



BROADBAND CONNECTED MINING

Opportunities Enabled by Multi-Orbit Satellite Systems

Mining operations directly underpin the economic well-being of local communities in countries such as Brazil, South Africa, Australia, Russia, Ukraine, Afghanistan, Guinea and many others. Due to highly dispersed and remote locations of mining operations around the world, past investments in telecommunications and network-connected Information and Operational Technology (IT/OT) systems for mines have been focused on separately connected analogue voice and narrowband data connections for SCADA, Programmable Logic Controllers (PLCs), and devices enabled by GEO or LEO satellites. Limits to connectivity between mining

sites, siloed IT and OT systems and processes, and disparate ageing excavation and transport equipment, are perpetuating miners' highly inefficient "pit-to-port" manual production path.

In an environment where commodity prices constantly fluctuate, price declines can quickly hurt profit margins, resulting in budget cuts, productivity slowdowns, and closures that further compound financial and socio-economic woes. Cost-cutting alone, without productivity and efficiency boosting technology in mind, can lead mining companies to:

- Reduce operations capacity and output
- Underutilise skilled mining personnel
- Become less competitive over the long-term.

Without investment in smarter mining machinery, tools and converged broadband-connected IT/OT systems, cost-cutting efforts may boost the bottom line short-term, but will put the mining company at a competitive disadvantage long-term.

TRANSFORMATIONAL ALTERNATIVES

Sustaining mining lifecycles and profits for years in a constantly changing market requires empowering mining companies with fully-connected, more intelligent automated solutions. A multi-orbit satellite system is the most cost-effective way to achieve the performance and availability necessary for these connectivity next-generation solutions. Forward-thinking mining companies, such as Guyana Goldfields, Newcrest Mining, Ivanhoe Mines and others, are using IP and Ethernet services delivered over SES Networks’ satellite technology to expand mine productivity, improve safety, and achieve positive business outcomes.

Transforming legacy mines into flexible, future-proof smart mines simplifies mining operations so on-site and remotely located personnel can focus on improving metrics and pit-to-port productivity and yield, not managing complex communication and IT/OT systems. Low-latency, fibre-equivalent connectivity with differentiated Quality of Service (QoS) capabilities ensures high performance, application-aware access to internet, cloud and private network content and business applications — and enhanced mobile 3G and 4G/LTE device performance — at mines anywhere. Mining operators can simply and quickly connect to cloud and edge applications, sensors, and remotely controlled mining vehicles, robots and equipment to gain true process and operations efficiency.

The transformation to broadband connected mining doesn’t require heavy infrastructure investment or major upgrades to IT/OT systems (see Fig. 1). By deploying and linking new Industrial Internet of Things (IIoT) capable sensors and programmable logic controllers (PLCs) embedded in trucks, conveyor belts, excavation tools and equipment, to cloud-based IIoT platforms, mining companies can remotely monitor, control and manage mining assets and all aspects of their operations across far-flung locations. In addition, broadband connected mining operations bring telemetry and “big data” intelligence benefits, giving operators and commodities traders a consistent flow of aggregated real-time data from which they can proactively derive insights to more quickly act in response to market changes.

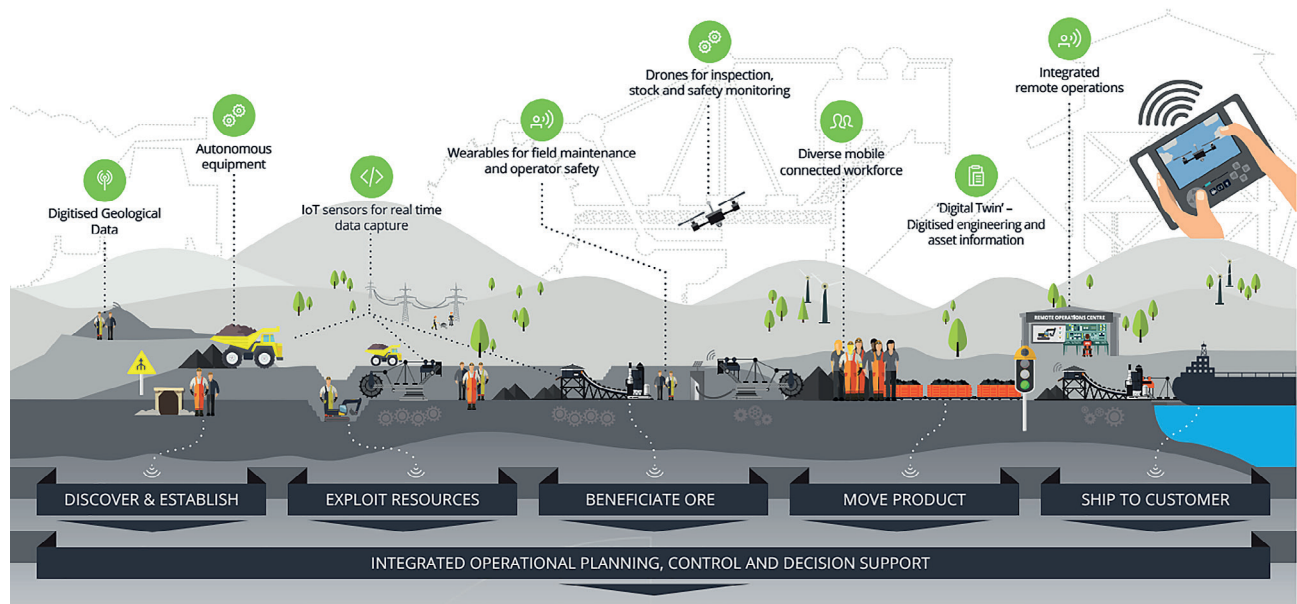


Figure 1
 “Mining starts to reinvent the future”, Deloitte, Feb. 2017

IMPROVE EFFICIENCY, SAFETY, AND UPTIME

Broadband connected mining equipment and systems improve safety, productivity and efficiency by offering operators capabilities such as: remote control of assets, teleoperation of vehicles and tools, real-time video inspection and training, predictive maintenance, and more. Various levels of automation require different network configurations and data throughput levels. Automation levels typically fall into these categories:

- Mining vehicles such as excavators, trucks and bulldozers can be remotely controlled via hand-held devices used on-site to operate unmanned equipment in dangerous blast zones, underground mines, or on unstable ground.
- Teleoperation of mining equipment takes safety to an even higher level as it uses video, sensor data and control software delivered over a broadband connection to give operators real-time control of vehicles and equipment from a more protected environment. Vehicle telemetry and GPS data are also delivered over the same connection.
- Assistive technology such as collision avoidance systems and spotting assistance is also available in a fully connected mine for times where operator attention is temporarily needed.
- Fully connected mines enable operators to facilitate and troubleshoot operations at multiple sites using autonomous controls for mining vehicles and their critical functions (e.g. ignition, steering, transmission, acceleration, braking, etc.). Production-specific functions (e.g. blade control, dump bed control, excavator bucket and boom, etc.) can also be controlled without the need for on-site operator intervention.

THE FULLY CONNECTED MINING OPERATION

In the future, mining operations will be fully broadband-connected and automated (see Fig. 2). SES Networks' Signature Mining Solution enables automated mining via our high-throughput hybrid MEO/GEO system that provides ubiquitous internet and private network connectivity at throughput rates up to more than 2Gbps (1Gbps uplink/1Gbps downlink). Low-latency MEO connects IoT sensors for real-time data capture, wearable technology to monitor miner well-being and safety, drones with real-time video feeds from inspections and monitoring, and operation of autonomous equipment, while GEO ensures business continuity.

GEO-MEO Satellite Architecture

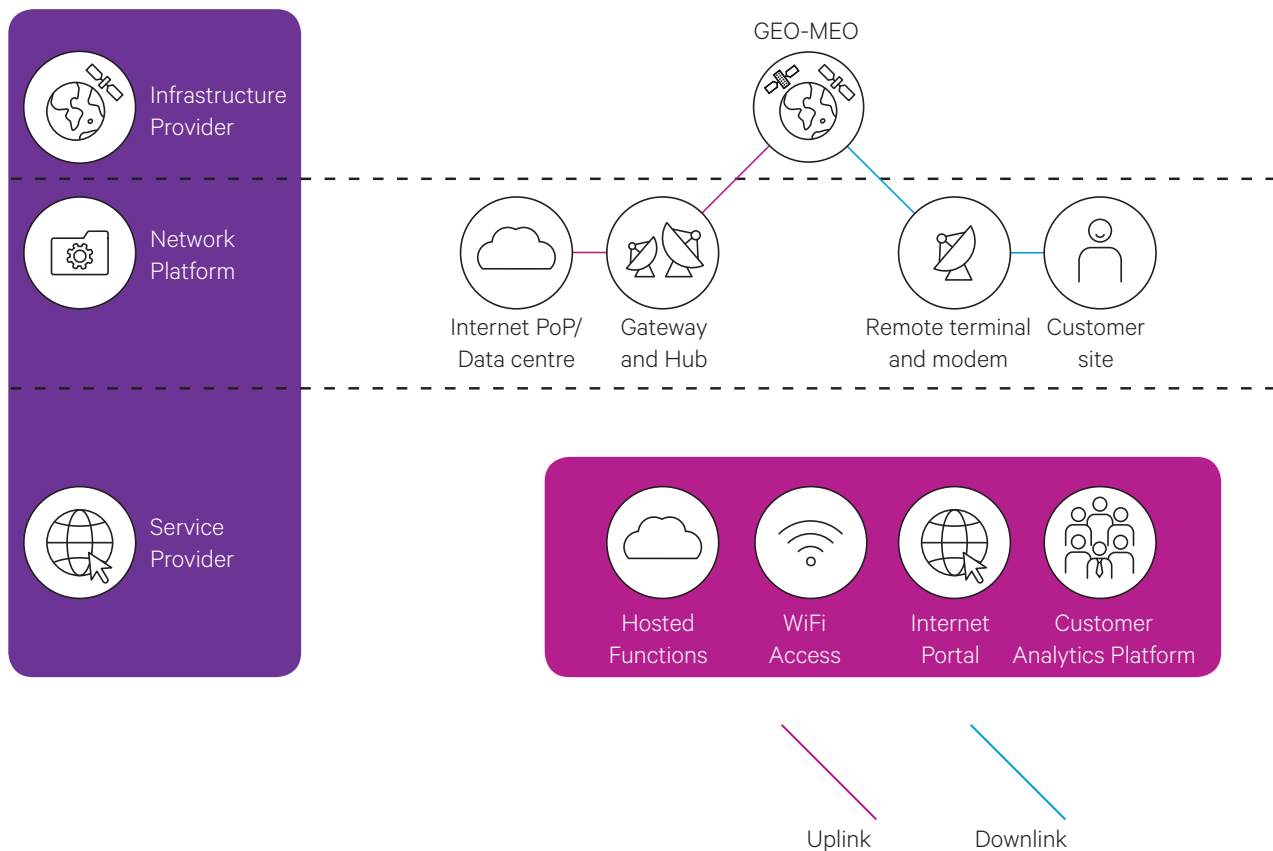


Figure 2
GEO-MEO Satellite Architecture

Automation and continuous optimisation of mining assets and operations are now possible due to:

- MEO satellite connectivity with round-trip latency of <150ms
- 3G and 4G/LTE mobile networks that support new low-cost sensors and mobile broadband-capable devices
- Embedded control systems in equipment, assets, and around mining sites
- Scalable, low-cost cloud computing and storage available anywhere
- Advanced algorithms and IIoT cloud analytics platforms

SUCCESSFUL TRANSFORMATIONS

Having implemented a smart mining solution enabled by our Signature Mining Solution, one SES Networks mining customer dramatically improved operating efficiencies, business-critical application performance, and field users' Quality of Experience (QoE) when using their mobile devices. Improved ERP, logistics fleet tracking, Sharefile and Office 365 performance in turn is driving staff and company productivity. In addition, the lower latency and increased bandwidth has allowed the mining company to implement new applications such as Voice over IP (VoIP), Remote Infrastructure Monitoring (RIM), and Business Continuity and Disaster Recovery (BCDR). Due to the very remote, hard to reach location of the mines, fibre connectivity was unavailable and a microwave solution required too much up front CAPEX and time to implement.

Other companies have transformed mining operations by:

- Converging multiple IT/OT and cloud-based applications on a unified platform
- Using IP-based collaboration platforms for voice, video and radio communications
- Remotely monitoring and controlling mining equipment and critical operations tasks
- Implementing autonomous trucks and automated processes for delivery of materials
- Automatically performing preventative maintenance tasks triggered from alerts
- Video monitoring of harvesting and the entire pit-to-port production process

SUMMARY

Next-generation multi-orbit satellite systems are transforming yesterday's mines into fully connected intelligent mining ecosystems, bringing improved productivity, safer working conditions, better business outcomes, and more economic and educational opportunities for mining communities — even in the most remote places on the planet. Broadband connected intelligent mines require a secure, scalable global network architecture built for mobility that supports sensors, machine-to-machine protocols and access to real-time voice, video, and data. SES Networks' Signature Mining Solution provides mining companies with low latency, high-performance broadband connectivity powered by next-generation multi-orbit satellite systems, bringing measurable sustained positive returns using an OPEX business model.



BROADBAND CONNECTED MINING

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