ROSY TO REALISTIC: A FRESH PERSPECTIVE ON 5G PRIVATE NETWORKS

Lessons from Germany's 5G campus networks experience

Five years into the market adoption of 5G mobile private networks (MPNs), it's time to reassess the initial demand expectations. Germany, particularly its manufacturing industry, ranks among the top three adopters globally, offering valuable insight into where and how the benefits of MPN have materialized. This Viewpoint investigates concrete areas where enterprises have realized value from private networks and presents commercial and technical sourcing strategies for successful implementation.

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GERMANY: OPPORTUNITIES AMIDST A GLOBAL HANGOVER

MPNs have garnered status as a transformative technology for a broad set of industries, driven by the promises of 5G technology, the Internet of Things (IoT), and advanced use case enablement. Industry users increasingly recognize the benefits MPNs provide, including dedicated, secure, and reliable connectivity, independent of the public network. Tailored to industry-specific needs, MPNs allow users to enhance security, optimize performance, and leverage robust coverage.

The initial hype around 5G created high expectations for its impact in the enterprise domain, particularly for MPNs. However, as market sentiment around 5G has cooled, it is clear that MPN adoption has faced significant barriers. Key among these are:

- **High total costs,** for enterprises to deploy MPNs, with no widely adopted "killer use case" to justify the investment

- **Delayed availability of cost-efficient 5G features,** such as network slicing, which are essential to offset the high costs of dedicated physical infrastructure through virtualization

MPN TECHNOLOGY REMAINS RELEVANT FOR INDUSTRY USERS

- **Limited availability of compatible devices and spectrum** across 5G bands and geographies, restricting functional use cases

- **Geopolitical restrictions on network vendors,** further constraining the range of viable supplier options

- **Limited partnerships between ICT and telco players,** limiting the delivery of seamless, integrated solutions for the industry

As a result, overly optimistic forecasts from early analyses are being replaced with more grounded, realistic projections by telco B2B planners. Despite the challenges suppliers face, MPN technology remains relevant for industry users, with implementations continuing to grow globally, albeit more slowly than initially anticipated. Recent deployment acceleration, highlighted by data from Nokia (see Figure 1), underscores the increasing value that MPN can provide to enterprise users.

Figure 1. Nokia private wireless customers globally
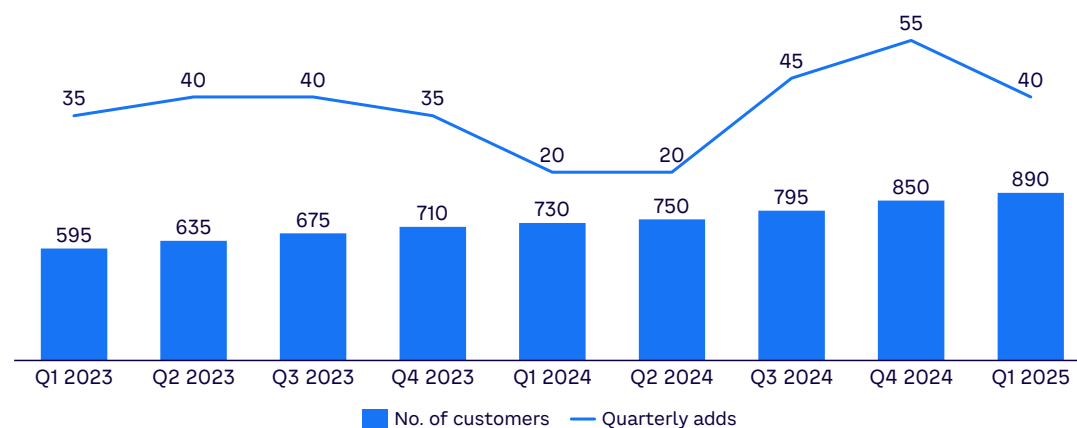
Source: Arthur D. Little, Nokia

Germany's 5G MPN market

On the global stage, Germany (among others, including the US and China) is one of the most active markets for 5G MPNs, with about 400 private network licenses as of 2024 (see Figure 2). Approximately 80 commercially operational MPNs are currently in use across a range of industries in Germany. An additional 100 or so networks are active within experimental settings or being operated by system integrators. The remaining license holders are either still in the planning or early implementation phases.

Adoption by the "Mittelstand" (Germany's small and mid-sized businesses) is critical for scaling 5G MPNs. These companies represent a high share of manufacturing sites and often greater propensity to experiment and innovate than larger enterprises. Local MNOs are well positioned to reach this segment, given their integrated value chains and B2B channel access. However, the competitive landscape is evolving, offering enterprises in Germany a growing set of choices:

1. **Local MNOs.** These are still the default choice, especially due to existing B2B telco relationships with the industry.

2. **Global B2B telco players.** Increasingly active in the MPN domain, these providers are furthering their end-customer sales efforts, particularly targeting large multinational enterprises operating in the country.

3. **Hyperscalers.** Shifting their focus from use cases toward network operations, hyperscalers' goal is to harness long-term customer potential.

4. **Network equipment providers (NEPs).** Offering "out-of-the-box" MPN solutions, these providers often bypass national MNOs by leveraging direct industry spectrum. However, many NEPs have since reverted to partnering with MNOs and integrators due to slow market development.

5. **Local integrators/specialists.** With small-scale equipment solutions and a gradual expansion of enterprise accounts via network upgrades, many local specialists in Germany are enabling the MPN business.

Figure 2. Global MPN deployment in leading countries

MPN leaders   MPN relevant   Approx. # deployments
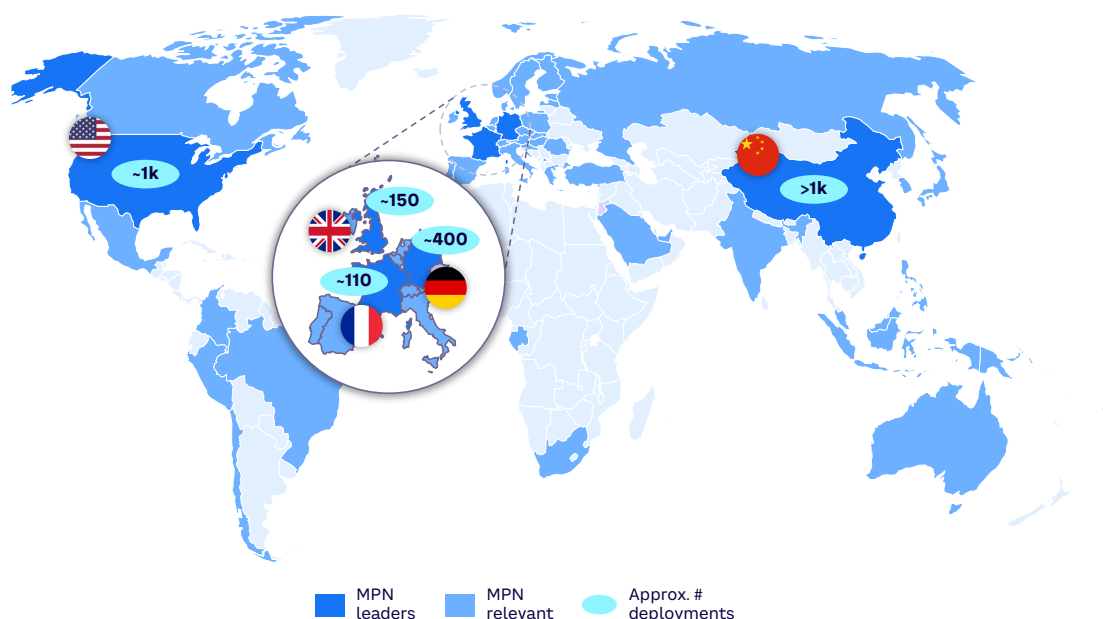
Source: Arthur D. Little

MPN ADOPTION ITSELF HAS LAGGED INITIAL EXPECTATION

At the global level, the MPN and small cell markets are experiencing significant turbulence. Specialized vendors are facing mounting financial pressure, with several companies, including Casa Systems, CommScope, and Celona, undergoing restructuring or entering bankruptcy proceedings. A consolidation of network equipment providers now appears likely, as the industry responds to initial overexpansion and slower market uptake.

In this context, although Germany has not enacted a formal ban on Chinese vendors in the MPN space, many enterprises remain cautious, opting for alternative suppliers due to perceived security and geopolitical risks. This reflects a wider international trend, where vendor selection is increasingly influenced by concerns beyond technical performance alone.

MPN adoption itself has lagged initial expectations, a pattern seen in other 5G enterprise features and applications (e.g., network slicing). However, recent signs of global acceleration suggest the market may be entering a sustainable growth phase.

MANUFACTURING: THE EARLY ADOPTER SEGMENT

The manufacturing sector is a beacon among early MPN adopters in Germany. Representing approximately 41% of private spectrum license holders in 2023, it is expected to account for nearly 42% of total MPN-enabled sites by 2030. Manufacturing plays a central role in the country's economy and industrial innovation and, due to its extensive operational needs and complex site topologies, it has become a critical segment for MPN deployment.

Rather than relying on traditional industry verticals, our analysis segments MPN implementations based on "place type." This approach better reflects network deployment decisions, as physical site requirements and specific use cases tend to drive network decisions more directly than broader sector labels. For example, within the healthcare industry, hospitals (places for immediate care) are relevant for MPNs, while pharmacies typically are not, even though they belong to the same industry vertical.

Although other segments (e.g., airports, mining) also yield relevant MPN implementations (see Figure 3), our focus is on the manufacturing segment due to the numerous examples and their broad replication potential.

Figure 3. German MPN sites forecast by place
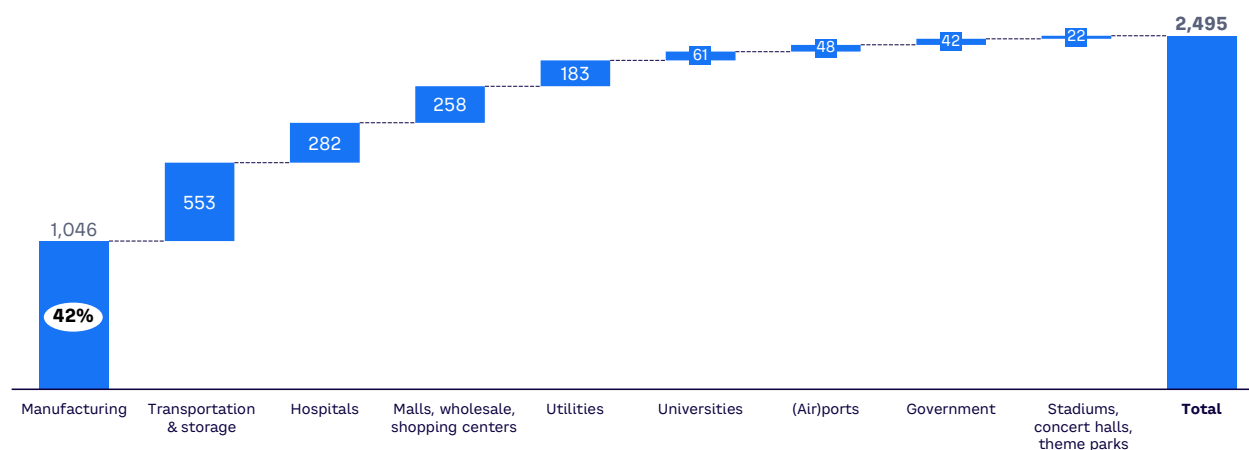
Source: Arthur D. Little

Interviews with more than 10 manufacturing enterprises in the process of deploying MPN across Germany and Austria revealed that manufacturing players are often technology-focused and value best-in-class delivery, with high network requirements that traditional Wi-Fi solutions often struggle to deliver. Further, given the business-critical nature of operations, these enterprises are often highly risk-averse, increasing the value of the managed services and strict service-level agreement (SLA) adherence that MPNs provide. MPNs in the manufacturing setting typically address three core domains:

1. Coverage and capacity

2. Enhanced security and resilience

3. Digital roadmap enablement

As a result, MPN technology can address both the short-term and long-term pain points of the manufacturing industry, supporting the immediate needs of manufacturing enterprises while providing up-side benefits via the use cases it enables. Figure 4 summarizes these pain points and outlines the corresponding use cases.

These use cases (beyond simple coverage/capacity extension) are expected to drive the majority of long-term MPN value creation for the manufacturing segment, as they are addressed in scenarios where Wi-Fi is insufficient. In addition, as MPN use cases mature over time, the benefits to the industry will grow. Such benefits are already evident, with MPNs offering a more cost-efficient solution than Wi-Fi, as illustrated in Figure 5.
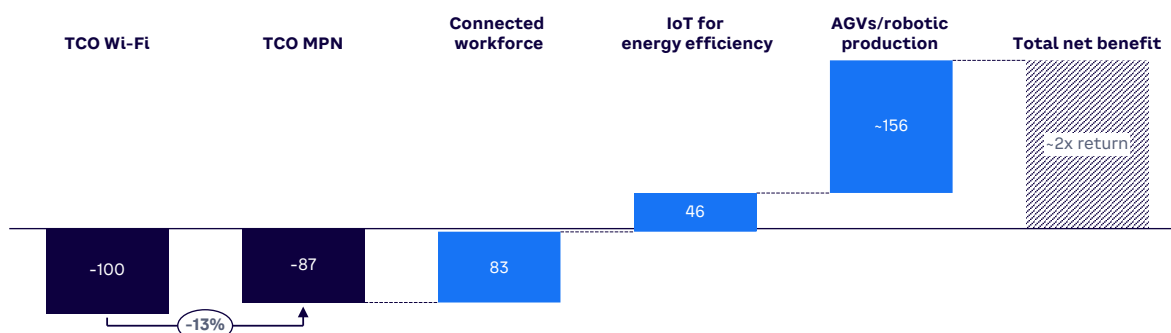
Figure 4. Pain points and use cases

PAIN POINTS	MPN USE CASES
1 **Insufficient or unstable mobile/Wi-Fi coverage** in indoor facilities or outdoor spaces of facility	**Additional coverage with small cells (indoor) or macro cells (outdoor)** — provide secure private connectivity, often cheaper than WiFi
2 **Safety & cybersecurity threats** along production & sourcing	**On-premise & secured** data management & security through dedicated hardware/software
3 **Missing local expertise** & lack of knowledge transfer	**Remote expert support** of employees via video link or smart glasses ensuring expert opinion at the right time & place
Production faults & errors, resulting in production downtime & resource waste	**Video analytics/computer vision** to automate quality control & spot production faults in real time
Rising energy costs across most stages of production line	**Power management analytics** of production sites, allowing optimized energy use & monitoring
Unpredicted machine failures due to maintenance delays or production faults	**Wireless sensors for predictive maintenance** in production equipment, providing real-time status & feedback
Manual efforts in sustaining **asset flow** in increasingly complex production	**Automated guided vehicles (AGVs)** used to optimize material flow & relieve manual efforts
Gaps in **digital processes** between **logistics, inventory** & **production**	**Process automation, automated real-time inventory control** & **asset tracking** enables "lot-size one" manufacturing

Source: Arthur D. Little

Figure 5. Cost-benefit analysis

Indexed, 7-year perspective   *ILLUSTRATIVE*

TCO Wi-Fi	TCO MPN	Connected workforce	IoT for energy efficiency	AGVs/robotic production	Total net benefit
-100	-87	83	46	~156	~2x return

-13%

Source: Arthur D. Little

In Germany, innovative Mittelstand companies are already investing in MPN licenses and commercial networks, actively exploring real-world applications of MPN technology. For manufacturing enterprises, starting with a business case that compares the cost and benefits across technologies (e.g., Wi-Fi vs. MPN) is essential for securing internal buy-in.

A notable example in the manufacturing segment is the Prinzhorn Group, which has deployed MPN technology across two of its major sites in Germany. The company found 5G MPN to be more cost-efficient than Wi-Fi, particularly given that approximately 40% of the site area is outdoors. Through MPN deployment, Prinzhorn Group unlocked several benefits, including:

1. More sustainable and faster production processes

2. Enhanced labor efficiency and safety

3. Higher automation with fewer manual inspections

4. Digital twin capabilities under development

These deployments serve as real-world proof of the value of MPNs for the German manufacturing segment, highlighting the technology's ability to transform manufacturing operations and efficiency.
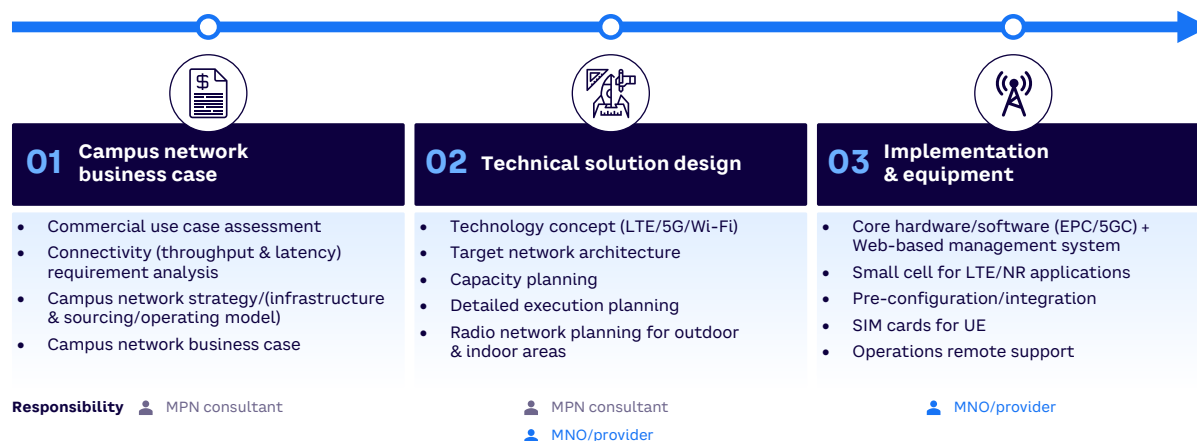
MPN SOURCING: FROM IDEA TO REALITY

Manufacturing players today face a complex landscape shaped by both external forces (geopolitical disruptions, regulatory changes, and rapid technological advancements) and internal pressures to improve efficiency and reduce costs. To stay competitive, manufacturers must constantly refine their business strategies to align with shifting priorities and emerging opportunities. Digitalization is at the heart of this strategic evolution. Harnessing the full potential of 5G on the manufacturing floor enables innovative digital use cases that can significantly boost performance and set manufacturers apart from the competition.

Implementing a private 5G network requires pragmatic decision-making, uniting key business and technology stakeholders. Based on market experience, we recommend following the sourcing blueprint outlined in Figure 6. Critically, the process must begin with a well-defined business case, not just a comparison of technology solutions. The business case should clearly quantify the expected benefits and establish the investment's justification. Many projects falter at this step by jumping instead into architecture and technical implementation plans.

Once management buy-in is secured through a strong business case, the focus can shift toward the implementation process, beginning with the technical solution design. The final steps involve sourcing the right equipment and integrating it seamlessly into existing operations.

Figure 6. MPN implementation process

01 Campus network business case	02 Technical solution design	03 Implementation & equipment
• Commercial use case assessment • Connectivity (throughput & latency) requirement analysis • Campus network strategy/(infrastructure & sourcing/operating model) • Campus network business case	• Technology concept (LTE/5G/Wi-Fi) • Target network architecture • Capacity planning • Detailed execution planning • Radio network planning for outdoor & indoor areas	• Core hardware/software (EPC/5GC) + Web-based management system • Small cell for LTE/NR applications • Pre-configuration/integration • SIM cards for UE • Operations remote support

Responsibility	👤 MPN consultant	👤 MPN consultant 👤 MNO/provider	👤 MNO/provider

EPC = evolved packet core (4G); 5GC = 5G core; LTE = long-term evolution; NR = new radio (5G); UE = user equipment
Source: Arthur D. Little

CONCLUSION

A REALISTIC PATH TO 5G MPN SUCCESS

SUCCESSFUL ENTERPRISES APPROACH MPNs AS AN OPPORTUNITY TO ENABLE AND DRIVE DIGITAL TRANSFORMATION

Despite slower-than-expected 5G MPN adoption globally, there are promising dynamics in Germany's manufacturing segment. With hundreds of deployments and a growing list of enterprises using private mobile technology, sentiment in the country is moving to a more positive but grounded view. Successful enterprises approach MPNs as an opportunity to enable and drive digital transformation, linking with the overall digital strategy. Starting with a business case clearly linked to business benefits, not solely a procurement process or technical design linked to costs, is critical for success.

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