



HOW 5G MAKES THE MINE OF THE FUTURE A REALITY

A mine operates in a silo, literally. A subterranean mining site is a parallel universe decoupled from the extended mining enterprise. Moreover, it is a forbidding workplace fraught with risk for mine workers. Fortunately, advances in Information and Communications Technologies (ICT) integrate mining activities with the ecosystem and ensure sustainable operations.

Industrial Internet of Things (IIoT) provides viable solutions across dimensions of industrial and environmental safety, enterprise productivity, and operational efficiency. Robotic automation, telemetric positioning systems, wireless environment sensors, IoT safety devices, and remote monitoring of operations streamline production, minimize downtime, and ensure sustainable mining.

Reliable, fast and secure wireless connectivity is a prerequisite for IIoT applications. Although legacy wired and 4G WiFi solutions are deployed at surface and underground mining sites, they are constrained by coverage, connectivity and maintenance issues. 4G mobile applications and automation solutions modernize operations and boost productivity, but cannot match the capabilities of 5G connectivity.

Smart mine powered by 5G

5G transforms communication by enabling mining enterprises to deploy a dedicated private network for business-critical applications and machine-to-machine data transfer. It offers ultra-low latency, better accessibility and higher reliability, while supporting high device / equipment density. 5G data transfer speed is 10x faster than 4G, which coupled with near real-time end-to-end communication makes a robust business case for adoption of 5G technology in mining.

Faster data transmission and extremely low response times enable seamless communication between connected devices as well as mining sites and remote operations centers. High bandwidth facilitates simultaneous data sharing between in-motion assets. Moreover, pervasive coverage provides the ability to share video and data while optimizing onboard computing power in autonomous vehicles or heavy equipment.

The fifth-generation wireless communication technology allows mining enterprises to configure a bespoke network using New Radio (NR), the global standard for a unified air interface for 5G. It achieves high throughput by directing traffic through the fastest pathways in a dedicated network. A standalone 5G network delivers superior outcomes while eliminating challenges due to network congestion.

5G technology infrastructure allows uninterrupted mining operations even when external communication is disrupted. It boosts enterprise functionality through continuous video surveillance, accurate location tracking, and autonomous operations. Augmented Reality (AR) and Artificial Intelligence (AI) applications enhance the ecosystem of smart mines.

The smart mining imperative

Automation and predictive intelligence enable metals and minerals enterprises to address the dynamics of production, quality, safety, and regulations, be it ore located underground or spread across a vast swathe of land. A robust communication backbone drives smarter prospecting, drilling, blasting, and logistics.

Accurate positioning assistance and real-time remote control are the underlying components of autonomous systems and smart operations. 5G network technology offers both high-precision navigation as well as supreme control of machinery. It integrates endpoints of a connected ecosystem to rationalize labor intensity while maximizing productivity and operating time.

5G wireless networks support autonomous mining operations. Drones equipped with sensors, imaging solutions and thermal cameras facilitate high-definition video streaming. Aerial and underground video surveillance is useful for exploration, geological surveys, seismic monitoring, site inspection, and environment monitoring. High resolution 5G video footage also helps eliminate human intervention / presence in potentially hazardous sites. Further, mining equipment, drill rigs, loaders, and hauler trucks can be retrofitted for remote operations, close monitoring, and harvesting real-time data.



Insights from a data trove

A digital mining ecosystem powered by 5G assimilates diverse types and formats of data from unmanned equipment, autonomous machines, and remote locations. It ranges from speed of a driller and post-blast fume or gas density to complex geological data and images. This rich data repository feeds 3D computer-aided applications, analytical tools, predictive models, and machine learning algorithms to create a smart mining enterprise.

An integrated 5G private network automates collection of real-time data for intelligent services to ensure operational excellence, improve safety, reduce waste, and mitigate risks. Accurate data boosts the efficiency of geo modeling, geotechnical assessment and hazard analysis. Besides, enhanced visibility into mining data facilitates informed decision making, be it the installation of an automated ventilation system to improve safety or optimization of the production schedule to maximize equipment utilization.

The collection and analysis of data from connected underground and open pit mining systems helps identify the root cause(s) of performance issues and logistical challenges. Further, it supports demand forecasting while discovering opportunities for rationalizing costs such as predictive maintenance of assets, automating loading and unloading operations, optimizing spare part inventory, or simplifying fleet management.

Real-time 5G access to smart assets, a distributed workforce, enterprise systems, and environmental factors enables sustainable operations. Visibility into air and water quality, fuel consumption, greenhouse gas emissions, and transportation flow allows real-time interventions for safe operations, waste management, and risk control.

The mine migrates to the cloud

Terabytes of data from sensors, IIoT devices, autonomous machines, analytical models, and business systems in a 5G network can be securely stored on the cloud. Further, the cloud architecture complements 5G communication infrastructure by providing the ability to combine video, voice and data streams for edge analytics. Secure and scalable cloud platforms combined with reliable connectivity accelerate mission-critical use cases and smart mining systems. In addition, the cloud simplifies on-boarding of technology, equipment and applications to meet the demand for continuous monitoring, autonomous operations, analytics, and emerging business services.

The cloud supports 5G NR for seamless upgrade of existing 4G communication network-based systems to a standalone connectivity framework. Systems integrators use robust cloud platforms to create a network-agnostic architecture that addresses the requirements of real-time mining applications. The integrators combine expertise in network connectivity, edge computing and mining technologies to adapt a standalone network to specific mining operations. A 5G-ready network-agnostic platform is a cost-effective solution to integrate engineering services, IoT hardware and sensor-based applications.

A cloud ecosystem augments the data lifecycle by integrating diverse sources. It simplifies data acquisition, ingestion, analyses, and presentation. A centralized cloud server provides better control over documentation and reporting. Significantly, the cloud addresses the issue of latency in communication networks, which is the unique value proposition of 5G. Operational data and business metrics can be accessed from anywhere in real time. Moreover, cloud data solutions can be designed for direct transmission of data from the ecosystem to specific users / teams for timely decisions and / or prompt action.

Returns on 5G network technology investment can be maximized through training in support systems. Training in virtual reality simulations, emergency management, and remote access control systems empowers mine operators with the knowledge to apply digital tools for ensuring industrial safety and protecting business interests. Notably, cloud-hosted e-learning modules encourage the adoption of safety measures, energy saving devices and productivity tools.

Standalone 5G networks are set to transform surface and subterranean mining operations significantly. Stable connectivity, precision positioning, and uninterrupted monitoring will boost enterprise efficiency, while establishing the foundation for a mine of the future.



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