Private 5G in Warehouses: Solving the Connectivity Challenges Wi-Fi Can't in the Warehouse of Tomorrow

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XCOM RAN™ by Globalstar

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INTRODUCTION

Warehouse operations are experiencing monumental shifts, as operators face rising throughput requirements driven by increased e-commerce adoption, but remain constrained by labor shortages, legacy infrastructure, and a volatile upstream supply chain. To keep up with market demand, supply chain organizations must digitally transform their warehouses with the right connectivity platform to ensure operations can thrive.

When it comes to digitally transforming a warehouse, operators are taking a multifaceted approach, investing in:

1) Mobile automation solutions such as Automated Guided Vehicles (AGVs) and Autonomous Mobile Robots (AMRs) for picking, sorting, and replenishment
2) Fixed automated material handling systems to maximize storage space and handle growing volumes at higher speeds
3) Advanced connected worker applications, such as Extended Reality (XR) devices, to optimize and extend the capabilities of available labor

All these solutions are essential pieces of the puzzle as warehouses look to tackle their labor and real estate constraints in the face of ever-rising throughput requirements. Still, the effectiveness of these solutions is heavily dependent on the network they operate on. Private 5G networks are the foundation for next-generation automation and connected worker applications, enabling seamless communication between machines, sensors, and personnel across the warehouse by offering ultra-reliable, low-latency connectivity and enhanced security.

Other areas of the supply chain, including ports and manufacturing facilities, have been realizing the benefits of private 5G networks, gaining more reliable real-time asset tracking, enhanced performance of automation, and smoother coordination across complex operations. Warehouses facing similar pressures for efficiency and resilience must take note to avoid falling behind.

While the benefits of private cellular networks have often been discussed in theory, this exercise quantifies the real cost savings and Return on Investment (ROI) of deploying Globalstar's XCOM Radio Access Network (RAN) in a 220,000 sq ft U.S. warehouse. The model compares private cellular adoption against a status quo warehouse that relies on a mix of Wi-Fi and fixed-line connectivity, providing clear evidence of the value unlocked through improved automation, connectivity, and operational efficiency.

The findings of this study are compelling. Compared to traditional Wi-Fi, which around 85% of U.S. warehouses currently operate, deploying private 5G networks can deliver annually:

More than 180 thousand additional packages processed—an increase of 35% compared to traditional warehouses—through enhanced automated operations & AGVs

More than US$800 thousand— in additional throughput value and productivity

Generate savings of over US$1.1 million—related to downtime, labor, and maintenance

WAREHOUSING SECTOR CHALLENGES AND THE NEXT GENERATION CONNECTIVITY CASE

Warehouses are now plagued by internal constraints and external pressures more than ever. The market continues to demand more from their fulfilment operations, but structural issues have left warehouse operators having to do more with less. Key challenges facing the warehouse sector can be broadly categorized into three areas:

Market and Real Estate Challenges

- Higher throughput and Just-In-Time (JIT) fulfilment requirements driven by e-commerce
- Rising volumes and storage requirements hindered by the inability to extend or develop new warehouse space
- Limited availability of modern warehouses equipped for automation and sustainability

The Bottom Line: Demand is climbing, but space and modern infrastructure are not keeping pace.

Workforce and Operations Challenges

- Allocating tasks to workers, ensuring safety, and staying reactive with real-time plan adjustments based on live information
- Hiring, retaining, and upskilling manual workers to handle increasingly complex requirements and work with new digital tools and automation
- Managing outdated, siloed technology solutions and equipment downtime

The Bottom Line: Labor shortages and outdated systems make scaling operations difficult.

Leveraging New Technology

- Ensuring minimal process disruption and achieving a fast ROI
- Increasingly connected and automated systems limited by existing network infrastructure
- Balancing manual workflows with increasingly automated material handling systems

The Bottom Line: Tech adoption is necessary, but ROI and connectivity bottlenecks remain barriers.

Why Connectivity Matters

New technologies such as Warehouse Management/Execution/Control Systems (WMS, WES, WCS), automated material handling systems, advanced devices for workers, Artificial Intelligence (AI)-based Machine Vision (MV), and asset tracking systems are all solutions to the challenges faced, but all require carefully considered implementation plans.

Any system or device must be able to receive and transmit data in real time to work to its full potential. Without strong and consistent connectivity, mission-critical systems can experience latency and even downtime, creating serious knock-on effects to picking and fulfillment requirements.

Warehouses are rapidly outgrowing traditional Wi-Fi. The volume and requirements of systems, devices, and automation deployed within facilities can no longer be effectively supported by existing connectivity setups, which is why more warehouses are turning to private 5G.

Key Takeaways

- Space and labor constraints are colliding with rising e-commerce demands
- Legacy tech and Wi-Fi-based networks cannot keep up with automation needs
- Private 5G offers the resilient, scalable foundation needed to overcome these barriers

QUANTIFYING THE VALUE OF PRIVATE 5G

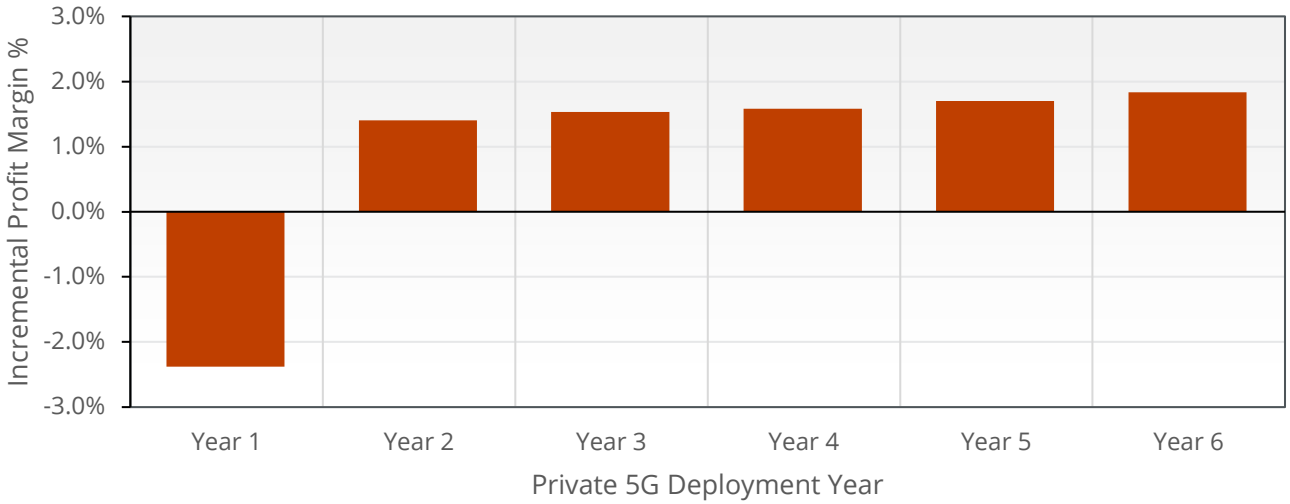
To understand why a private 5G network is so important for warehouse operations, ABI Research analysts have quantified both the ROI and the Cost of Inaction (CoI) of deploying Globalstar's XCOM RAN. The analysis is based on a representative U.S. warehouse—220,000 square feet in size with 120 staff—and reveals substantial financial benefits driven by cost savings and operational efficiencies. These benefits grow exponentially over time, as warehouses become more adept at integrating private 5G use cases into their workflows. The model accounts for all major cost components, including device retrofitting and replacement, network infrastructure, mobile spectrum access, and ongoing network management.

Key financial benefits

1. **Additional net revenue of US$1.1 million** for the average US warehouse by Year 6
2. **For every US$1 invested in private 5G,** a US warehouse can expect to see a return of US$5 by Year 6
3. **The net financial benefits of a private 5G network** will outweigh network infrastructure costs by Year 2

Chart 1: Incremental Profit Margin of Deploying a Private 5G Network

(Source: ABI Research)



By year 6, deploying private 5G helps a warehouse generate nearly 2% more profit annually—just by operating faster, safer, and more efficiently.

While the total cost of private 5G—including network infrastructure, devices, and management software—remains relatively fixed, the benefits to an organization continue to scale over time. Analyzing how warehouse requirements are shifting and combining this with the efficiencies gained through a private 5G network deployment makes it clear how the value compounds as operations evolve.

Positive benefits gained within 5 years of the deployment:

- **Over 180 Thousand Additional Packages Processed Annually (35% higher than a status quo warehouse):** A warehouse can ship more packages by improving the efficiency of both manual and automated picking systems, tackling the issue of rising volumes and delivery speeds driven by e-commerce.

- **US$12 Thousand in Additional Annual Revenue Driven by Overall Workforce Productivity Gains:** Private 5G empowers warehouse teams to work more efficiently by enabling real-time access to information, supporting advanced devices like Extended Reality/Virtual Reality (XR/VR), and ensuring seamless mobility. These enhancements collectively boost productivity across the entire workforce, resulting in measurable revenue growth for the warehouse.

- **Opportunity to Redeploy 15 Full-Time Equivalents (FTEs), More Than 12% of a Typical Warehouse's Workforce:** By maximizing the efficiency of autonomous equipment, more manual workers are freed up to take on additional, higher-value tasks, helping to optimize available labor.

Costs avoided within 5 years:

- **121 Hours of Annual Equipment Downtime Avoided, Saving Warehouses Almost 20% of Their Unplanned Downtime:** Any time mission-critical equipment is not functioning due to drops in connectivity creates significant delays to order fulfillment. Maximizing equipment uptime with reliable connectivity helps maximize a warehouse's revenue.
- **US$253 Thousand in Annual Safety and Insurance Savings, Reducing Safety and Insurance-Related Expenses by Just More than 37%:** By facilitating more Internet of Things (IoT) devices such as wearables and smart sensors and supporting real-time communication, hazards can be better monitored and rapid alerts sent to workers or equipment to avoid incidents.
- **US$51 Thousand in Annual Training Costs Saved, Reducing Onboarding Expenses for a Typical Warehouse by Almost 10%:** Supporting more advanced connected worker applications, such as XR/VR, helps significantly reduce the training time of warehouse workers, especially given the cyclical nature of both permanent and agency staff.
- **2-4% Reduction in Annual Worker Attrition (from an industry average of around 40%):** Creating a safer and digitally optimized warehouse environment helps greatly reduce worker attrition, helping to tackle the ongoing warehouse labor challenges.

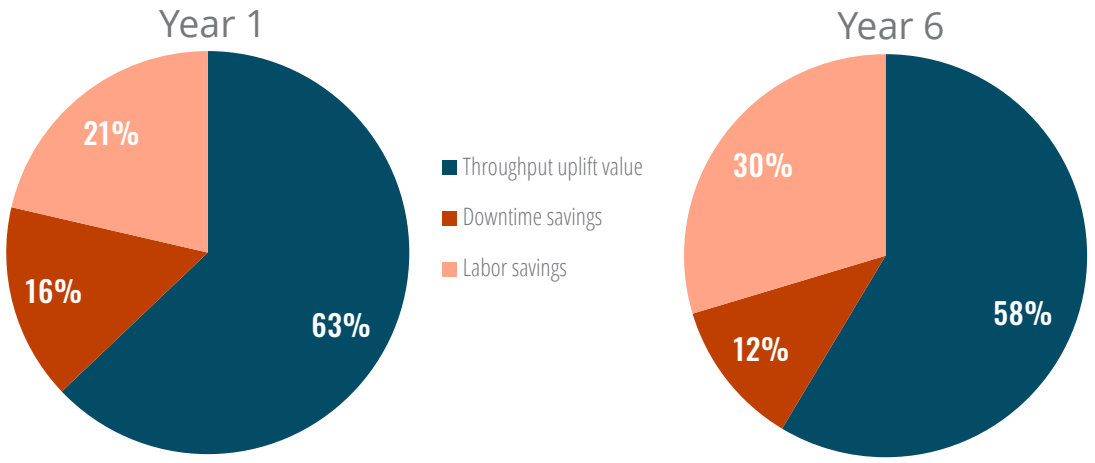
Mobile Robotics (AGVs, AMRs)

Private cellular networks are becoming a critical enabler for AGVs and AMRs in modern warehouse environments. These autonomous systems rely on fast, reliable, and low-latency connectivity to navigate, coordinate, and respond in real time. Unlike traditional Wi-Fi, which can struggle with coverage gaps and congestion, private 5G offers consistent performance across large warehouse spaces—ensuring uninterrupted operation of mobile robots. This connectivity unlocks higher throughput, reduces downtime, and enables more flexible automation, making private cellular a foundational technology for scalable, intelligent warehouse logistics.

Benefits	Operational Improvement for a Typical Warehouse (220,000 sq ft; 120 members of staff)
Throughput Uplift	Increase of 5% in Year 1 (~25 thousand extra orders), rising to an increase of 15% in Year 6 (~100 thousand extra orders)
Downtime Avoided	50 hours in Year 1 (~US$50 thousand savings), scaling to 121 (a reduction of 30%) in Year 6 (translating to ~US$115 thousand savings)
Labor Freed Up	2 FTEs in Year 1, increasing to 7 FTEs (5% of a warehouse's labor force, ~14,000 work hours annually) by Year 6

Chart 2: Financial Gains from an XCOM RAN-Powered Private 5G Network for AGVs / AMRs

(Source: ABI Research)



The Private 5G Advantage: Uses cellular-style handovers designed for fast-moving devices. Latency is more predictable (less than 10ms), and 5G can also support network slicing to give mission-critical robots priority bandwidth. Early deployments revealed that a private 5G network allows warehouses to operate their AGV fleet at more than 30% higher speed.

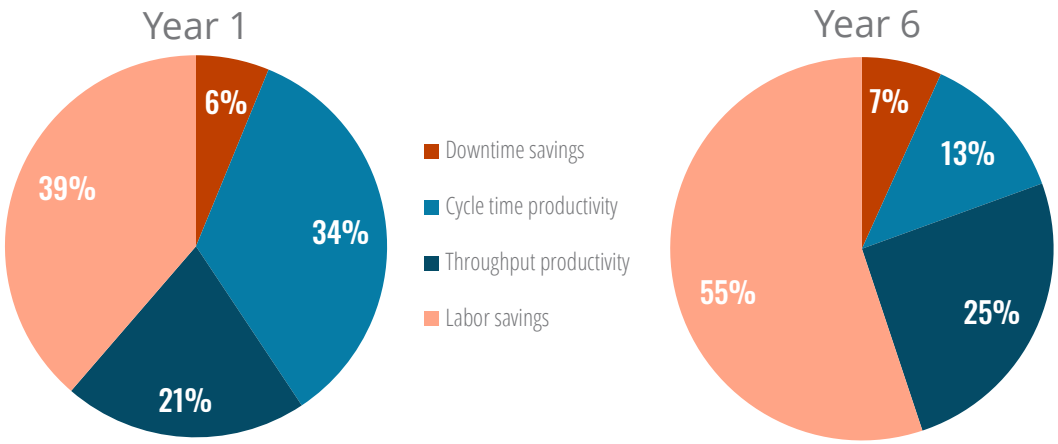
Autonomous Operations

Private cellular networks are a foundational enabler of autonomous operations in modern warehouses. These operations include systems like automated inventory tracking, smart conveyor belts, robotic picking arms, and real-time environmental monitoring—all of which require fast, reliable, and secure connectivity. Private 5G delivers the low latency and high bandwidth needed to support these technologies, allowing warehouses to reduce downtime, optimize cycle times, and scale operations with greater precision. As these systems become more integrated into daily workflows, private cellular ensures they perform consistently and adapt dynamically to changing demands.

Benefits	Operational Improvement for a Typical Warehouse (220,000 sq ft; 120 members of staff)
Process Efficiency Gains	+2% cycle-time productivity in Year 1 (~US$40 thousand added value), growing to +4% in Year 6 (~US$125 thousand added value)
Throughput Increase	+2% in Year 1, scaling to +6% in Year 6 (~40 thousand additional orders shipped annually)
Labor Redeployment	3 FTE in Year 1, increasing to 12 FTEs (10% of a warehouse's workforce) by Year 6 (~US$300 thousand in annual savings)
Downtime Avoided	12 downtime hours avoided in Year 1 (~US$6 thousand in avoided losses), increasing to 35 hours in Year 6 (shaving off 5% of a warehouse's annual downtime, translating into ~US$60 thousand in avoided losses)

Chart 3: Financial Gains from an XCOM RAN-Powered Private 5G Network for Autonomous Operations

(Source: ABI Research)



The Private 5G Advantage: By providing deterministic and lower latency connectivity, private 5G networks can facilitate precise timings between Automated Storage and Retrieval Systems (ASRS), conveyors, and robotic picking systems, increasing efficiency of automated systems and reducing downtime. Private 5G also has stronger signal propagation and coordinated cell planning, meaning that signal can penetrate tracking and equipment more reliably, and receive less interference from other wireless systems. In one large-scale deployment, private 5G reduced downtime of automated guided vehicles by more than 20% in dense racking areas where Wi-Fi connections frequently dropped, highlighting its ability to maintain stable performance in environments with significant interference and signal obstructions.

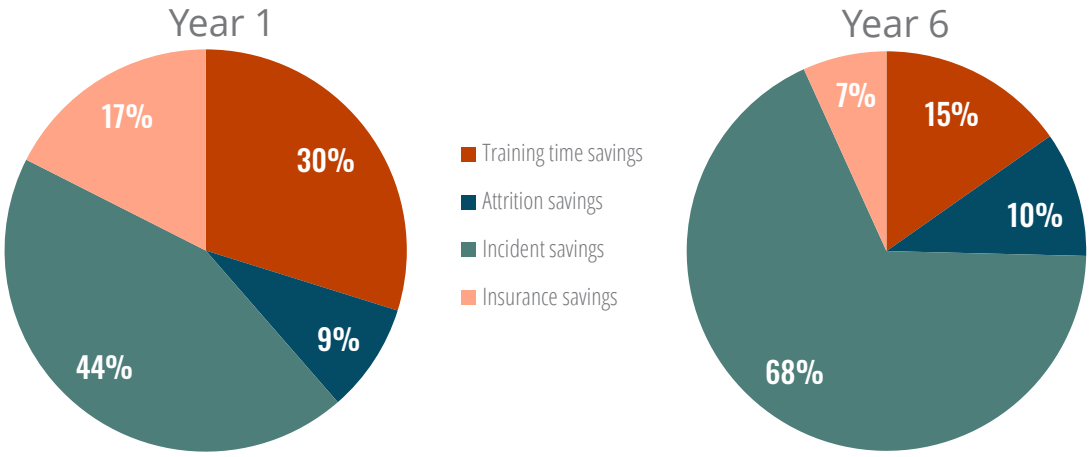
Connected Worker Applications

Private cellular networks are transforming how warehouse workers stay connected, safe, and productive. Connected worker applications—such as smart wearables, voice-directed picking, real-time location tracking, and digital training tools—depend on reliable, low-latency connectivity to function effectively. Private 5G provides the consistent coverage and bandwidth needed to support these tools across large warehouse environments, enabling faster onboarding, reducing safety incidents, and improving task efficiency. Private cellular helps unlock a more agile, informed, and resilient workforce by empowering frontline staff with real-time data and communication.

Benefits	Operational Improvement for a Typical Warehouse (220,000 sq ft; 120 members of staff)
Training Time Saved	20 hours saved per worker per year, equating to ~2,500 hours (amounting to more than 1 FTE annually) of work time freed up per warehouse by Year 6 (~US$52 thousand per year in value)
Attrition Reduction	Churn reduction of 2 to 4% (from an industry average of 40%), creating ~US$10 thousand savings in Year 1, growing to ~US$34 thousand per year by Year 6
Safety Incidents Reduced	Baseline 5 per year drops to 2 per year by Year 6. ~US$230 thousand per year in avoided incident costs and stronger insurance compliance.

Chart 3: Financial Gains from an XCOM RAN-Powered Private 5G Network for Connected Worker Applications

(Source: ABI Research)



The Private 5G Advantage: Private 5G is engineered to handle high IoT volume and also has built-in Quality of Service (QoS) controls to help prioritize critical applications. Lower latency creates the desired user experience with smooth visuals and real-time rendering, as well as maintaining necessary connectivity for multiple workers using XR/VR simultaneously.

STRATEGIC RECOMMENDATIONS

Private 5G networks can provide significant benefits for warehousing and fulfilment operations, unlocking new efficiencies and generating savings by avoiding costly issues and maintaining operational consistency. This executive brief has shown how the financial benefits significantly outweigh the upfront and ongoing costs of deploying private 5G. Still, as with any infrastructure investment, warehouse managers must consider key considerations and work with the right provider to ensure seamless deployment.

Deployment Considerations

1. **Invest in the Right Solution Providers That Will Take Care of Integrating and Facilitating the Network Upgrade:** Working with existing and upcoming solution providers when deploying a private 5G network is essential to maximize returns. Warehouse operators should define their specific needs, identify the most important capabilities for their operations, and continuously assess providers based on these changing metrics.

2. **Upgrade Adjacent Infrastructure to Support Real-Time Capabilities:** In addition to optimizing mission-critical autonomous operations and connected workers, enhanced connectivity between equipment, assets, workers, and central planning systems unlocks a myriad of real-time analytics capabilities. Operators must ensure their central planning systems, from their WMS to their supply chain planning systems, can process and share incoming operational data to drive better forecasts and resource planning.

3. **Facilitate the Enhanced Network Security Offered by Private Networks:** Private wireless uses SIM-based authentication and encrypted connections to offer stronger security than Wi-Fi, but still requires robust access controls and monitoring. Given the increasing prevalence of cyberattacks across the supply chain, organizations must emphasize their Operational Technology (OT) and Information Technology (IT) environments to develop a comprehensive security profile.

4. **Understand Retrofitting Requirements to Ensure 5G Compatibility:** Certain legacy equipment will likely not be 5G compatible and must either be retrofitted with 5G modules or replaced with a 5G-enabled version. Working closely with equipment providers to facilitate a smooth transition to 5G compatibility will be key and provide a unique opportunity to future-proof operations.

5. **Assess How to Reallocate Workers as Automation Expands:** As 5G facilitates the expansion of automated material handling systems and supports more advanced connected worker applications like XR/VR, warehouse managers must identify more value-added tasks for workers and support the transition to new roles with dedicated training programs.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