

eBook

Why Oil & Gas Refineries and Petrochemicals are choosing Private Wireless over Wi-Fi

Boost worker-efficiency and operational excellence

celona



Introduction

\$250,000 an hour and \$2,000,000 per event. That's an estimate of the cost of unplanned outages and emergency shutdowns in the oil, gas and petrochemical industries, according to a recent study¹. And that's before you consider the cost of any other consequences, such as environmental or infrastructure damage, personal injury or business reputation damage.

Avoiding them is a complex balance between preventative maintenance, inspections and periodic turnarounds costing millions of dollars. Finding ways to reduce the cost of this preventative work is always top-of-mind and has been a long-term focus. Initiatives include more efficient processes and better staff training, through to digital transformation projects that extend the use of IoT, AI and sensors to collect and analyze performance data.

All of these initiatives have enormous potential to increase the efficiency and effectiveness of planned maintenance, and prevent or reduce the impact of unplanned shutdowns, but their deployment has been hindered by one huge underlying factor. Reliable connectivity.

¹ <http://www.truevaluemetrics.org/DBpdfs/Initiatives/AIChE/AIChE-Total-Cost-Assessment-Methodology.pdf>

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Sector Highlight | Energy and Mining

“State of the Private Wireless Market | 2023 and Beyond”

September 2023

Oil and Mining operations take place in places with poor network coverage, and require heavy machinery to run 24 hours every day. The number of sensors on pumps, tanks, and pipes in a refinery can overwhelm simple radio systems. Automation has been embraced by these roughnecks, with most large outdoor projects covered by LTE technology already.² As more spectrum options and 5G devices become available, the market will move toward using LTE/5G for almost all of their wireless needs.

Known Customer Deployments:

Oil & Gas companies have started to embrace LTE technology, including Origem Energia in Brazil, the Posiva plant in Finland, and Tampnet in the Gulf of Mexico. At least 15 energy companies have now implemented Private LTE in drilling, extraction, refining, and downstream applications. Similar levels of investment are happening in the mining industry, with the number of autonomous haul trucks at mines grew to more than 1,000 during 2023, according to PwC.



² Data from 20+ interviews with market participants, in Mobile Experts Industrial Private Cellular 2023 report



“ We chose Celona's technology for its outstanding coverage, even in challenging areas. Extensive testing confirmed its remarkable success. We're using Celona's turnkey solution which is backed by their great engineering support. This approach aligns with our preference not to build from scratch, and Celona's expertise has proven invaluable. ”

- Principal Enterprise Technology Engineer, BP

Challenges faced by plants due to poor connectivity.

Wi-Fi has been the default choice for wireless connectivity, but at these inspection sites, the reality is that it's non-existent or spotty at best. A large outdoor area (4000-5000 acres) in a harsh, metal-heavy environment is not very conducive to Wi-Fi.

When a lack of connectivity hampers digital solutions, refineries typically rely on labor-intensive solutions such as pen and paper, or an offline computer to gather sensor data, images, etc., at the inspection site. Once back at the office, personnel upload the data into SAP or similar platforms for consultations with on-site/off-site experts for the next course of action. When you consider that inspections occur 24x7, multiple times a day, these methods don't allow for any optimization or increases in efficiency - resulting in constantly increasing operational costs. They also introduce more opportunities for poor data-gathering practices and human error to impact the effectiveness of the work.

If you can address the connectivity challenges, you immediately open up numerous possibilities for Industry 4.0 technologies to dramatically improve results and reduce costs.

Evaluating connectivity choices

- Wi-Fi
- Public Cellular
- Land Mobile Radio
- Private Wireless

Wi-Fi

Wi-Fi works well for office spaces and is a natural extension of the existing corporate network, but the cost of covering thousands of acres of outdoor space with Wi-Fi is just not viable. This is due both to the large number of access points that will be needed, and the cost of trenching and providing fiber/power and installation of so many nodes³. Even proprietary mesh Wi-Fi solutions deliver inconsistent performance and require constant maintenance due to dynamic and challenging RF conditions – Wi-Fi just isn't a good fit for these environments.

Figure 1.



Connectivity for a site the size of 0.54 sq- miles (or 260 football fields)

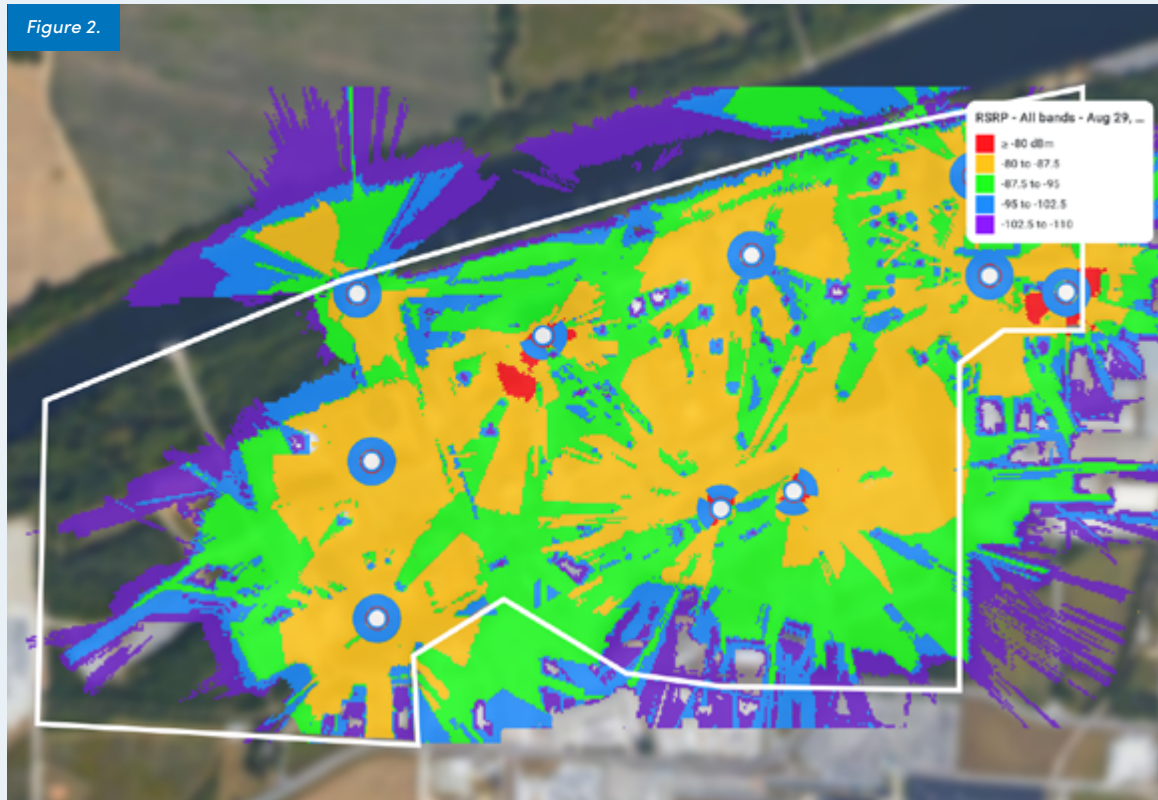
Figure 1.

Wi-Fi coverage (simulation)
Assumes 330 ft coverage per AP
Estimate 300 APs

Figure 2.

Celona 5G LAN Private cellular coverage (actual)
4G/5G network connected to existing enterprise network
10 APs, 1/30th the volume of Wi-Fi APs

Figure 2.



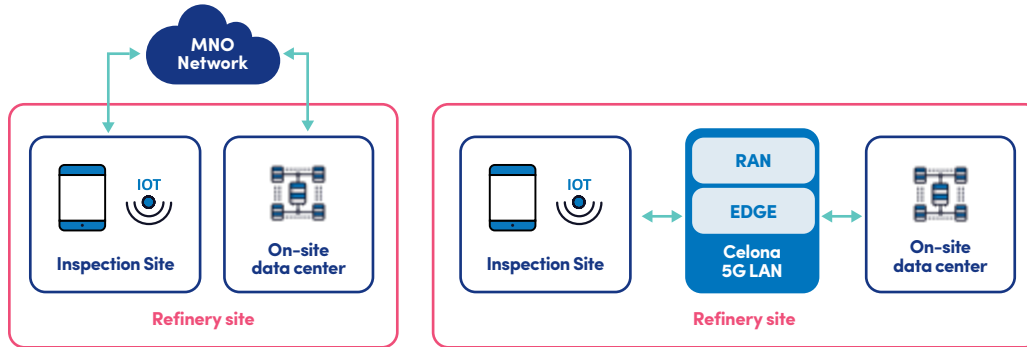
³ Comparing Wi-Fi and Celona Private Wireless within a real-world distribution center

Public Cellular

Public cellular connectivity from an operator has been considered, but it also presents many challenges. The IT team can neither guarantee the required data throughput and latency, nor the coverage required at every inspection point. A refinery also has little or no control over the carrier's radio network and data prioritization, and with local servers used to increase resiliency, "traffic hair-pinning" from the operator core to the local site becomes very inefficient. In addition, the cost of scaling operations would be expensive since every tablet/computer needs a data plan, and the refinery will need to deal with security concerns with its proprietary data going through the carrier's public network.

“ Oil companies have used WiMAX and other outdoor wireless technologies for some time, but the ecosystem for Private LTE gives them superior reliability, latency, and throughput performance. Reliability is cited as the #1 driver here, avoiding millions of dollars in unscheduled downtime every year.

Joe Madden, Mobile Experts
“State of the Private Wireless Market | 2023 and Beyond”
September 2023



With hairpinning

- \$\$ - paid data
- Leaves premises
- No QoS

Without hairpinning

- Unmetered
- Data never leaves site
- High QoS

Land Mobile Radio

Land Mobile Radio (LMR) has been used for mission-critical communications but has also been viewed as a possible connectivity solution for IoT, and as an alternative to public cellular. However, this involves deploying an entirely new overlay wireless network which increases the complexity of a solution, so it hasn't become widely used.

Private Wireless

Private wireless has shown potential, but previous solutions were effectively a re-packaging of public operator infrastructure, which introduced more complexities than they solved with respect to existing network integration, configuration and management, along with cost.

However, a new private wireless approach incorporating both 4G/LTE and 5G capabilities, explicitly redesigned for the enterprise, not operators, is changing the equation in terms of coverage, integration, capabilities and cost-effectiveness.

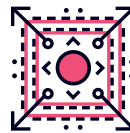
Some of the key advantages of enterprise private wireless include:



Pervasive 5G wireless coverage with 1/50th to 1/10th number of Wi-Fi Access Points in a refinery scenario



Complete control of network and data with no dependence on public cellular network



Seamless mobility with precisely timed roaming managed by network infrastructure.







Dedicated, clean spectrum with no unlicensed wireless interference.



Full end-to-end security for both data in-flight and at rest (secured using SIM and eSIM)

Comparing Connectivity Options

| 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 |  <p>Cellular coverage depends on the location of macro towers, construction materials, landscape and other external factors</p> |  <p>Poor Network Coverage especially outdoors Lower transmission power Susceptibility to spectrum noise - co-channel interference</p> |  <p>More pervasive wireless due to higher transmit power, lower noise floor and low wireless interference</p> |
| Unreliable QoS Mission critical applications require definitive latency and throughput |  <p>Public Cellular is best effort and cannot guarantee QoS without expensive on-site installations</p> |  <p>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</p> |  <p>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</p> |
| Mobility Issues Autonomous vehicles, robotics traverse large areas at speeds > 25 mph |  <p>Mobility outdoors is ok, but indoors is a challenge due to poor signal strength and depends on building materials used</p> |  <p>Not designed for seamless mobility - handover decisions made by devices which have to disconnect and reconnect to APs based on proximity</p> |  <p>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</p> |
| Inadequate security/Control Enterprise IT team need control of QoS and security policies |  <p>Carriers set the routing, security and QoS policies. Enterprises have very little control</p> |  <p>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</p> |  <p>Complete control of routing, security and QoS policies. End-End security for data in-flight and at rest secured using SIM/eSIM technology</p> |
| Constantly increasing costs Total cost of providing wireless networks over a large area is cost prohibitive |  <p>Public cellular charge based on consumption and subject to overages and complex contracts</p> |  <p>More APs are required due to lower coverage range of Wi-Fi. Outdoor installs require expensive installation, trenching and cabling</p> |  <p>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.</p> |

With reliable, pervasive connectivity, what becomes possible?

Quite simply, reducing turn-around times and minimizing shutdowns becomes a reality. One Celona customer estimated they've been able to reduce a 90-day refinery turn-around by 2 weeks (a 15% reduction) just by deploying private wireless and taking advantage of reliable connectivity through:

- **Connected worker solutions**

With a constantly connected device, inspectors can now gather and share data in real-time.

Personnel can also connect with off-site experts in real-time through Zoom/Teams calls at the location of the problem to resolve issues quickly.

It can enable AR/VR-based remote worker training.

Continuous worker safety/compliance monitoring.

- **IoT/Predictive maintenance/Digital twin/AI**

Reduces the need for manual inspection using IoT (Internet of Things) Sensors for predictive real-time monitoring and Digital Twin solutions for the refinery site and equipment.

Environmental sensors can be used for managing emissions and meeting regulatory requirements.

Gathering data wirelessly from anywhere in the plant can enable the use of Digital Twin technology for simulations and other AI initiatives for the company to develop competitive advantages in the industry.

“ Improved connectivity could add up to \$250 billion to upstream operations of the oil & gas industry between 2020 and 2030. ”

McKinsey & Company



However, it's not just shutdowns and turnaround that benefit from pervasive, reliable connectivity. With private 5G infrastructure, we're now seeing additional use cases including:

- The ability to deploy robots for inspection and repair in hazardous areas:
Private wireless radios can provide connectivity to autonomous robots operating at hazardous locations where manual inspection is not possible or dangerous.
Robots can also be deployed anywhere for site inspections and inventory management across the large property.
- Increased flexibility when deploying security cameras and machine vision:
Security cameras can now be set up anywhere with no need for expensive network cabling
Machine vision applications can monitor and alert conditions in the plant without manual intervention.
- Optimized supply chain management:
By enabling real-time tracking of materials and equipment, you can improve the efficiency of the supply chain, avoiding delays and ensuring timely availability of resources when required.

Customer Case Study Summary – Oil and Gas Refinery

Why did they pick private wireless?

- Wanted site wide connectivity across 0.54 sq-miles for inspection stations
- using Apple iPad tablets with Microsoft Teams video conferencing capability

What are the benefits

- Site wide reliable wireless connectivity.
- Ability to have real time data everywhere
- Ability to connect with subject matter experts remotely for problem resolution.

What are some of the criteria they used to evaluate private wireless vendors

- Ease of integration into their enterprise network
- Support for 4G devices today, and 5G in the future
- Securing data inside the premises without going into carrier's network.

What was the solution ?

- 10 Outdoor Celona AP11 (4G), with the option to add AP 21 (5G) to leverage the same mount and antenna setup.
- Celona Edge cluster for a highly redundant, scalable operation.

How was the network deployed and how long did it take.

- 2-3 months from a site survey to full installation and integration into the customer's enterprise network.



Comparing Wi-Fi and Celona Private Wireless within a real-world distribution center

[Read Case Study](#)



Why choose a Celona 5G LAN Private Wireless solution?

What is Celona 5G LAN

Celona 5G LAN is a turnkey private wireless solution uniquely engineered for the enterprise. It includes:

4G/LTE APs



5G NR APs



Celona Access Points

Indoor and outdoor ruggedized radios supporting global spectrum bands and self-organizing RF intelligence.

★ Preferred model for outdoor use cases at refineries

celona.io/access-points



Celona Edge OS

Fully scalable and resilient network OS that delivers converged 4G/5G core services, intelligent spectrum management and a full-function IP stack for seamless connectivity into enterprise LANs.

celona.io/edge-os



Celona Orchestrator

A network orchestration and management platform with complete visibility and control over your network, devices, and traffic flows - including zero-touch installation of Celona SIMs, APs, and Edge OS.

celona.io/orchestrator

Celona private wireless is explicitly designed for enterprise organizations in any industry, especially challenging environments like mining, oil and gas refineries and manufacturing. We haven't just re-packaged operator-based public cellular infrastructure for the enterprise, but re-thought the entire end-to-end experience of configuring and purchasing. You can integrate private wireless with existing IP-based enterprise infrastructure, including ongoing management and support.

The new principles of Enterprise wireless are:

- A focus on the user/app experiences, not just infrastructure
- Automated network dimensioning and optimization
- A cloud-native software stack to deploy across on-premises and private/public clouds
- Microservices for core functions with built-in reliability
- Wire-like reliability on wireless with dynamic SLAs

As a result, Celona provides:



An end-to-end turnkey private wireless solution for the global enterprise

- Celona or our partner will scope your need, perform RF design, network design and commission the network in days.
- Celona provides all the equipment and expertise needed to set up the network – all available in an easy-to-consume, no-CAPEX subscription model.
- Support for global private 5G spectrums, including n48, n77 and n78.



A converged 4G/5G architecture

- We provide support for both 4G and 5G devices concurrently, providing a graceful upgrade path as the market continues to evolve.
- Detailed step-by-step documentation means our customers can self-install, use their own electrical installers and contractors, or work with a Celona business partner.



Direct integration into existing enterprise infrastructure and policies

- No additional firewalls and switches are required.
- Full visibility and control of all 4G/5G devices on the network



Full end-to-end security for both data in-flight and at rest

- Your data never leaves the enterprise network and is secured by SIM/eSIM
- Secure SIM lifecycle management with granular policy controls like SIM locking, and flexible site level SIM authorization.



MicroSlicing offers the ability to manage Quality of service (QoS) on a per-device or per-app basis:

- You can prioritize Microsoft Teams, Zoom or an SAP application on the network without needing any device-level configurations.
- QoS can be centrally managed by the enterprise infrastructure.



Celona Orchestrator - an IT-friendly cloud management platform

- This is a single tool to manage subscribers and troubleshoot the entire network as well as manage the overall device experience.



A robust, open device ecosystem with complete interoperability with popular devices and applications used in the Oil & Gas industry

- Tablets: including iPad Air, Samsung, Zebra and Getac
- Laptop: Panasonic Touchbook G2
- Gateways: including Cradle point, Digi, Sierra Wireless RV55
- Phones: iPhone
- Software: including Microsoft Teams, Zoom, web-based apps.

For a full list of our current certified devices visit celona.io/devices



The ability to set up the network indoors or outdoors as well as in hazardous locations where coverage is needed.

- **Outdoor access points are IP66 rated, some with C1D2 certification for hazardous environments with gases and chemicals.**

RF Planning Made Easy

One of the key benefits of using private cellular over Wi-Fi is the huge reduction in the number of access points required – sometimes as little as 10%-20% for equivalent coverage.

However, getting the number of access points as low as possible requires optimal placement. Our RF planning workshop simplifies the planning experience, ensuring a cost-effective solution can be designed.

For more information visit celona.io

Learn more about the Celona Platform



Start your journey with Celona >



Custom demo >



TCO and ROI Calculator >



Proof of Concept >

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