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White Paper

# Industrial Private Cellular Business Case

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## **Executive Summary**

This white paper examines comparative three-year network costs of a Celona Private 5G LAN, an alternative private cellular offering, and a Wi-Fi 6 network deployment at a steel manufacturing plant. It highlights a private cellular advantage over Wi-Fi 6 in terms of 4-6x fewer indoor access points and 5-6x fewer outdoor access points.

Over a three-year term, the Celona solution provides 30% to 200% cost savings vs. private cellular offerings from vendors that traditionally serve carrier infrastructure, or enterprise Wi-Fi offerings. A real-world case study reveals a 50-75% yearly cost savings from eliminating network-related production disruptions.

Quick ROI payback of three months with Celona in this particular case study provides a glimpse into the critical motivations of industrial enterprises seeking reliable private cellular wireless connectivity solutions.

## **Private Cellular for Manufacturing, Warehousing, and Other Industrial Segments**

For decades, enterprises have connected information technology (IT) assets like workstations, printers, and workers with Wi-Fi. Even for critical operational technology (OT) applications (e.g., mobile crane operation), “hardened” outdoor Wi-Fi access points are widely used. However, in industrial environments covering vast outdoor areas and indoor spaces challenging for radio signal propagation, Wi-Fi tends to fall short for variety of reasons.

Large quantity of unexpected network disconnects for devices that are on the move across these spaces usually result in high cost of operational expenses for businesses that run their critical infrastructure on enterprise wireless. For example, Wi-Fi links sometimes drop from access point handoffs and uncontrollable RF environments due to external Wi-Fi interference.

To eliminate the high cost incurred during network disconnects and improve their overall operational uptime, industrial enterprises are beginning to tap the maturing private cellular ecosystem for the following key benefits of private LTE and 5G for business-critical connectivity:

- Reliability – wireless link transmissions are based on centralized scheduling, and support deterministic service levels for application throughput and latency in addition to quality of service (QoS)
- Mobility – mobility handling is centrally coordinated by the infrastructure, independent of the device type or model, and is a foundational pillar of wireless cellular technology
- Security – SIM-based authentication enables centralized encryption and device level authentication across the network, delivering a simple framework for enterprise-grade security across IT/OT assets and intellectual property

This paper examines the importance of enabling predictable wireless connectivity across the industrial enterprise, provides comparative cost models of private cellular and cloud-managed Wi-Fi solutions, and highlights a real-world example with key outcomes and results.

### **Importance of Reliable Wireless Connectivity**

Unlike typical IT applications like checking emails and providing connectivity to the Internet, operational applications in industrial settings are critical to the overall process flow. In tightly integrated industrial operations like those in manufacturing and warehousing, where a particular process depends on the previous and follow-on processes, it is critical to keep the processes “humming.”

A disruption in one area of the operation can ripple through the rest of the processes, causing unplanned downtimes, resulting in possible material loss and lost productivity. Likewise, in today’s supply- and labor-constrained environments where companies can sell everything they make, unreliable connectivity disruptions can lead to unplanned downtimes, which often results in revenue and profit losses.

In addition to reliability, today’s industrial applications demand robust wireless connectivity solutions that can dynamically handle mobility scenarios using handheld devices, mobile vehicles, and robots, and securely protect important company data within private networks. Furthermore, industrial applications increasingly demand deterministic network features and capabilities beyond “best-effort” attributes to gain a higher-order operational efficiency.

### **Comparative Cost Models of Private Cellular vs. Wi-Fi**

To examine the comparative costs of deploying the different private wireless networks in an industrial setting, we have identified a manufacturing plant with 250,000 square feet of indoor space and 1,000,000 square feet of outdoor space. Based on estimated coverage areas per indoor and outdoor access point, we have estimated the following number of access points to cover the manufacturing plant with Wi-Fi and private cellular, as shown in Figure 1.

<b>No. of Access Points</b>	<b>Private Cellular</b>	<b>Wi-Fi 6</b>
<b>Indoor</b> (~250,000 sq.ft.)	17	100
<b>Outdoor</b> (~1,000,000 sq.ft.)	4	20

**Figure 1. Scope of Wireless Network at a Steel Wheel Manufacturing Plant in the US**

Since the private cellular radios using the CBRS spectrum in the United States can offer a much greater “wireless coverage cell size,” a private cellular network requires fewer access points than Wi-Fi, indoors and out. As a result, we estimate that a private cellular network requires 4-6 times fewer indoor access points and 5-6 times fewer outdoor access points (APs) at the reference manufacturing plant.

So, how much does it cost to deploy an enterprise wireless network using the latest private cellular and Wi-Fi technologies? Using three-year subscription list prices of a private cellular solution from Celona and a cloud-managed Wi-Fi 6 solution (Figure 2), we have calculated the total network costs for a “greenfield” deployment at a reference manufacturing plant.

The total network costs include hardware and software components of a radio network, LAN/WAN switching, cabling and labor costs associated with AP installation, and cable pulls to the APs. It should be noted that the total network costs, as depicted in this paper, are based on list prices. Final project costs will vary depending on the scope of the network (i.e., the number of APs deployed) and actual negotiated prices for equipment and installation costs.

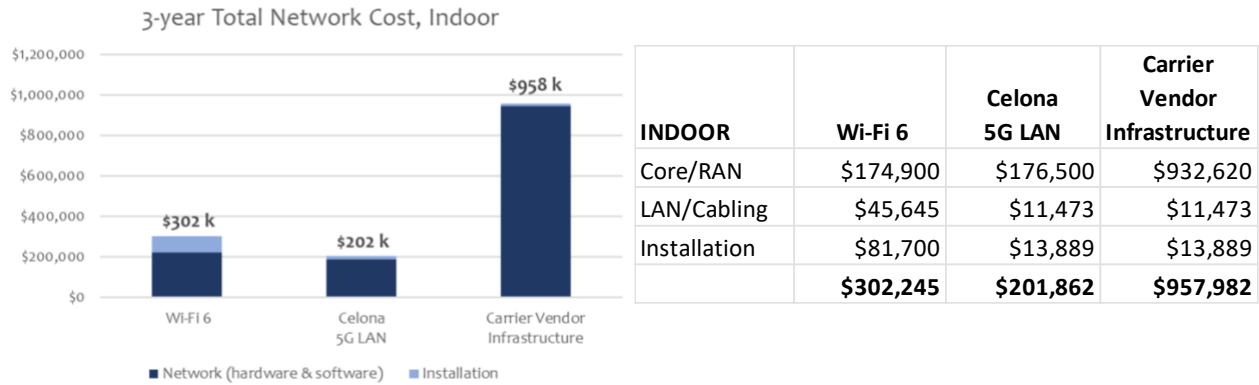
3-year subscription list prices	Wi-Fi 6	Celona 5G LAN <sup>1</sup>	Carrier vendor infrastructure
Indoor AP	\$1,749	\$9,500	\$9,500
Outdoor AP	\$2,750	\$30,000	\$12,900
Edge Solution		\$15,000	\$45,360 per AP
LAN (PoE) switching	3 x \$5,860	1 x \$5,860	1 x \$5,860
Cabling (Indoor)	5 x \$5,613	1 x \$5,613	1 x \$5,613
Cabling (Outdoor)	2 x \$51,000	1 x \$51,000	1 x \$51,000
Installation (Indoor)	100 x (\$317 cable pull + \$ 500 AP install)	17 x (\$317 cable pull + \$ 500 AP install)	17 x (\$317 cable pull + \$ 500 AP install)
Installation (Outdoor)	2 x \$19,000 (fiber backbone pull); 20 x (\$900 Cat 6a cable pull + \$3,000 AP install)	1 x \$19,000 (fiber backbone pull); 4 x (\$900 Cat 6a cable pull + \$3,000 AP install)	1 x \$19,000 (fiber backbone pull); 4 x (\$900 Cat 6a cable pull + \$3,000 AP install)
<b>Total</b>	<b>\$578,435</b>	<b>\$425,692</b>	<b>\$1,279,852</b>

**Figure 2. Network Cost Assumptions of Different Private Wireless Solutions<sup>2</sup>**

For indoor, covering 250,000 square feet of indoor space at the reference manufacturing plant, we see that the hardware and software network costs of a Celona private cellular solution are comparable to a Wi-Fi 6 solution. However, it comes out ahead of Wi-Fi because of the lower installation cost – due to fewer APs and associated cable pulls. Compared to the alternative private cellular solution, it is about 4-5 times cheaper, as shown in Figure 3.

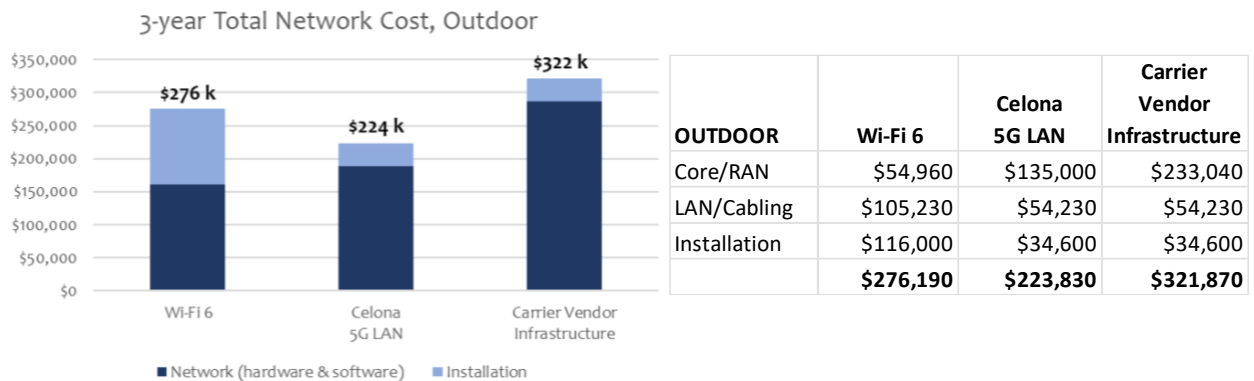
<sup>1</sup> Celona “5G LAN” reflects the name of the company’s private cellular solution. In the case study, the actual private wireless access was based on LTE.

<sup>2</sup> It should be noted that the Core, AP software and technical support costs are embedded in the Celona Indoor and Outdoor AP subscription costs. For alternative private cellular offerings, these costs are repeated per AP as an ‘Edge Solution’ subscription, increasing the total cost of ownership.



**Figure 3. Three-year Network Cost of Celona vs. Alternative Private Cellular vs. Wi-Fi 6 for Indoor**

For outdoor, covering 1,000,000 square feet of space at the reference manufacturing plant, the cost differences between Wi-Fi 6 and the two private cellular solutions are not that significant, as highlighted in Figure 4. While hardware and software costs of the two private cellular solutions are higher than Wi-Fi 6, the lower installation cost associated with fewer AP installations offers a cost advantage – especially for the cost-effective Celona private cellular solution.



**Figure 4. Three-year Network Cost of Celona vs. Alternative Private Cellular vs. Wi-Fi 6 for Outdoor**

Combining the costs for the network indoors and outdoors, we see that the Celona private cellular offers the lowest three-year total cost of ownership (~\$430,000) out of all options. Cloud-managed Wi-Fi 6 solution comes second at ~\$580,000, with the alternative private cellular solution requiring a substantial ~\$1,280,000 investment.

**Case Study: Steel Wheel Manufacturing**

To understand the power of private cellular networking in terms of lowering the overall cost of ownership (TCO) for a wireless infrastructure, Mobile Experts spoke with a steel manufacturer who produces high-precision wheels for the railroad industry. It was clear that the wireless networking investment with Celona’s private cellular solution not only met the TCO

requirements for the manufacturer but also delivered a rapid return on investment (ROI) thanks to much improved uptime in operations.

The steel wheel manufacturing process is highly integrated, requiring multiple steps to turn scrap metals into highly engineered railcar wheels that meet stringent industry quality standards and regular audits and inspections (Figure 5). The manufacturer traditionally relied on Wi-Fi to connect various instrumentation and mobile devices to collect data and send work instructions to workers. The company experienced, on average, five to six weekly disruptions on the Wi-Fi network during the scrap yard operations – a costly downtime that can bring manufacturing operations to a halt and significantly impact business margins if not kept under control.



**Figure 5. Steel Wheel Manufacturing Process**

An interruption in the scrap yard can potentially disrupt a truck bucket (i.e., bringing various metals to the scrap yard) and furnace (i.e., melt metals with other “recipe” materials to create the correct-grade stainless steel) operations. For instance, if a heat operation is disrupted for a long time, about \$90,000 worth of material can be deemed lost. Assuming one of the 5-6 weekly Wi-Fi disruptions in the scrap yard operation results in a “lost” event, that translates to over \$4.3 million in material and labor loss in a year.

After effectively replacing six Wi-Fi APs in the scrap yard with one Celona private cellular outdoor AP, the manufacturer reported only a handful of disruptions during the last 18 months.

Based on a dramatic decline in unplanned downtimes in the scrap yard, the private cellular network is yielding cost savings that range from 50 to 75%<sup>3</sup> for the steel manufacturing plant – resulting in \$2.2 - 3.2 million cost savings per year as compared to the Wi-Fi-based operation.

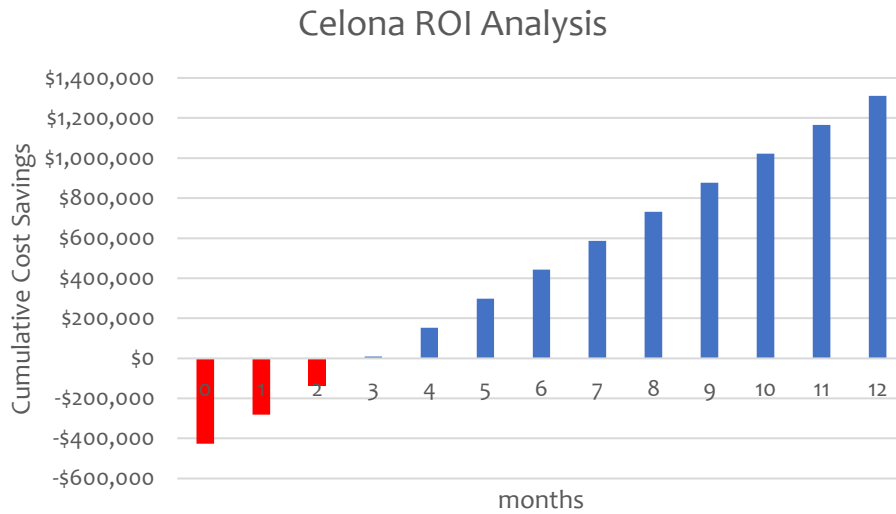
### **Return-on-Investment (ROI) Analysis**

We can determine the number of months for recouping the network costs based on the cost savings from eliminating unplanned downtimes as examined above. For example, the total three-year subscription costs of Celona’s indoor and outdoor solutions (\$430,000) can be recouped in just three months, after which the cost savings from the private cellular quickly accrues in the subsequent months.

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<sup>3</sup> With private cellular use in the scrap yard operation, the manufacturer is reporting a 90%+ reduction in wireless network disruptions. We are taking a more modest view of cost savings as we aim to stay conservative and consider applicability to other manufacturing industries.

Alternatively, the same ROI can never be achieved with Wi-Fi in this environment given that unplanned downtime continuously increases operational cost.



**Figure 6. ROI of private cellular is three months from the elimination of unplanned downtime<sup>4</sup>**

We can see that achieving a quick ROI for private cellular wireless in high-value industrial segments such as steel manufacturing is straightforward. Moreover, a few percentage points in cost savings from reliable private cellular networks yield considerable productivity and operational efficiency, leading to cost savings over the long term.

<sup>4</sup> For the ROI analysis, we took the mid-point of the estimated cost savings range at 62.5%

## Summary

Business-critical applications, such as connecting mobile crane operators via tablets to the overall end-to-end manufacturing process, are critical to an enterprise's success in the marketplace, especially in today's supply- and labor-constrained environment.

For manufacturing and warehousing environments, unplanned downtime can directly lead to loss of revenue and hamper profitability goals. As we have seen with the reference case study, the total private cellular network cost can be less than Wi-Fi 6. More importantly, it also delivers 50-75% cost savings from potential material loss and labor costs.

The cost savings are a direct result of eliminating unplanned downtimes with significantly more reliable private cellular wireless connectivity for critical operations. As a result, the ROI payback period is only three months with a Celona private cellular solution in the given case study.

With reliable private cellular networking leading to huge ROIs, as examined in this paper, we believe industrial enterprises will increasingly seek private cellular networks to augment Wi-Fi networks and take on digitizing more of their business-critical process workflows. As a result, accelerating how they do business and how fast they serve their customers.