

What is a campus network?

Understanding both the unique and overlapping characteristics of campus networks is key to unlocking growth through private network connectivity. This article defines what a campus network is and how different players can seize the opportunity.

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The unique characteristics of campus networks

A campus is a defined geographic area or complex where various facilities and operations are concentrated, such as airports, ports, stadiums, business parks, and hospitals. These environments often support multiple organisations and industries simultaneously. For instance, airports function not only as transportation hubs but also accommodate logistics, retail, and hospitality operations. Each of these functions requires different levels of network performance, security and management.

Campus networks address this need by providing connectivity across the various functions within the same physical location, using sophisticated configurations to manage the diverse requirements of each operation. As a result, campus networks are frequently deployed to serve multiple industries and commercial functions concurrently. The diversity of organisations, industries and purposes a campus network serves adds complexity to planning, deployment and operation. For instance, in network planning, operators must balance traffic patterns and service needs across different sectors.

A common challenge for campuses is poor macro network coverage, particularly in industrial zones or remote areas. Weak signal strength from traditional wide-area networks can pose significant problems for IoT applications, such as perimeter security or connected machinery, where reliable connectivity is essential. To address these coverage gaps, MNOs and vendors often need to implement dedicated campus infrastructure, tailoring the network to ensure strong coverage and robust connectivity. These environments also present physical challenges, including large metal structures, underground tunnels, and interference from machinery. As higher-frequency 5G bands, like mmWave, become more prevalent, these challenges will be exacerbated, requiring more sophisticated network design and planning.

Recognising that campuses are characterised by multiple different parties and types of operations on site as well as poor coverage from the macro networks, means that new campus network technologies need to offer enhanced coverage as well as connectivity tailored for use by multiple parties.

Emerging technologies and trends in campus networks

The rise of 5G has accelerated several transformative technologies and trends within campus networks, enabling advanced connectivity for high-capacity across many campus venues. Key developments include network slicing for specialised connectivity, the integration of private 5G with edge computing, and the emergence of smart campuses. Together, these innovations allow campuses to meet diverse operational demands, improve efficiency and enhance security while resolving challenges in providing campus-wide coverage.

Private 5G and edge computing

Deploying edge resources on-site allows campus networks to reduce latency, making them ideal for applications requiring real-time data processing, such as analytics for cargo management and machine vision in port operations. By processing data locally, campus environments can enhance security and data privacy, keeping sensitive information within the campus perimeter. This approach not only improves the responsiveness of connected systems but aligns with stringent data governance requirements often associated with campuses.

Network Slicing

Network slicing allows operators to segment the 5G network to deliver tailored services for specific use cases. For example, in a stadium setting, network slicing can provide ultra-reliable low-latency communication (URLLC) for security and emergency response systems while delivering high-bandwidth services for fan engagement applications, such as streaming or interactive displays. This ability to create network partitions

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with the same infrastructure enables campus networks to manage varied needs effectively, enhancing performance and meeting sector-specific requirements.

Smart campus initiatives

Smart campus initiatives are gaining momentum, with connected infrastructure supporting energy management, security, and other operational functions. Business parks, for instance, are increasingly adopting smart technologies, using connected systems for monitoring energy consumption, optimising systems, and managing security across large complexes with multiple tenants. Reliable and extensive network coverage is essential for these systems to operate seamlessly across diverse buildings and facilities. Additionally, campus environments face strict regulatory standards, requiring network vendors and integrators to comply with cybersecurity protocols, RF emissions limits, and physical infrastructure specifications such as tower heights and safety features.

The role of MNOs and Future Campus Networks

As campus networks grow in complexity, the role of MNOs must transform to meet diverse connectivity needs in high-traffic, multi-use environments. MNOs are adapting their strategies in network coordination, private network solutions, and deployment models to address the unique demands of enterprise campuses.

Coordinated indoor and outdoor coverage

From a Radio Access Network (RAN) perspective, MNOs are increasingly focused on providing seamless connectivity across both indoor and outdoor spaces, especially in high-traffic areas where uninterrupted service is critical. This approach not only improves network efficiency and minimises interference but also ensures a consistent user experience across the entire campus. By coordinating RAN elements in densely populated areas, MNOs can better manage capacity, reduce connectivity gaps, and enhance performance for all users.

Emerging deployment models

To meet the varied needs of campus environments, several deployment models are gaining traction. Some enterprises opt to acquire local spectrum and independently deploy their own RAN and core networks. Others may partner with MNOs or neutral-host providers who manage the network infrastructure, offering greater flexibility and operational support. Hybrid public-private models are also gaining traction, particularly in large, multi-tenant campuses where stakeholders share the network. These hybrid models enable the shared infrastructure to meet both public and specialised enterprise requirements, making them well-suited for complex, multi-use campuses. Hybrid is one of 3 different deployment models that are available to enterprises.

The Rise of Neutral-Host Models

Neutral-host models are becoming increasingly popular in campus network deployments. These models involve infrastructure providers who manage the network and lease access to multiple MNOs. This approach is particularly useful in campus environments where there are lots of organisations using the network. For example, in airports, where multiple mobile operators need to offer connectivity to passengers and businesses. By leveraging shared infrastructure, neutral-host providers can offer more cost-effective solutions while avoiding network duplication.

Transport hubs like ports and airports are emerging as key players in this space, functioning not only as physical interchanges but also as hubs for network connectivity. Different companies operating within these campuses may contract with the port or airport operator for connectivity, instead of a traditional MNO. For example, shipping companies may lease 5G connectivity from a port authority who supplies connectivity to all

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companies that have operations within the port. Players like the port authority may evolve to operate similarly to local MNOs, providing connectivity services to multiple tenants, businesses, and government agencies while managing their own network infrastructure.

Conclusion

Campus networks are becoming a critical component of private network innovation, offering MNOs and vendors new opportunities to meet the connectivity demands of large, multi-vertical environments. With the adoption of 5G and the integration of technologies like edge computing and network slicing, campus networks are poised to play a pivotal role in the future of enterprise connectivity. As MNOs and private network vendors continue to explore these opportunities, understanding the unique characteristics and evolving deployment models of campus networks will be key to success in this growing market.

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