TELECOM NETWORKS FOR MINING: MAKING SMART MINING A REALITY

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Abstract

The mining industry is undergoing a digital transformation, driven by the convergence of advanced telecom networks and Industry 4.0 technologies. Smart mining leverages telecom infrastructure to enable automation, real-time monitoring, enhanced safety, and improved operational efficiency.

In the recent times, here at Infosys Consulting, we are witnessing an increasing trend in the mining industry's adoption of emerging technologies. Many industry and analyst estimates have been making bold predictions as early circa 2019 – that by 2030, a staggering 77% of mining sector roles will be enhanced and/or redesigned due to technological advancements.

These initiatives are not just about keeping up with trends; they aim to revolutionize the industry by enhancing miners' safety, ensuring strict regulatory compliance, boosting operational efficiency, and maximizing productivity and revenue.

Emerging technologies such as Cloud Computing, Data Analytics, AI/ML, and Reliable Networks are transforming the vision of Smart Mining into a reality. These advancements are now a top priority in the annual reports of mining enterprises, showcasing quantifiable benefits. For instance, BHP's 2024 Annual Report highlighted that the use of AI contributed to US$18.9 million increase in revenue for FY 2024 by enabling drill and blast teams to select more optimal blasting pattern designs.

However, achieving this at scale hinges on a robust Network strategy and roadmap that delivers low latency, far reaching and reliable connectivity.

The scope of a Network Strategy in mining extends far beyond upgrading end-of-life assets and improving cybersecurity. It encompasses the integration of cutting-edge telco technologies (e.g., private 5G, satellite etc) with IT innovations (e.g., edge computing etc.) and as well adopting new operating models.

Join us as we dive into the future of mining with two exciting explorations:

1. How will next-gen telco network technology transform mining operations?

2. How can you design a network strategy to navigate the smart mining journey?
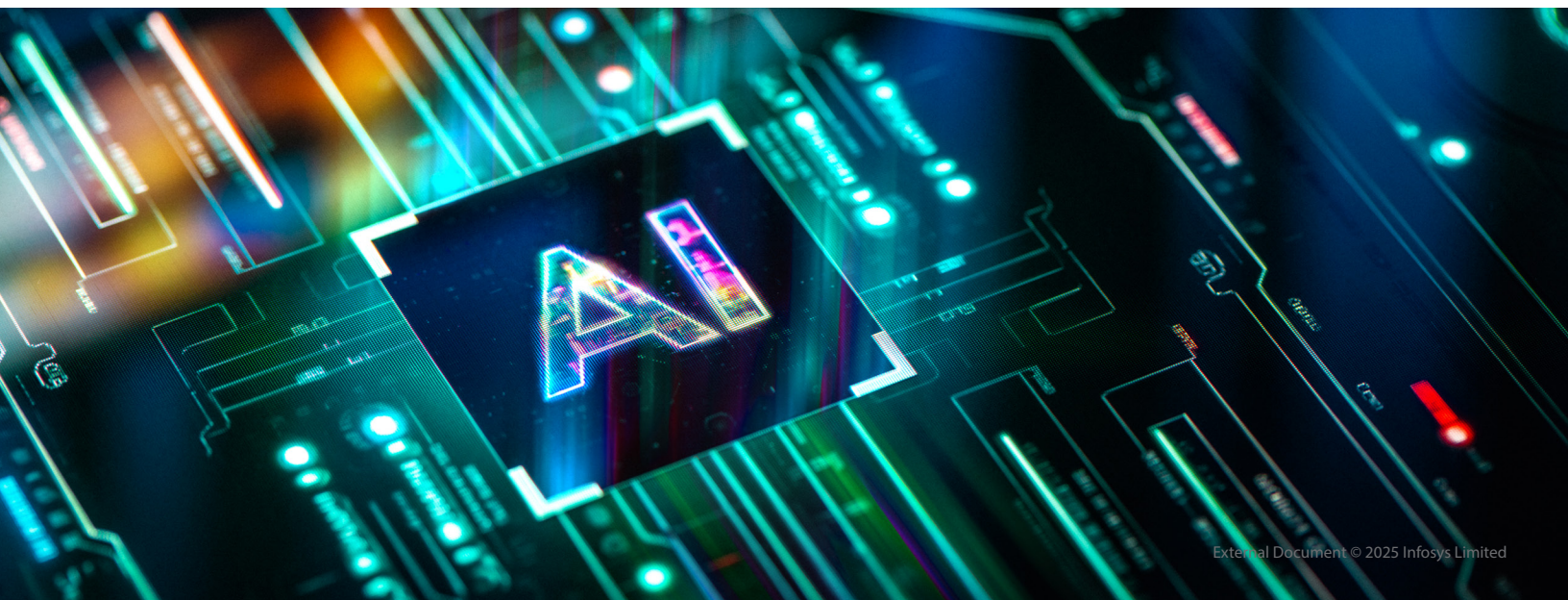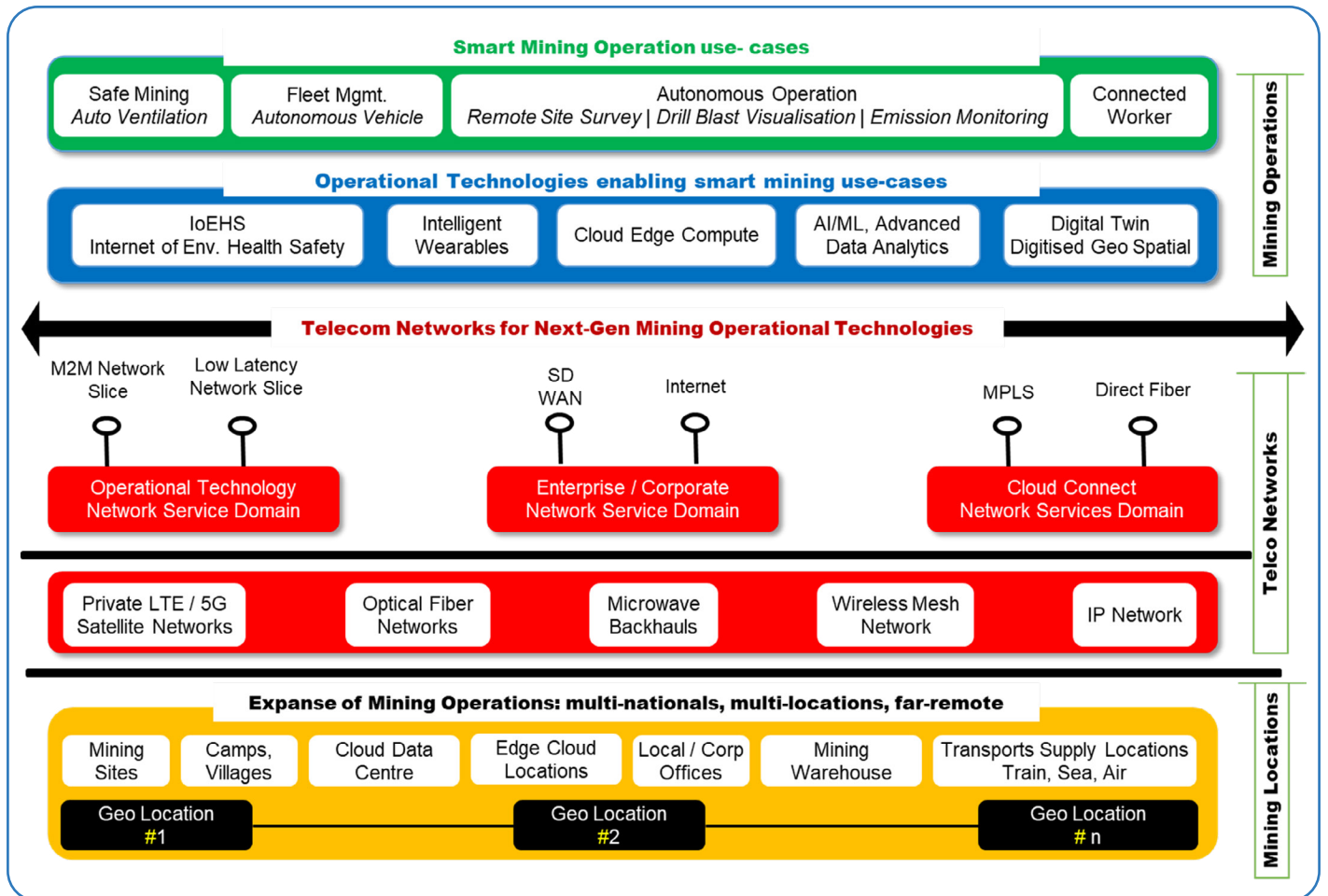
Telco Network enabling Smart Mining

Smart mining envisions a future where mining organizations offer safe workplaces with features like auto ventilation, adhere to most stringent regulatory compliance (e.g., ESG - Environment, Social and Governance), and autonomous operations (e.g., unmanned vehicles, auto fleet management, digital twins, and supply chain automation).

This vision includes remote site monitoring (from survey exploration to drilling blasts) and connected workers (e.g.,

using intelligent wearables). The telecommunication network connectivity is critical to realising this smart mining vision.
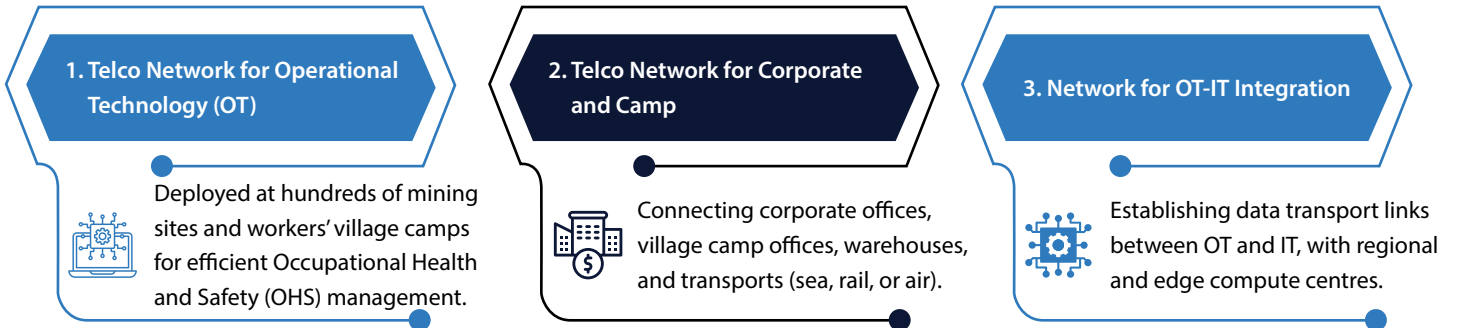
Traditionally, implementing such telco network connectivity has been prohibitively expensive and complex. However, next-generation telecommunication technologies have matured enough to make smart mining design simpler and more economical.

Telco Network for Smart Mining - Challenges

The biggest challenge is expanse of mining operations. The Mining operations are often massive and located in remote and rural areas, requiring robust network connectivity solutions.

In General, mining organisations need three types of telco Networks:

1. Telco Network for Operational Technology (OT)

Deployed at hundreds of mining sites and workers' village camps for efficient Occupational Health and Safety (OHS) management.

2. Telco Network for Corporate and Camp

Connecting corporate offices, village camp offices, warehouses, and transports (sea, rail, or air).

3. Network for OT-IT Integration

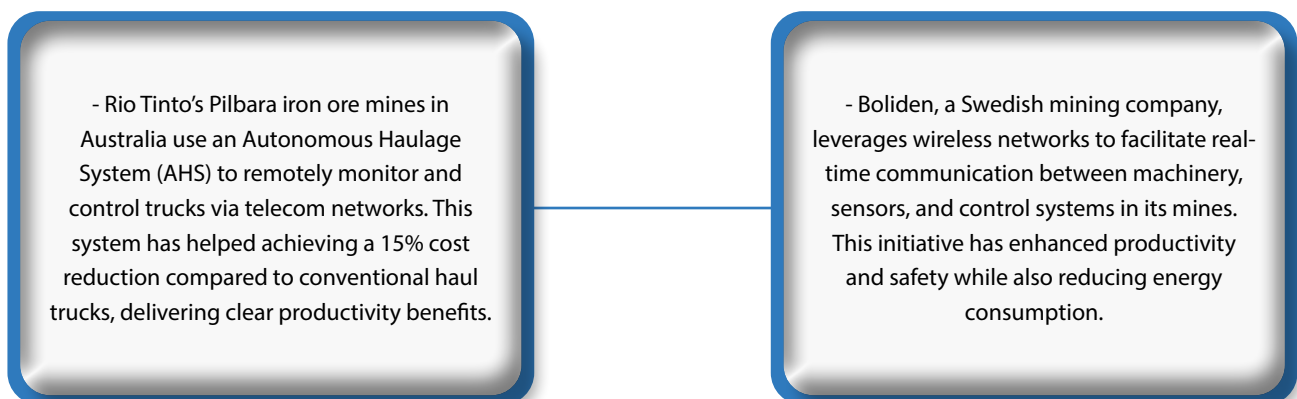Establishing data transport links between OT and IT, with regional and edge compute centres.

Telco Network for Smart Mining - Network Service Specifications

Furthermore, each mining connectivity needs different network services specifications. For example:

Low-Latency Networks:

Critical for autonomous operations to function seamlessly.

Reliable Networks:

Always-on connectivity is paramount for worker safety.

High Bandwidth Networks:

Essential to handle industrial IoT sensors and video data transport without congestion.

Telco Network for Smart Mining – Emerging use-cases

`Numerous case studies have emerged demonstrating how telecommunications networks revolutionize mining operations, enhancing productivity without compromising safety and regulatory compliance. For example:

- Rio Tinto's Pilbara iron ore mines in Australia use an Autonomous Haulage System (AHS) to remotely monitor and control trucks via telecom networks. This system has helped achieving a 15% cost reduction compared to conventional haul trucks, delivering clear productivity benefits.

- Boliden, a Swedish mining company, leverages wireless networks to facilitate real-time communication between machinery, sensors, and control systems in its mines. This initiative has enhanced productivity and safety while also reducing energy consumption.

Telco Network for Smart Mining - Design Consideration

The telecom network designs for smart mining face the unique challenge of supporting remote connectivity, always-on availability, and mission-critical operations.

This is achieved using a mix of telecommunications technologies like private LTE/5G, satellite, optical fibre, microwave backhaul, wireless mesh, and IP networks to fulfill diversified mining connectivity demands.

Telco Network for Smart Mining - Security Considerations

While mining networks provide a much-needed foundation for digital transformation, they also pose security threats.

Thus, a meticulously planned multi-layer security design, from core to the network's very edge, is essential to protect robotic machinery, sensors, cloud services, and business IP against cyber threats.

The advanced connectivity solutions and robust network designs are paving the way for a smarter, safer, and more efficient mining industry.
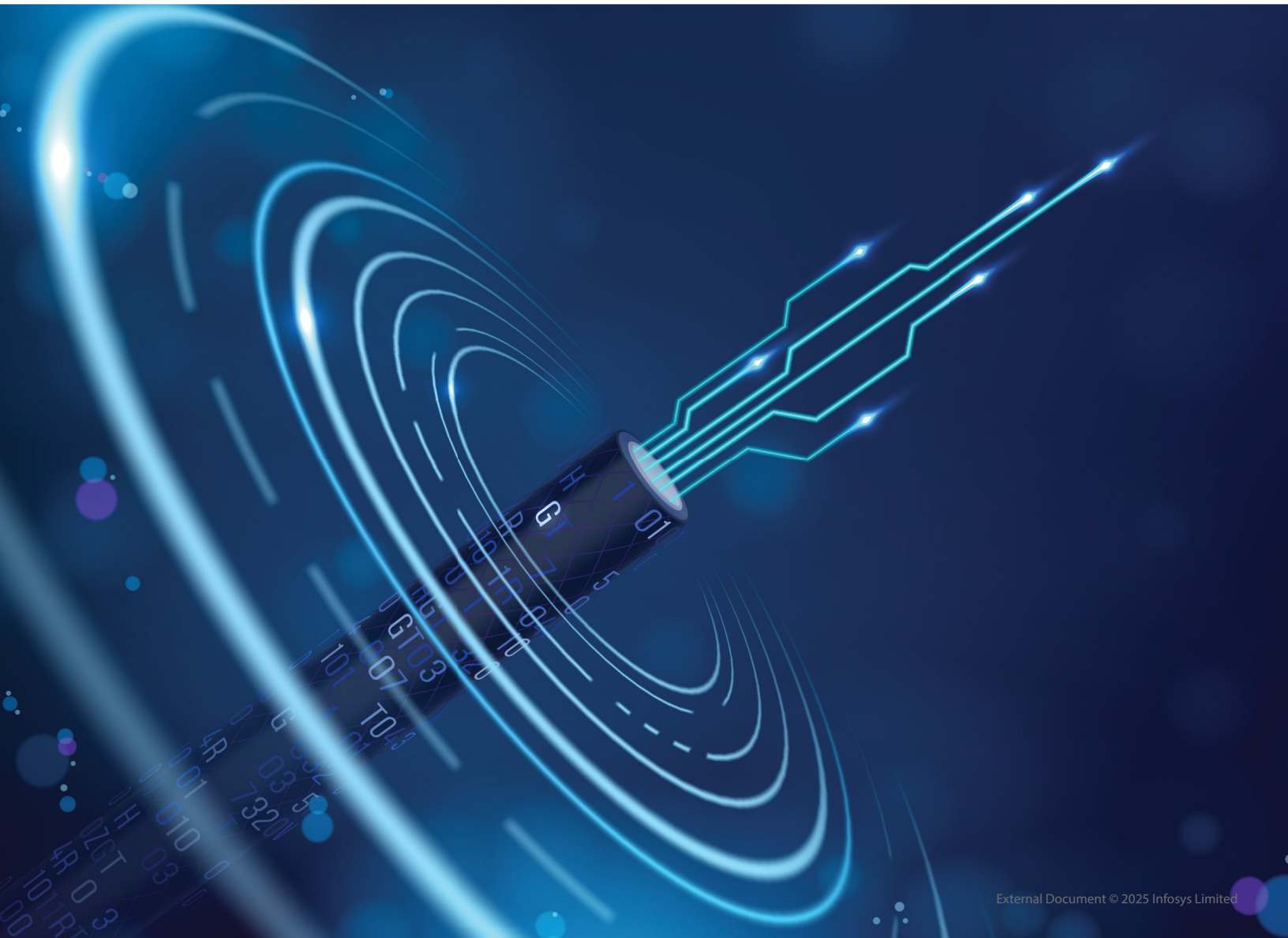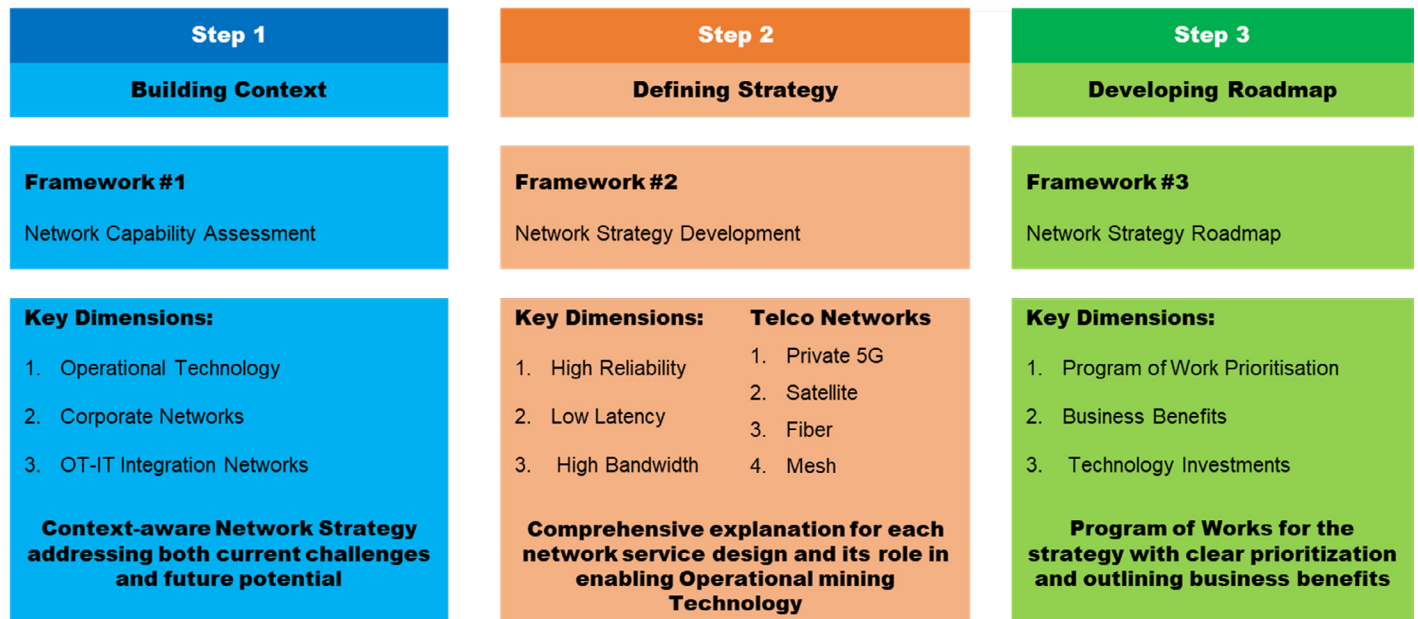
Telco Network Strategy Development for Smart Mining

The mining industry is experiencing a technological revolution, with advancements in operational technology and innovative operating models. We're seeing a surge in the deployment of massive Industrial IoT, drones, and intelligent wearables (AR/VR/XR). This widespread adoption is driving mining tech leaders to craft long-term network transformation strategies and implementation roadmaps. These strategies are essential for leveraging next-gen communication and information technologies, including private 5G, satellite, mesh networks, IoEHS (Internet of Environment, Health & Safety), and edge computing.

At Infosys Consulting Australia, we're at the forefront of this transformation. We're helping our mining clients design network strategies that not only address immediate end-of-life concerns but also build a compelling business case for long-term network adoption, making smart mining a reality.

Our approach is collaborative and forward-thinking. We partner with telco and mining industry tech leaders to develop a three steps strategy for network transformation in mining. This ensures that our clients are not just keeping up with the times but leading the charge into the future of mining.

Step 1	Step 2	Step 3
Building Context	**Defining Strategy**	**Developing Roadmap**
Framework #1 Network Capability Assessment	**Framework #2** Network Strategy Development	**Framework #3** Network Strategy Roadmap
Key Dimensions: 1. Operational Technology 2. Corporate Networks 3. OT-IT Integration Networks **Context-aware Network Strategy addressing both current challenges and future potential**	**Key Dimensions:** **Telco Networks** 1. High Reliability 1. Private 5G 2. Low Latency 2. Satellite 3. High Bandwidth 3. Fiber 4. Mesh **Comprehensive explanation for each network service design and its role in enabling Operational mining Technology**	**Key Dimensions:** 1. Program of Work Prioritisation 2. Business Benefits 3. Technology Investments **Program of Works for the strategy with clear prioritization and outlining business benefits**

1. Building Context:

The mining operational context is essential foundation for a pragmatic network transformation strategy.

The discovery typically entails taking a long view on emerging business opportunities, site limitations and regulatory posture.

- **Inventory use cases** (e.g., IoT, autonomous vehicles, remote operation, worker safety), including potential for future expansion, new smart mining initiatives and the need to support additional devices and applications.

- **Identify data transmission needs** for the use cases such as latency, bandwidth, reliability, and coverage.

- **Capture site-specific conditions,** including geography (open-pit vs. underground), remoteness, and harsh environments that may impact network performance.

At Infosys Consulting, we have developed a robust framework for "network capability assessment" for smart mining. This framework is designed to collect and evaluate current, in-flight, and future operational technology capabilities, along with their network connectivity infrastructure and service demands.

This is the crucial first step towards creating a context-aware, future ready Network Strategy for mining organizations, addressing challenges of today and creating a potential for tomorrow.

2. Defining Strategy:

A sound strategy relies on context awareness, through options analysis with short measurable targets.

Smart mining and industry 4.0 rely heavily on a digital backbone of network connectivity. A plethora of emerging and established network technology options exist today. These include private 5G, Wi-Fi, fiber optics, LoRaWAN, satellite, and mesh networks, each brining their own strengths and limitations.

The deployment considerations, existing network footprint, timeframes, coupled with financial and operational feasibility play a crucial role in defining the network strategy and the north star view.

The Infosys Consulting framework for "network strategy development" for smart mining is designed to identify the network service demands for smart mining use cases enabled by advanced mining operational technologies.

This framework offers a compendium of patterns, with a comprehensive explanation for each telco network service design and its role in meeting the networking requirements of operational technology. By integrating detailed insights and strategic perspectives, it ensures that mining operations are not just technologically advanced but also optimally connected.

3. Developing Roadmap

Realising the strategy involves planning a series of transient states. A well-contextualized and thoroughly explained mining network strategy requires detailed decomposition, prioritization, and accurate estimation.

Infosys Consulting framework for "network strategy roadmap" for smart mining simplifies this by creating a comprehensive program of works (PoWs) for the entire strategy. This framework provides clear prioritization over three years, outlining both the business benefits in commercial terms and the estimated technology investments required.

The program of works enables a confident kick-off of the implementation journey, setting a clear and actionable path forward.

If you're planning or already on the journey towards smart mining enablement and haven't yet conducted detailed network connectivity assessments, the Infosys Consulting "telco network for smart mining" framework can guide you confidently through your transformation journey.

About the Authors

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He collaborates closely with telecommunications clients across the APAC region, specialises in developing practical technology strategies and architectures to enable NaaS, Closed Loop and Intent based Autonomous Networks. Sanjay is passionate about applying emerging IT and Network technologies to solve current and future business challenges across diverse industries including mining.

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Himanshu is a seasoned digital transformation consultant with more than two decades of experience across various industries and regions. Currently, he is concentrating on the Telecom and Resources sectors, where he identifies significant opportunities for synergy through telecom virtualization and Mining 4.0.

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