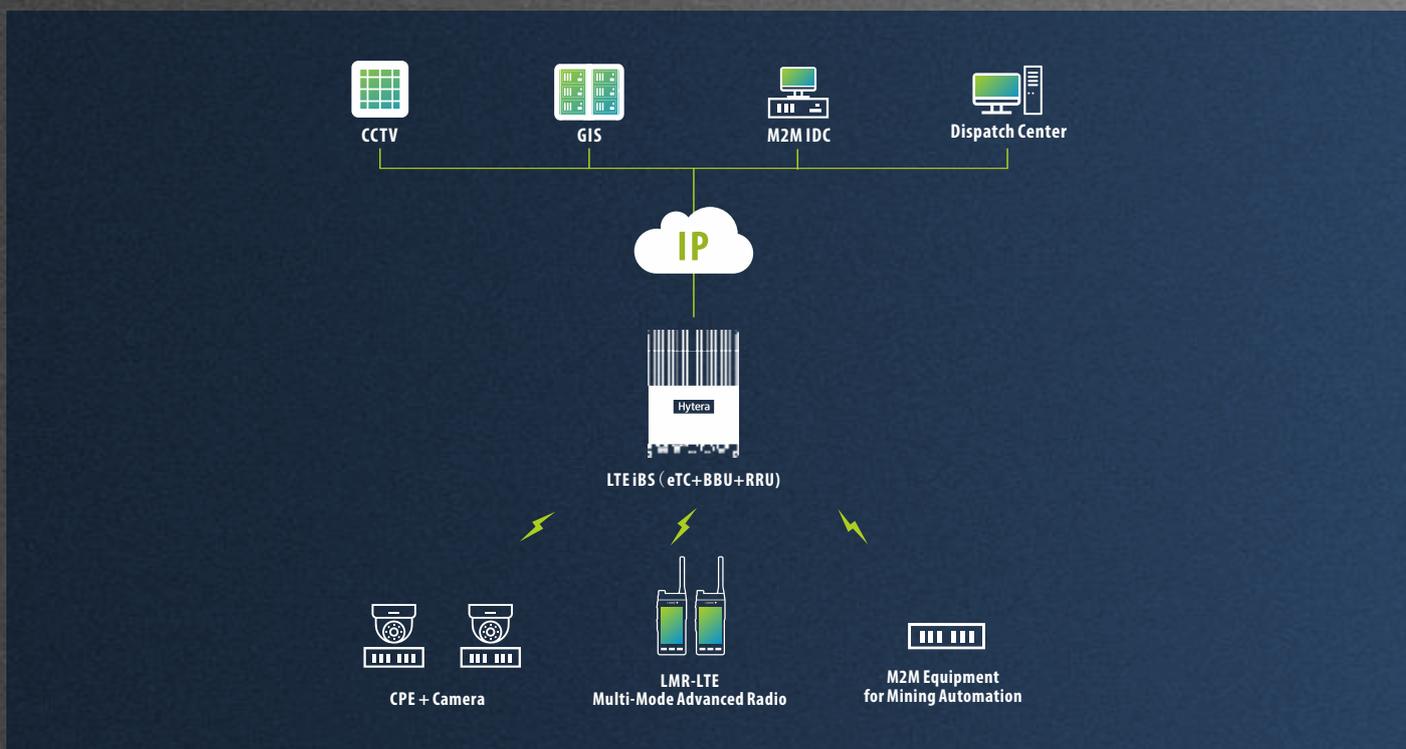
Given the conditions most mining operations work in it is important that the eNodeB units are ruggedised and able to cope with extreme temperatures, weather conditions, shock and vibration, dust and dirt intrusion. The Hytera units are IP66 rated against dust and dirt intrusion and are housed in a robust metal casing.

Very large mines may need more than four eNodeBs, in which case a larger scale enhanced network core would be needed to manage all the nodes.

In underground mines the LTE RF signal can be distributed via leaky cables and indoor DAS

(distributed antenna system). This provides RF for radios and data and can be used by in-cab and personal CPE devices to bridge with LTE sites and provide the wireless signal for the surrounding devices. It can be used to transmit telemetry data back to the data centre and support sensors, automated controls, triggers, alerts and so on.

The Hytera Smart MDM (mobile device management) server provides a unified management and remote configuration capability for dispatch consoles and communication devices. It enables remote programming and upgrading of devices, application management and push, remote data erase and radio stun/kill, a secured database and packaged license, and mutual authentication and encrypted data transmission.





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HYTERA IMESH BROADBAND SOLUTION

If there is no solid network coverage available, Hytera's iMesh broadband self-organising network solution can be used to provide a mesh network. iMesh is a fast deployable, portable solution supporting high throughput voice, video and data applications. It is automatically self-configuring, self-optimising and self-healing. No cables are needed as the nodes link wirelessly together.

The iMesh solution can be used to provide additional coverage and capacity to the existing LTE network or to provide coverage in blind spots. For example, it can provide communications in underground mines where ground signals cannot penetrate or where underground leaky feeder communications are not available for some reason, perhaps after an explosion or tunnel collapse.

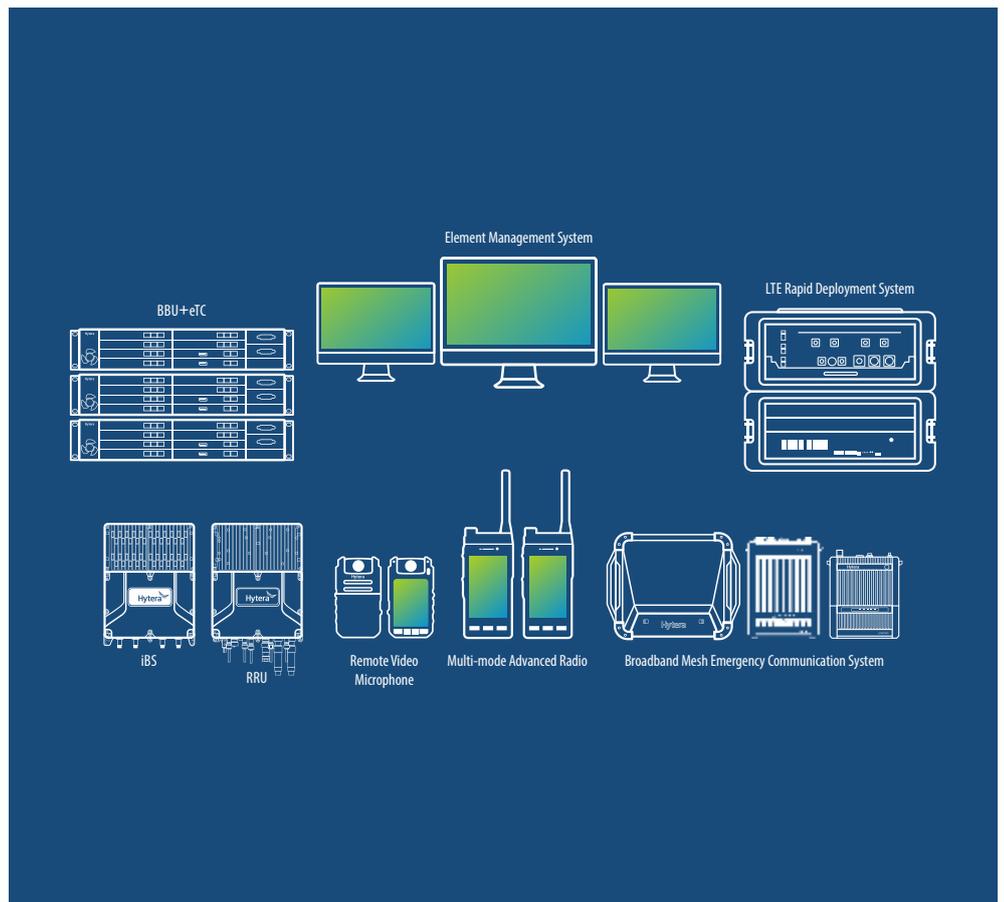
CONVERGED LTE/LMR NETWORKS

As mentioned earlier, the Hytera Intelligent LTE Solution for mining also enables convergence with legacy LMR networks such as TETRA and DMR. This enables mining companies to get the best of what narrowband and broadband networks can offer - high quality, mission critical push-to-talk over both LMR and LTE/Wi-Fi voice calling and broadband video calling and multi-media messaging.

The converged solution also enables LMR radios to communicate with LTE smartphones and allows LMR communications to be extended via LTE beyond the LMR coverage area.

What Hytera's solution offers is more than a simple gateway linking the separate LMR and LTE networks. Instead it uses a lower layer connection between the two systems involving three main levels. For voice calling, Hytera uses the Mission Critical Service (one of the high tier Push-To-Talk over Cellular or PoC) for the LTE and connects to the LMR system via a special interface with mission critical level of QoS, latency and trunking functions.

The solution also provides convergence network management, so one tool manages both the LTE and the LMR side. Hytera is planning a further development in the future that will integrate the hardware of the core network equipment for both LMR and LTE.



TERMINALS

The Hytera LTE solution supports pure LTE and (if converged) LMR devices, along with hybrid LTE/LMR terminals. But given the harsh environments typical of the mining industry it is advisable to deploy ruggedised terminals rather than consumer grade products.

Hybrid devices are particularly useful where integrated LTE and LMR networks have been deployed as it means mining operatives only need to carry one communication device. Hytera's multi-mode advanced radio features, such as the rugged PDC760 DMR/LTE multi-mode advanced radio and PTC760 TETRA/LTE multi-mode advanced radio, are ideal handsets for mining.

The radios feature an ergonomic and ruggedised design in a traditional LMR form factor with large dual display screen, dual camera, dual SIM card, unified seamless connectivity and hierarchical encryption. They are built to withstand harsh environments as they can operate in temperatures from -20°C to +60°C and are drop resistant from 1.2m. The radios are IP67 rated against dust and moisture intrusion and are MIL-STD-810G certified for shock and vibration.



PTC760



PDC760

CONCLUSION

The World Economic Forum report argues that if mining companies are to take full advantage of the digitisation and communication technology they must move beyond one-off investments in technology. "Instead they need to build a focused strategy that incorporates digital, and aligns it with their business model, processes and organisation, to encourage digital usage and experimentation."

The basic building block for increased digitisation and communication is to invest in a single, unified

communications technology platform capable of supporting a wide range of audio, data and M2M/IoT applications. Analysing Big Data captured from the machinery, equipment and sensors connected to this platform will help managers in their decision making to maximise efficiency, productivity, safety and profitability.

The Hytera Intelligent Communications Solution for Mining offers just such a platform and one that is cost effective, robust, resilient, secure and flexible.





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