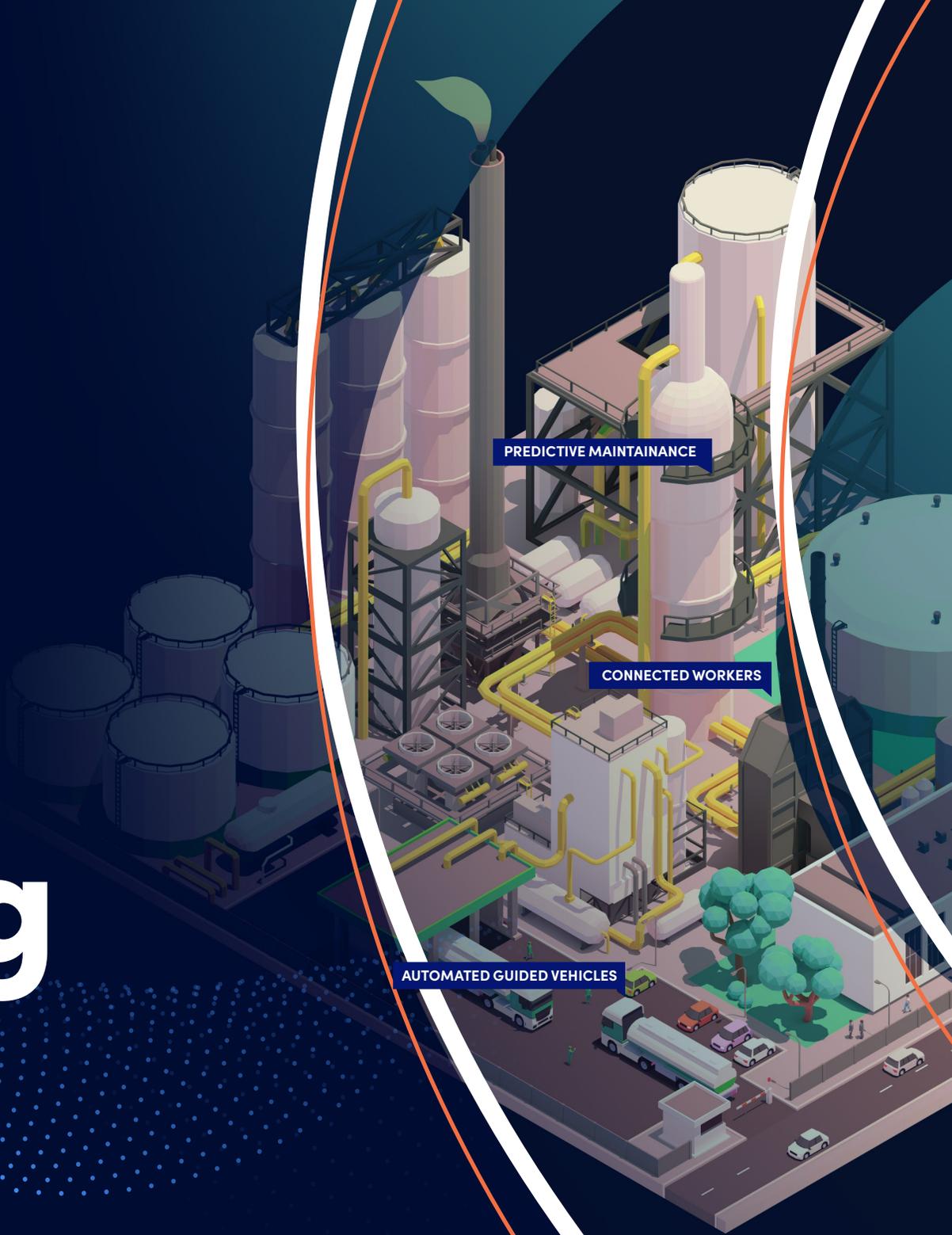


celona

SOLUTION BRIEF

Energy & Mining





Private wireless networks: Powering smart energy & mining solutions

The energy and mining sectors are crucial segments of the global economy, encompassing oil and gas rigs, refineries, petrochemical plants, renewable energy farms, and mining sites. These companies have similar challenges and goals. They seek ways to enhance operational efficiency by reducing costs, increasing output, and minimizing wastage while reacting to pricing changes in the market. Digital transformation affects include improving labor productivity and safety while reducing fatigue and turnover, minimizing environmental impact through cleaner operations, regulatory compliance, and increased transparency via data analysis.

These goals are achievable with modern technologies like connected workers, connected assets, and machines and workflow automation, computer vision and robotics. Increasingly, private wireless networks are being called on to provide the level of reliable, interference-free wireless connectivity needed to power these smart energy and mining solutions of tomorrow.

Typical connectivity requirements

The location of energy and mining sites tends to be remote, with complex terrain occupying large outdoor areas and sometimes in very harsh environments. Public cellular and broadband coverage is typically poor, with operators relying on legacy disparate networks for voice, data, security, and equipment monitoring.

- Coverage is required everywhere - indoors and out - with minimal interference from other signals
- The network must be reliable and deliver guaranteed QoS with data prioritized based on devices/applications on the network
- All equipment must remain connected as they move around properties and vast outdoor areas
- Critical applications such as collision avoidance for autonomous vehicles require low-latency networks
- Given the large footprint, the network must have low installation and TCO owning and scaling the network
- Connectivity needs to meet stringent security requirements

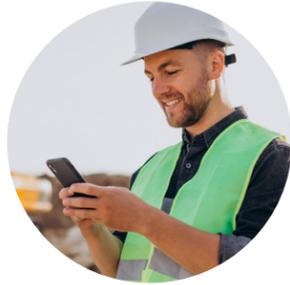


Energy & Mining use cases



Remote equipment monitoring and predictive maintenance

To improve operational efficiency and reduce downtime, on-site equipment requires near real-time connectivity to detect issues and minimize damage. For example, monitoring sites with HD video cameras enable experts to monitor and resolve issues without traveling to a remote site. Similarly, modeling equipment using a digital twin can help the site increase productivity without disrupting operations. But to enable these types of remote monitoring and data collection, wireless connectivity must be reliable and widely available across a large outdoor area. And for near-real time operation, the network must have low latency wireless connectivity (< 20 msec) to allow for reliable machinery command and control.



Connected worker

On-site workers need to be mobile and able to communicate with engineers who may be either off-site or on-site. They are often equipped with tablets, scanners, smart helmets, and other devices for voice communication, training, tracking, and increasing worker safety and engagement – all requiring ubiquitous, reliable wireless connectivity throughout the site.



Autonomous Mobile robots (AMR), Autonomous guided vehicles (AGV)

Autonomous vehicles are used at these locations to transport people and materials, while autonomous robots are used to manage staff shortages, and repetitive tasks and as a proxy at hazardous locations where it is unsafe to send personnel. These robots and AGVs often travel at speeds > 25 mph and require continuous connectivity as they traverse long distances. If connectivity is unavailable, the vehicle will stall or operate in highly limited modes, significantly limiting productivity.

Energy & Mining use cases (cont.)



Environmental data collection and compliance

Reducing environmental impact also requires the collection of large amounts of data to ensure compliance and transparency. For example, to avoid an environmental catastrophe and ensure compliance, IoT sensors can be used to identify oil or gas leaks early on. Likewise, data gathering by on-site staff can be automated or simplified with good wireless connectivity.



High-definition video cameras/analytics

HD Video cameras and video analytics are used for surveillance, video based monitoring of equipment, and employee safety. With reliable wireless technology, the cameras can be placed anywhere on site – indoors and outdoors – without the need for expensive wiring or cabling.



Need for satellite back-haul

Due to its remoteness, mining, and energy sites suffer from poor cellular and broadband coverage. Most of the use cases discussed won't work if no communication link is available to the internet. If other coverage options are unavailable or unreliable, satellite backhaul with providers like Starlink could be an option. Refer to **page 10** for more information.



When Wi-Fi is no longer up to the task

Wi-Fi has been the conventional choice for wireless connectivity in energy and mining sites. While Wi-Fi is a great fit for home or office environments, it doesn't perform as well in vast outdoor/indoor areas like a energy and mining site. Their large footprints and need for pervasive connectivity pose specific challenges for Wi-Fi:



Spotty wireless coverage

Unreliable connectivity causes delays in gathering and transmitting data, often resulting in a loss of productivity. Wireless signal strength is often particularly patchy around temporary storage across sites.



Unreliable Quality of Service (QoS)

Wi-Fi is unable to guarantee throughput and latency levels for mission-critical business applications.



Mobility issues

The constant movement of personnel and equipment across a large area requires endpoints to move from one access point to another. As devices on the Wi-Fi network scan and connect to the nearest access point, connections often drop in motion. As a result, some applications constantly disconnect in this environment leading to a poor user experience and significant drops in productivity.



Total cost of operations (TCO)

To cover the footprint of a energy and mining site, Wi-Fi requires a large number of access points. Significant engineering resources are needed to undertake complex mesh deployments and install new cabling to connect the access points. Overall this leads to an extremely high total cost of ownership.

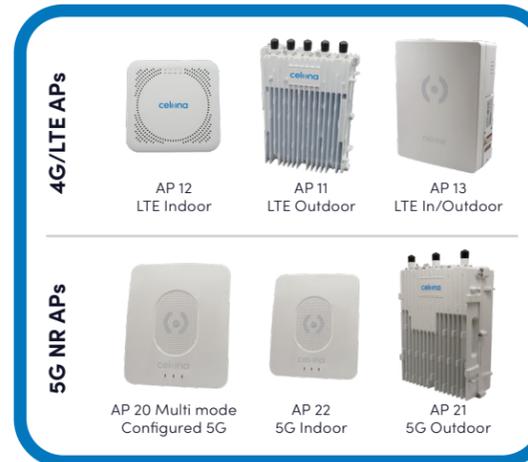


Future applications

Applications such as autonomous guided vehicles (AGV), high-def video surveillance, and automated gate check-in/exit of vehicles all require a far more reliable and consistent wireless link than Wi-Fi can deliver.

Celona private wireless to the rescue

Private wireless offers a far better solution for dispersed industrial environments.



Celona Access Points

Comprehensive 4G, 5G portfolio



Celona Edge

Converged 4G & 5G core



Celona Orchestrator

Converged 4G & 5G ops

Widely considered the most comprehensive private wireless solution for today's enterprise, Celona private wireless promises industrial strength wireless connectivity, performance, and mobility.

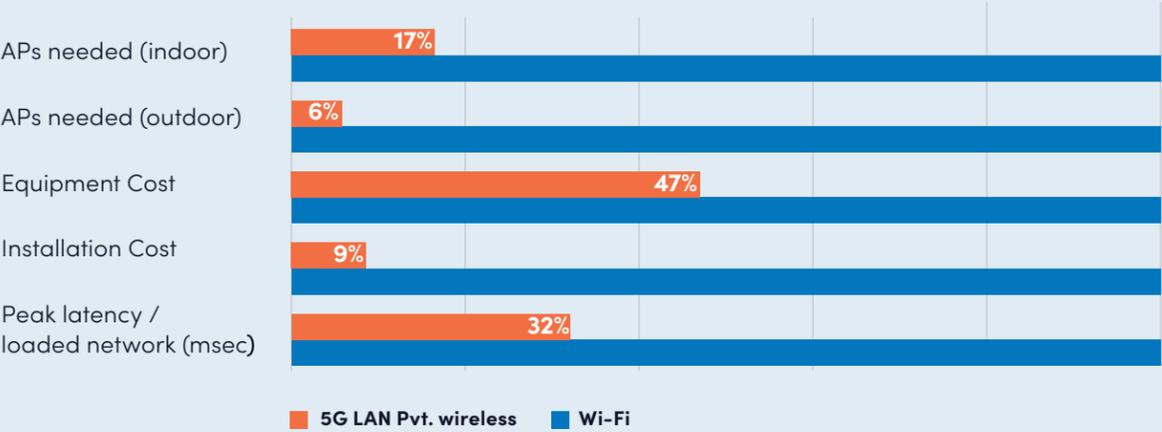
The turnkey solution includes LTE/5G access points, a converged LTE/5G network edge hardware/software, radio resource management software, and cloud-based orchestration tools.

Connectivity challenges & the unique advantages of private wireless

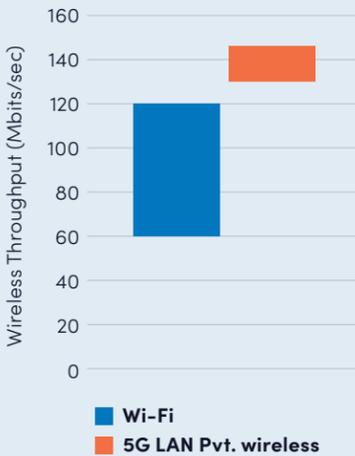
Issue	Public Cellular Best for roaming outside the company's facilities	Wi-Fi Best for home & office	5G LAN Private Wireless Best for indoor/outdoor uncarpeted enterprise
Spotty coverage Spotty wireless coverage indoor and especially outdoor causes delays in gathering and transmitting data, often resulting in loss of productivity	❌ Cellular coverage depends on the location of macro towers, construction materials, landscape and other external factors	❌ Poor Network Coverage especially outdoors Lower transmission power Susceptibility to spectrum noise – co-channel interference	✅ More pervasive wireless due to higher transmit power, lower noise floor and managed dedicated spectrum with low wireless interference
Unreliable QoS Business critical applications require definitive latency and throughput	❌ Public Cellular is best effort and cannot guarantee QoS without expensive on-site installations	❌ No guarantee on throughput and latency as Wi-Fi does not support deterministic QoS with strict priority Contention-based (CSMA-CA), requiring devices to “fight” for access, making prioritizing challenging	✅ Guaranteed SLA for critical applications. 5G LAN features Microslicing™ technology that enables deterministic QoS with strict priority. Guaranteed bit rate and guaranteed latency values can be configured for each device and application.
Mobility Issues Autonomous vehicles, robotics traverse large areas at speeds > 25 mph	⚠️ Mobility outdoors is ok, but indoors is a challenge due to poor signal strength and depends on building materials used	❌ Not designed for seamless mobility – handover decision made by devices, which have to disconnect and reconnect to APs based on proximity	✅ Private wireless is specifically designed for seamless mobility within the company's indoor/outdoor facilities. The network infrastructure controls handover decisions that are precisely timed.
Inadequate security/Control Enterprise IT team need control of QoS and security policies	❌ Carriers set the routing, security and QoS policies. Enterprises have very little control	⚠️ Many Wi-Fi networks utilize pre-shared keys and open SSIDs to allow for IoT and/or guest device connectivity, opening doors to additional risk factors for critical enterprise infrastructure.	✅ Complete control of routing, security and QoS policies. End-End security for data in-flight and at rest secured using SIM/eSIM technology
Constantly increasing costs Total cost of providing wireless networks over a large area is cost prohibitive	❌ Public cellular charge based on consumption and subject to overages and complex contracts	⚠️ More APs are required due to lower coverage range of Wi-Fi. Outdoor installs require expensive installation, trenching and cabling.	✅ Fewer APs due to higher coverage range of Private Wireless. Outdoor APs can be roof mounted to provide very large outdoor coverage, avoiding cost of trenching, cabling etc.

Performance of private wireless vs. Wi-Fi

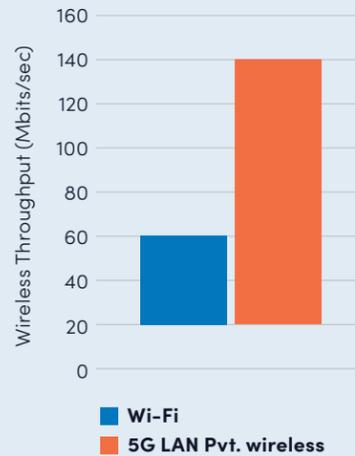
Comparing Wi-Fi and Pvt. Cellular
 (Based on data from an actual Distribution Center)



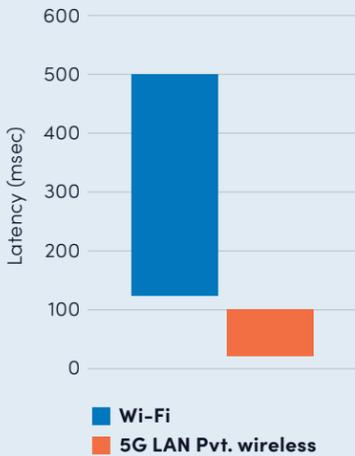
Throughput in a Loaded network



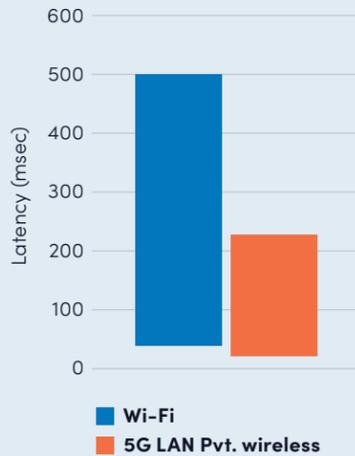
Throughput in motion



Latency in a Loaded network



Latency in motion



Starlink and Celona's 5GLAN: Reliable connectivity for remote sites

Due to its remoteness, energy and mining sites often suffer from poor cellular and broadband coverage. Yet critically, most connected use cases will not work without a connection to the internet. If other coverage options are unavailable or unreliable, satellite backhaul with Starlink could be viable.

Starlink utilizes earth spanning low orbit satellites to provide lower latency communications compared to traditional satellite-based wide area networking (WAN). As Starlink increases the number of its satellites in orbit, the capacity and coverage will continue to improve.

By pairing Starlink's highly flexible satellite-based backhaul capability with Celona's 5GLAN private wireless, companies can deploy and operate an on-site private 4G/5G wireless network for their business-critical applications – even in the most remote of locations, where getting reliable backhaul in a timely manner is challenging. See this [Case study](#) for further details.

How Celona's 5GLAN and Starlink work together

- All on-site 4G/5G devices, including ruggedized tablets, smartphones, scanners, and modems on-site, connect to Celona Access Points (APs) on interference-free dedicated private wireless spectrums (CBRS: b48, n48, n77, n78, etc.).
- The Celona APs then connect to Starlink via the Local area network and Celona Edge Appliance (also on -site).
- Celona Edge provides the converged 4G/5G data plane that directly integrates with the local enterprise LAN.
- Starlink then enables Celona's private wireless network and local LAN to connect to the internet (the company's enterprise network) via satellite backhauls.
- Cloud-based private wireless network management platform, Celona orchestrator also uses internet connectivity via Starlink.

Through this hybrid private wireless and Starlink back-haul, enterprises can deploy pervasive, high reliability, low latency local wireless network on-site for business-critical applications with the additional option of connecting to the internet via satellite.

For more implementation-level details, please see [this article](#).



Why use Celona 5G LAN for energy & mining sites?

The industry's only turnkey private wireless expressly engineered for the enterprise

Celona 5G LAN delivers an end-to-end solution from the radio, core, and spectrum management to network and subscriber management systems. It's built from the ground up to create the best possible Day 0, Day 1, and Day N experience for customers at a lower TCO.

5GLAN ROUTING FEATURE BRIEF

Industrial strength private wireless designed for the most critical business apps

Business critical apps need deterministic performance from wireless, but the exact requirements vary from app to app. Celona 5G LAN features MicroSlicing technology for deterministic performance for all your mission critical applications. C1D2, IP65 rated APs available for hazardous and challenging environments..

MICROSLICING FEATURE BRIEF

Tight integrations to secure all wireless communications

A business-critical wireless network requires enterprise grade security to protect against cybersecurity threats. The Celona 5G LAN solution extends the inherently strong security architecture of cellular networks, such as support for eSIM and IMEI lock, with a tight integration between existing enterprise security systems to safeguard the network from edge-to-cloud.

5GLAN SECURITY WHITE PAPER

Enterprise friendly management and operations

Get unmatched simplicity and use-of use with Celona's cloud-based management system for deploying, configuring, and monitoring your private 5G network.

ORCHESTRATOR BRIEF

Global spectrum model support

A wide range of spectrum bands for LTE and 5G ensure Celona is an ideal fit for global facilities looking for a common networking infrastructure.

AP PRODUCT BRIEF

Device certification program eliminates guess work on compatibility

Many popular devices used on manufacturing floors are certified to work with Celona private wireless:

Zebra TC26, TC58, TC78
Zebra ET45, ET85
Zebra L10 Series tablet
Honeywell CT47
Getac: ZX10, F110G6

Digi: EX50, iX10
Sierra Wireless RV55
Cradlepoint R500
MultiTech MultiConnect
rCell 600

SEE FULL LIST OF CERTIFIED DEVICES

Real-life case study: Celona in action

“Our testing and analysis clearly revealed the value of private wireless in delivering lower latency jitter, improved wireless coverage, and seamless mobility at a lower total cost of ownership over traditional warehouse Wi-Fi implementations.”

Ken Wright

P.E. Director of Technology,
M.S. Benbrow and Associates

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