How Private 5G Outperforms Wi-Fi 6

A LionsGate Systems Whitepaper for Industrial Manufacturing & Large Enterprise Campuses

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Introduction

Industrial facilities and large enterprise campuses are no longer just buildings—they're dense digital ecosystems. Robotics, autonomous vehicles, machine vision, IoT sensors, AR headsets, safety systems, and connected workers all depend on one thing:

A wireless network that never flinches.

Two technologies sit at the center of that conversation today: **Private 5G** and **Wi-Fi 6**. Both are powerful. Both have their place. But when the environment is:

- large,
- mission-critical,
- metal-dense,
- and constantly in motion,

Private 5G typically delivers a stronger foundation than Wi-Fi 6.

This LionsGate Systems whitepaper explains *why*—from coverage and reliability to total cost of ownership and real-world industrial use cases.

Key Takeaways

- **Private 5G provides superior coverage and mobility** across large, complex, and RF-hostile environments compared to Wi-Fi 6.
- **Total Cost of Ownership (TCO)** for Private 5G can be *lower* over time because you need fewer radios, less redesign, and gain better uptime.
- **Security and control are stronger** with Private 5G thanks to SIM-based identity, dedicated spectrum options, and carrier-grade encryption.
- **Industrial and logistics environments**—where downtime is expensive, major gains in predictability, automation, and operational efficiency with Private 5G.

- For **enterprises with large footprints**, Private 5G is a *future-ready backbone* that can scale with growth, new apps, and new spectrum bands.

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1. Private 5G vs Wi-Fi 6: The Fundamentals

1.1 What is Private 5G?

A **Private 5G** network is a dedicated cellular network deployed for a single enterprise or site. It uses:

- Licensed, shared, or unlicensed spectrum (e.g., CBRS in the U.S.)
- 4G/5G radio access technology
- A private core that the enterprise can control and integrate with its own IT/OT stack

Private 5G is designed for:

- deterministic performance,
- mobility at scale (forklifts, AGVs, robots, handhelds),
- strong security, and
- industrial-grade reliability.

1.2 What is Wi-Fi 6?

Wi-Fi 6 (802.11ax) is the latest major evolution of enterprise Wi-Fi, built primarily for high-density environments like offices, schools, venues, and public spaces.

Key improvements over past Wi-Fi generations include:

- Higher throughput and better spectral efficiency
- Technologies like OFDMA and MU-MIMO for multi-user performance
- Target Wake Time (TWT) for improved device battery life

Wi-Fi 6 shines in **indoor, people-centric spaces** with short to medium ranges and relatively predictable RF conditions.

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2. Key Differences: Why Private 5G Wins in Industrial & Large-Footprint Use Cases

2.1 Coverage & Range

- **Private 5G:**
    - Much larger cell radius per radio.
    - Stronger penetration through metal, racking, glass, and high-bay environments.
    - Ideal for factories, yards, ports, mines, airports, and large campuses.
- **Wi-Fi 6:**
    - Shorter effective range per AP.
    - Coverage shrinks fast with obstacles (racking, machinery, thick walls).
    - Requires many more APs to cover the same area—especially in high-ceiling, metal-heavy spaces.

Bottom line: For a 500k–1M+ sq ft facility or mixed indoor/outdoor operation, Private 5G reduces the "AP forest" problem.

2.2 Mobility & Handover

- **Private 5G:**
  Designed for *moving things*: phones, vehicles, robots, tablets, wearables.
    - Seamless handovers between cells
    - Low jitter and predictable session continuity
    - Excellent for AGVs, AMRs, yard trucks, cranes, and roaming technicians.
- **Wi-Fi 6:**
    - Mobility is best effort, not guaranteed.
    - Handoffs between APs can be inconsistent, especially with mixed vendors or older clients.
    - Not ideal when devices are moving quickly through RF-noisy or reflective spaces.

Bottom line: If it moves and it matters, Private 5G is the safer bet.

2.3 Security & Access Control

- **Private 5G:**

    - SIM/eSIM-based identity for every device
    - Carrier-grade encryption, mutual authentication, network slicing possible
    - Easier to build tight segmentation between OT, IT, guest, and safety systems
- **Wi-Fi 6:**
    - WPA3 is a big improvement—but relies heavily on correct configuration and key management
    - Shared keys, misconfigured PSKs, or "guest SSID leaks" are still common failure modes

Bottom line: Private 5G treats every device like a subscriber with a unique identity—much closer to operator-grade security.

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3. Total Cost of Ownership (TCO) & ROI

3.1 Initial Setup Costs

Private 5G will often show a **higher upfront cost** than Wi-Fi 6:

- Specialized radios and core
- Spectrum planning and RF design
- Integration with existing OT/IT

Wi-Fi 6 gear is usually cheaper per AP and more familiar to IT teams.

However,

3.2 Long-Term Economics

Over a multi-year horizon, **Private 5G can win on TCO** for large or complex sites:

- Fewer radios are needed to cover the same area
- Less cabling, fewer ceiling penetrations
- Less frequent redesign when sites expand or layouts change
- Reduced downtime from RF interference and congestion
- Better support for high-value workloads (robots, critical IoT, safety links)

When you factor in **production uptime, fewer line stoppages, and predictable performance**, the ROI often tips in favor of Private 5G—especially for manufacturing, logistics, and yard/port operations.

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4. Private 5G in Industrial Manufacturing

4.1 Automating Production Lines

Private 5G's **ultra-reliable low-latency communication (URLLC)** supports:

- Coordinated robotic cells
- Real-time machine control
- Conveyor and line automation
- Synchronized motion and safety systems

Compared to Wi-Fi, which can suffer from jitter and RF collisions, Private 5G behaves more like a deterministic fieldbus—wireless, but predictable.

4.2 Real-Time Monitoring & Data Processing

Industrial sites can deploy thousands of sensors for:

- vibration and condition monitoring,
- energy and utility usage,
- product quality measurements,
- environmental and safety thresholds.

Private 5G supports **massive machine-type communications (mMTC)** and integrates cleanly with **edge computing** so you can:

- collect high-volume telemetry,
- process it in near real time,
- trigger maintenance or quality actions automatically.

4.3 Operational Flexibility

Reconfiguring a line or warehouse layout under Wi-Fi may require:

- moving multiple APs,
- retuning channels,
- re-surveying coverage.

With Private 5G:

- Radio footprint is sparser.
- Coverage is broader per cell.
- You can rearrange equipment and flows without constantly re-wiring the RF layer.

That flexibility is gold when you're doing **high-mix, low-volume manufacturing** or shifting SKUs frequently.

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5. Security & Reliability in Harsh Environments

5.1 Security by Design

Private 5G networks typically benefit from:

- SIM/eSIM-based device identity
- Per-subscriber policy control
- Strong mutual authentication
- End-to-end encryption on air and core segments

This is ideal when you:

- run safety-critical equipment,
- exchange IP-sensitive designs,
- or integrate with regulated systems (health, defense, energy, etc.).

5.2 Reliability in High-Density Industrial Settings

Factories and warehouses are RF nightmares:

- metal racks
- moving vehicles
- welders, motors, VFDs
- thick walls and mezzanines

Wi-Fi 6 improves on previous generations, but it still lives in unlicensed, noisy spectrum and suffers from contention.

Private 5G:

- uses scheduled access instead of contention
- can leverage cleaner bands (e.g., CBRS)
- provides steadier throughput and latency underload

That translates directly into **fewer unexpected line stoppages** and **more predictable SLAs** for operations.

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6. Real-World Patterns (Without Vendor Hype)

Across manufacturing, logistics, and critical infrastructure, we repeatedly see similar patterns when facilities move key workloads onto Private 5G:

- **Automotive & heavy manufacturing**
    - Wireless retooling of lines without pulling new copper
    - High-bandwidth video for inspection and machine vision
    - Reduced downtime from "mystery Wi-Fi interference" in welding and paint areas
- **Pharmaceutical & food production**
    - Stricter control of who and what connects, with full auditability
    - Environmental monitoring (temp, humidity, pressure) feeding compliance logs
    - Strong segregation between OT networks and office/guest traffic
- **Large-scale warehousing & distribution**
    - Reliable roaming for handhelds, scanners, and wearables
    - Coordination of AGVs/AMRs and automated storage/retrieval systems
    - Yard and dock coverage without dozens of outdoor APs

The story is consistent: **Private 5G becomes the industrial backbone**, and Wi-Fi is often retained for office users, guest access, and non-critical workloads.

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7. Enterprises with Large Footprints: Where Private 5G Shines

7.1 Enhanced Connectivity Across Vast Areas

Private 5G is particularly well-suited for:

- multi-building campuses,
- airport and seaport operations,
- refineries and energy corridors,
- large hospitals and research parks.

One 5G sector can often do the work of many Wi-Fi APs, especially outdoors or in high-ceiling environments.

7.2 Built-In Scalability

As you add:

- more robots,
- more vehicles,
- more sensors,
- more AR/VR use cases,

Private 5G scales gracefully:

- large address space for devices,
- standardized QoS and slices per service class,
- straightforward policy management per SIM/device group.

You're not constantly juggling SSIDs, VLANs, and channel plans just to keep things stable.

7.3 Cost-Effectiveness Over Time

While the initial line item might look higher than Wi-Fi:

- fewer radios,
- fewer physical changes as you grow,
- less downtime from interference and congestion,
- and better support for high-value workloads

mean **the long-term economics often favor Private 5G** for large, complex sites.

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8. Future Outlook: Private 5G, IoT, and Edge Computing

The next wave isn't just "more bandwidth"—it's **tighter integration**:

- **Private 5G + Edge Compute**
    - Processing close to machines for ultra-low latency
    - Local analytics for quality, safety, and optimization
- **Private 5G + Massive IoT**
    - Tens of thousands of sensors per site
    - Energy, environmental, and productivity telemetry
- **Private 5G + Computer Vision & AR**
    - Wireless machine vision for defect detection
    - Technician guidance and remote expert support with low latency

Wi-Fi 6 will continue to improve and remain essential in offices, meeting spaces, and hospitality areas. But for **industrial manufacturing and large enterprise footprints**, Private 5G is increasingly the **strategic backbone**.

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9. LionsGate Systems Perspective

LionsGate Systems focuses on **real-world, RF-hostile environments**—factories, logistics hubs, healthcare campuses, and large commercial sites. Our role isn't to "pick a winner" between Wi-Fi and 5G in slides; it's to:

- analyze your physical plant,
- understand your critical workflows,
- map your wireless pain points,
- and design a layered architecture that just works.

In many cases, that means:

- **Private 5G as the industrial spine**
- **Wi-Fi 6 as the office & guest access layer**
- Unified monitoring, RF health, and lifecycle management across both

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10. Sample FAQ for This Whitepaper

You can use or adapt this as a sidebar or separate page on the site.

Q1: Does Private 5G replace Wi-Fi entirely?

No. Think of Private 5G and Wi-Fi 6 as complementary. Private 5G is ideal for mobile, mission-critical, industrial workloads. Wi-Fi 6 remains excellent for offices, conference rooms, guest access, and general IT users.

Q2: Is Private 5G only for very large companies?

Not anymore. With shared spectrum (like CBRS), more flexible cores, and smaller form-factor radios, Private 5G is now accessible for mid-sized manufacturers and logistics operators—not just global giants.

Q3: Do I need new devices to use Private 5G?

Many modern industrial devices, scanners, tablets, and CPEs already support LTE/5G or can be equipped with compatible modules. Where that's not the case, LionsGate Systems can design transitional architecture.

Q4: How does LionsGate Systems help us decide?

We start with an RF and operations assessment: your floor plans, materials, existing networks, critical applications, and growth plans. From there, we model coverage, interference, and TCO for multiple options—then design a phased rollout aligned with your budget and priorities.