

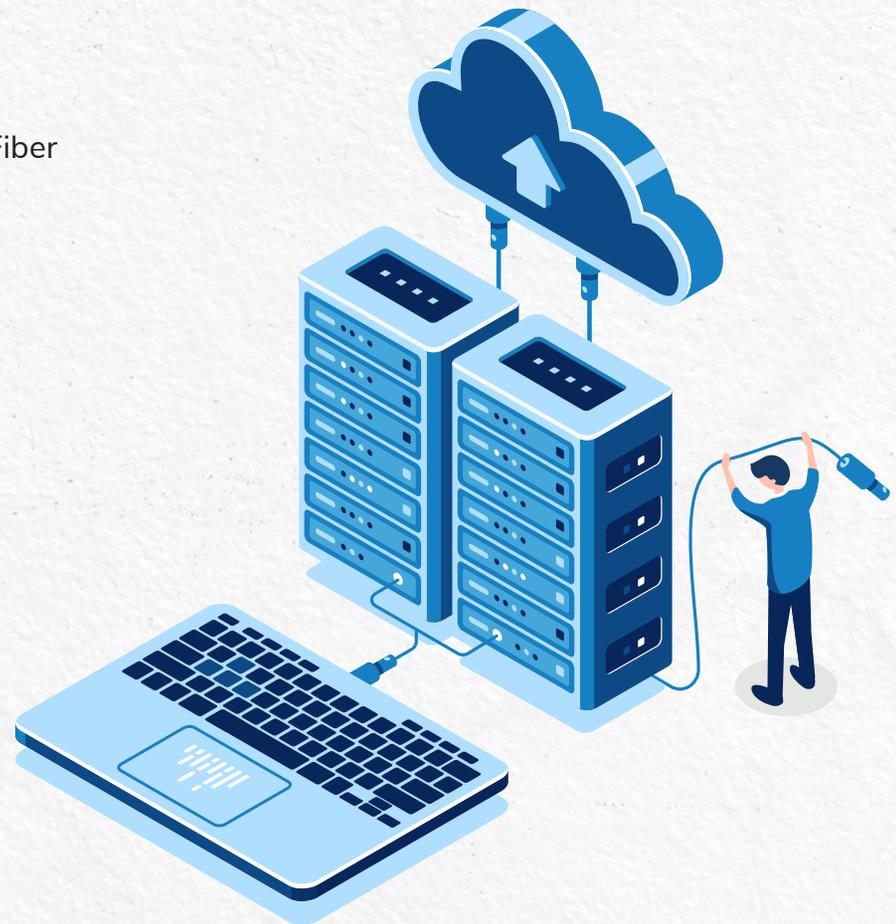
Building an AI-Ready Infrastructure with Optical Networking Services

FROST & SULLIVAN VBOOK



CONTENTS

- 3** Introduction: AI's Role in Reshaping Global Infrastructure
- 4** AI's Hidden Engine: Why Dark Fiber Is the New Strategic Asset
- 5** Engineering the Fast Lane: Fiber's Role in AI Acceleration
- 6** Use Cases: Connecting Data Centers and Campuses with Dark Fiber
- 7** Use Cases: Managed Optical Fiber Networking (MOFN): Simplified Operations
- 10** Colocation Backed by High-Capacity Wavelength Services
- 13** Lumen Dark Fiber & Colocation Services: The Foundation for Smart Enterprise Networks





Introduction: AI's Role in Reshaping Global Infrastructure

The AI industry isn't just expanding—it's fundamentally reshaping the global economy. Estimates from the [World Economic Forum](#) and [KKR](#) point to a transformation comparable to the interstate highway buildout, signaling a \$10 to \$15 trillion infrastructure overhaul. This scale demands a rethinking of the foundational systems that include connectivity, compute, and energy.

Infrastructure must evolve beyond legacy models to meet AI's exponential demands for compute and data, and dark fiber and colocation have emerged as the backbone of modern digital strategy. They directly address bottlenecks in bandwidth, latency, and proximity to compute. These capabilities are becoming essential pillars of enabling AI at scale.

Dark fiber offers unmatched control, security, and scalability. It enables organizations to architect private, high-performance networks tailored to their specific needs.

Colocation provides the physical space to deploy compute and networking gear close to cloud on-ramps, edge nodes, and high-density power, all without the overhead of owning and operating facilities. Together, they form the backbone of modern digital strategy.

Dark fiber and colocation work in tandem to support AI-ready infrastructure, combining strategically placed hardware in data centers with dedicated dark fiber connections. This setup enables ultra-low latency and high-throughput data exchange across distributed environments.

Beyond enhanced network control, dark fiber also offers key advantages, including data sovereignty, improved scalability, superior application performance, and the ability to bypass public networks, making it ideal for mission-critical workloads.

Infrastructure is no longer a support function in an AI-driven economy; it is a competitive differentiator. Enterprises that invest in dark fiber and colocation today will be positioned to lead the next wave of AI-driven infrastructure transformation.



AI's Hidden Engine: Why Dark Fiber Is the New Strategic Asset

For enterprise buyers, dark fiber isn't just a connectivity option; it's a strategic asset.

By investing in this asset, enterprises gain the right-of-way agreements, the splice points, the access vaults, and the maintenance protocols. Enterprises maintain control over their network's performance, security, and scalability, without relying on a carrier's architecture or traffic priorities.

Once lit, dark fiber becomes an enterprise's private, high-speed data highway. Enterprises control how it's used, how it's secured, and how it scales. It's ideal for connecting data centers, office campuses, and powering AI workloads—basically anything that demands fast, reliable, and secure data movement.

With low latency, high throughput, and full data sovereignty, dark fiber provides a performance and flexibility edge.



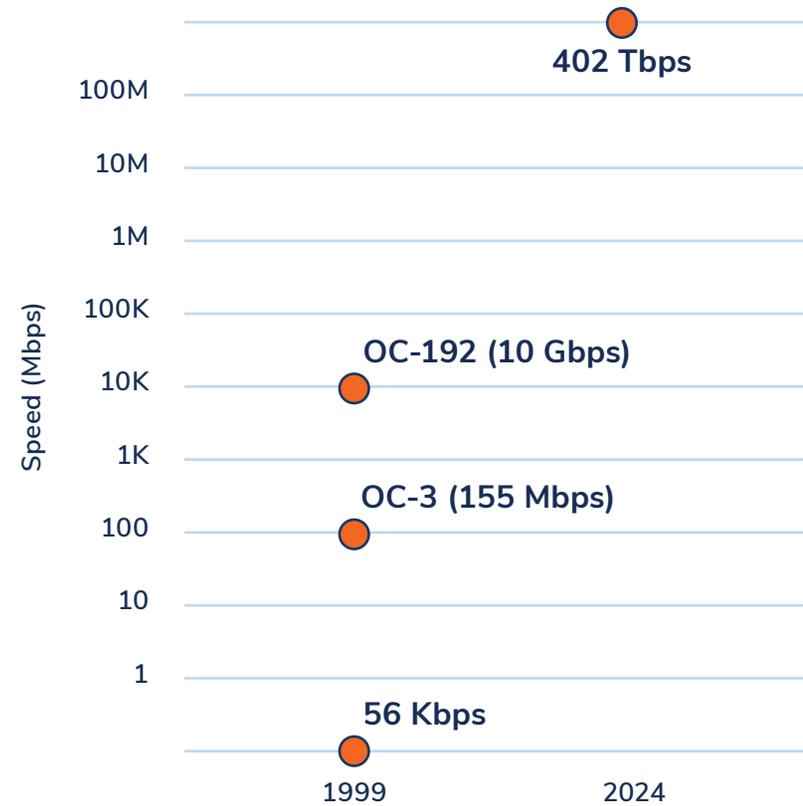


Engineering the Fast Lane: Fiber's Role in AI Acceleration

To put today's infrastructure wave into perspective, the KKR interview noted that the industry invested \$700 billion worth of fiber in the 1990s, which is equivalent to what the industry is doing annually today. Those early networks laid the groundwork for modern digital infrastructure, and while they were considered high-speed at the time, the technology has evolved dramatically. The glass used in earlier cables wasn't as refined, resulting in greater signal degradation. Today's fiber is far more advanced and supports multi-terabit speeds, lower latency, and more efficient transmission while still being physically smaller.

Modern fiber is like a freshly paved expressway, an autobahn for data. The glass is engineered to be ultra-clear, allowing signals to travel farther and faster with minimal loss. This results in fewer repeaters, lower latency, and enhanced performance. For enterprises connecting data centers, buildings, or campuses, modern fiber delivers not just speed, but also greater control, reliability, and scalability for future growth.

The leap in network speeds is staggering. In 1999, the average internet speed was just 56 Kbps, and backbone networks typically operated between OC-3 (155 Mbps) to a maximum OC-192 (10 Gbps). Fast forward to 2024, researchers at Aston University in the UK set a new world record by transmitting 402 terabits per second over a single optical fiber, surpassing their own earlier record of 301 terabits set just months prior.



Multi-terabit transmission speeds empower enterprises with the capacity, reliability, and scalability needed to meet today's data demands and tomorrow's innovations, delivering infrastructure that drives competitive advantage.



USE CASES

Connecting Data Centers and Campuses with Dark Fiber

Enterprises with multiple data centers and office buildings across a metro area need high-speed, private connectivity. Instead of purchasing extra services, enterprises can invest in dark fiber. The fiber is already routed through city easements and across railroad corridors, and the best part is that it is already permitted and engineered. By lighting their own strands, enterprises built secure, low-latency backbones between facilities, enabling real-time data replication, seamless failover, and unified networking.

Dark fiber is a critical enabler of scalable AI infrastructure, especially for high-throughput, low-latency workloads. AI factories, which are large data centers filled with GPUs and accelerators, generate massive volumes of data that must move quickly across compute nodes. Dark fiber networks support this demand by providing fast, reliable connectivity for distributed AI processing.

Industries are deploying dark fiber to meet growing AI needs. In manufacturing, it connects edge nodes for real-time automation and predictive maintenance. Healthcare and life sciences use it to transfer imaging and research data for AI-driven diagnostics and genomics. Financial institutions rely on it for secure, low-latency fraud detection



and risk modeling. Universities and smart cities use dark fiber to link campuses, research clusters, and infrastructure, enabling collaborative AI research and urban analytics.

As AI workloads become more latency-sensitive and geographically distributed, strategic dark fiber deployment is essential for resilient, future-ready networks.

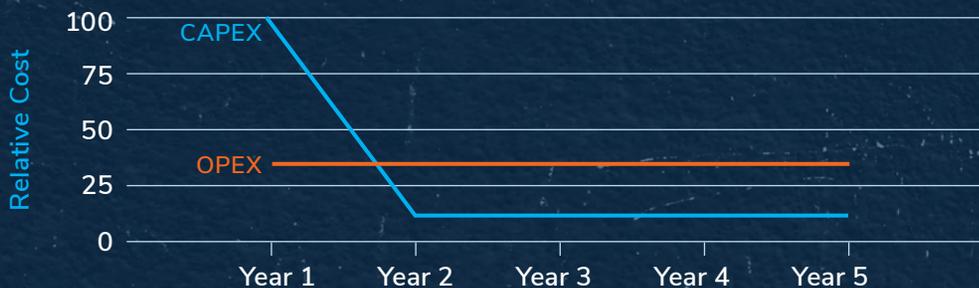
Dark fiber is no longer niche—it's a cornerstone of enterprise AI infrastructure. Organizations that invest in private optical networks gain performance, control, security, and future-proof scalability. As AI workloads grow, so does the strategic value of owning the data highway.



USE CASES

Managed Optical Fiber Networking (MOFN): Simplified Operations

As enterprises shift how they consume dark fiber, MOFN represents a strategic evolution in connectivity by transforming fiber from a static asset into a dynamic, service-driven platform. Instead of lighting, provisioning, and maintaining fiber in-house, enterprises can consume it as a managed service. MOFN providers handle the configuration, performance optimization, and fault management, delivering fiber as an operational expense (OPEX) rather than a capital investment (CAPEX). This model offers the scale and flexibility of optical networking without the engineering overhead and upfront cash outlays.



Utilizing MOFN allows enterprises to orchestrate their dark fiber infrastructure, easing the implementation of a dynamic, intelligent network built for speed, precision, and growth.

MOFN complements dark fiber by adding:

- ▶ **Design Engineering:** Expert-led network architecture ensures a fiber investment is optimized for performance, scalability, and future expansion.
- ▶ **Network Monitoring:** 24/7 proactive surveillance keeps a network healthy and responsive, minimizing downtime and maximizing uptime.
- ▶ **Technical Support:** Access to deep technical expertise accelerates issue resolution and enhances operational confidence.
- ▶ **Hardware & Spares:** Rapid recovery and consistent performance are ensured through dedicated infrastructure and spare components.
- ▶ **Field Tech Services:** On-site support for installations, upgrades, and repairs reduces internal resource strain and improves service quality.

MOFN transforms dark fiber from a passive infrastructure investment into a managed, intelligent service layer. It empowers enterprises to scale faster, operate leaner, and deliver high-performance connectivity without the burden of ownership, making it a critical enabler for AI, cloud, and next-gen digital infrastructure.



Colocation: The Gateway to AI, Cloud, and Edge

Powering the Future of AI Infrastructure

Colocation allows organizations to deploy their own compute and networking gear in neutral party data centers without the overhead of building and maintaining private facilities.

It's a natural fit for AI, offering proximity to cloud on-ramps, edge nodes, and high-density power and cooling.

It supports the evolving demands of AI with:

1. Control without the overhead
2. Strategic proximity to cloud on-ramps and edge nodes
3. High-density power and cooling
4. Enhanced physical security, access controls, and compliance with industry standards (e.g., SOC 2, ISO 27001).

As AI workloads grow more complex and data-intensive, colocation provides the flexibility and scalability enterprises need to stay ahead.

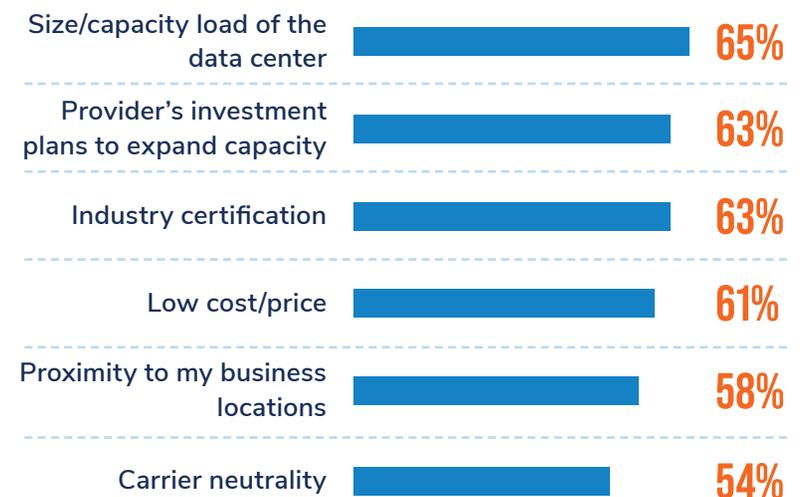
But what drives the selection of a colocation provider in this evolving landscape?

Recent feedback from a Frost & Sullivan cloud survey reveals a clear shift in priorities. While traditional factors like carrier neutrality and proximity to business locations still play a role, they are no longer the dominant decision-makers. Instead, organizations are placing greater emphasis on scalability and future readiness.

The size and capacity load of the data center stand out as a top consideration, underscoring the need for facilities that can support high-density compute and rapid expansion. Additionally, buyers are looking for providers with clear investment plans to expand capacity, signaling a preference for partners who are actively preparing for tomorrow's infrastructure demands.

The specific data paints a picture of a market that is maturing, where colocation is no longer just about space and connectivity, but about strategic alignment with long-term digital transformation goals.

Reasons for Selecting a Colo Provider





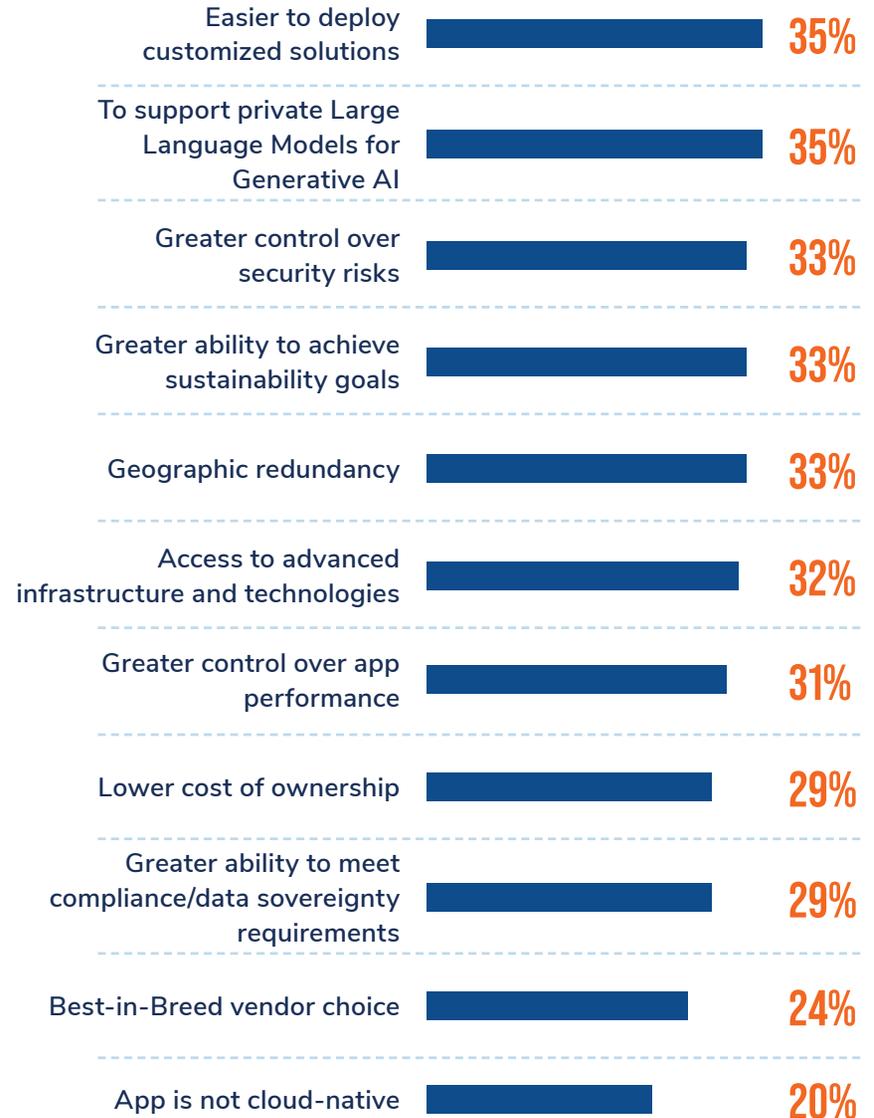
As enterprises evaluate infrastructure strategies beyond AI-specific workloads, many are turning to colocation rather than migrating to public clouds. Colocation offers greater control, flexibility, and resilience, making it a strategic choice for organizations with complex operational needs.

Key benefits of colocation include:

-  Improved security and control over application performance
-  Support for compliance and data sovereignty, critical in regulated industries
-  Flexibility to choose best-in-breed vendors and deploy customized solutions
-  Geographic redundancy and scalability for resilient infrastructure expansion
-  Access to advanced technologies that empower innovation
-  Optimization for total cost of ownership

These advantages position colocation as a powerful foundation for long-term IT strategy, especially for enterprises seeking tailored, secure, and scalable infrastructure solutions.

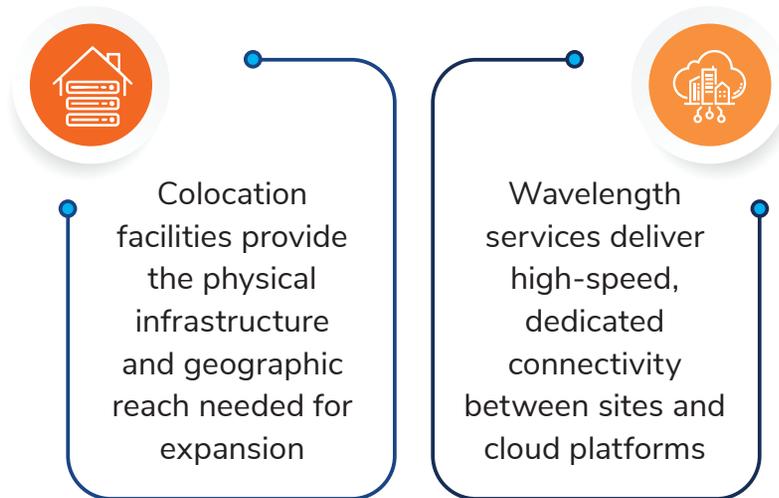
Reasons for Deploying Apps via Colocation Services instead of Public Cloud



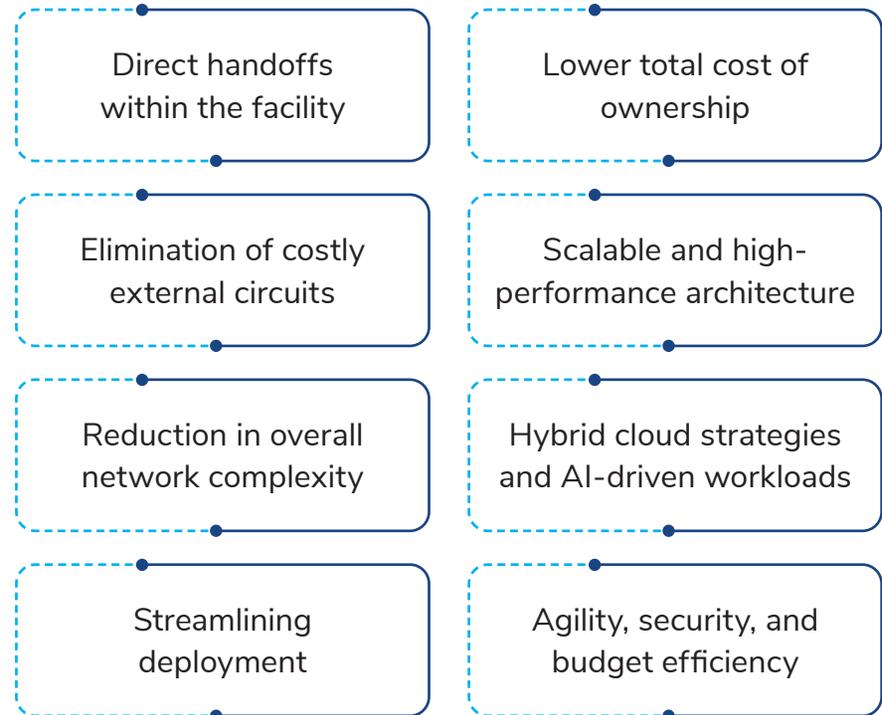


Colocation Backed by High-Capacity Wavelength Services

As enterprises prepare to scale their networks and support increasingly demanding workloads, combining colocation with wavelength services offers a strategic advantage. Colocation provides access to physical infrastructure and proximity to key network hubs, while wavelength services deliver high-speed, dedicated connectivity—today 1 Gbps to 100 Gbps are common, 400 Gbps is available, and 800 Gbps up to 1.6 Tbps are very near future capabilities. Wavelengths are used between data centers, enterprise sites, and cloud platforms. This pairing supports secure, scalable architectures essential for modern, data-intensive applications.



Colocation and wavelength services enable:



With modern optical infrastructure colocation, providers can now activate high-speed wavelength services in minutes, rather than months, at densely populated sites. This rapid provisioning accelerates deployment, enhances operational agility, and delivers a more responsive and efficient customer experience.



Bringing It All Together: Choosing the Right Mix

There's no one-size-fits-all approach to AI and enterprise infrastructure. The right mix depends on **Who, What, When, and Where**:

Who has the expertise—whether in-house, managed, or hybrid

What scale is required—training large models or running inference

When deployment is needed—immediate or phased

Where the infrastructure resides—on-premises, metro, regional, or national

At the heart of this strategy, dark fiber and colocation serve as the anchors, offering unmatched control, scalability, and proximity to cloud and edge ecosystems. Dark fiber enables organizations to build custom, high-capacity networks with full operational control. At the same time, colocation provides a secure, high-performance environment to host critical workloads and interconnect with partners and platforms. Augmenting this foundation, wavelength services deliver fast, cost-effective bandwidth, with the added benefit of direct handoffs inside the facility, while MOFN enables an ease of operational deployment. Together, these services form a flexible, future-ready infrastructure that supports hybrid cloud, AI, and data-intensive workloads. By aligning the right combination of control, scale, and management, enterprises can confidently build a network that meets today's demands and is ready for tomorrow's intelligent applications.



Optical Networking Services



DARK FIBER

Leased, unlit optical fiber for custom deployment

KEY USE CASES

- ▶ Full infrastructure control
- ▶ Long-term scalability

TOP BENEFITS

- ▶ High capacity potential
- ▶ Full control over network



WAVELENGTHS

Leased optical wavelengths on a shared fiber network

KEY USE CASES

- ▶ Datacenter Interconnection
- ▶ High-capacity transport

TOP BENEFITS

- ▶ Fast deployment
- ▶ Cost-effective bandwidth



MANAGED OPTICAL FIBER NETWORK (MOFN)

Provider-managed, end-to-end optical network

KEY BENEFITS

- ▶ Expert management
- ▶ Low maintenance

LIMITATIONS

- ▶ Less network control
- ▶ Vendor lock-in



COLOCATION

Housing servers in a third-party: carrier-neutral facility

KEY CASES

- ▶ Network access
- ▶ Disaster recovery

LIMITATION

- ▶ Limited physical access



Lumen Dark Fiber & Colocation Services: The Foundation for Smart Enterprise Networks

Lumen's Edge in Control, Scalability, and Connectivity

Lumen is building the backbone for the AI economy with its expanding optical network that hosts the #1 IP peered network globally.

Lumen stands at the forefront of enterprise infrastructure, delivering dark fiber and colocation services that can be tailored to businesses that demand reliability and future-ready solutions. Lumen equips organizations with the means to navigate the complex challenges posed by AI, hybrid cloud, and high-volume data applications, ensuring agility and operational excellence.

Through Lumen Dark Fiber, businesses gain full ownership and design flexibility over their network architecture, constructing high-capacity, low-latency connections precisely matched to evolving needs. This direct control over fiber pathways not only strengthens privacy but also enables rapid

scaling and customization. Lumen Network Colocation facilities provide the secure, high-performance environments needed to host mission-critical workloads. The facilities offer direct interconnection to cloud providers and partner networks, all supported by resilient power and advanced security standards. Lumen has a footprint of over 175 data centers, an additional 400+ data centers across the 7 reseller partner locations, plus access to more than 2,200 third-party facilities.

Lumen goes further by integrating wavelength services, managed optical networking, and platforms into its infrastructure suite. These services deliver rapid scalability, cost-effective bandwidth, and seamless connections all orchestrated within Lumen's expansive ecosystem.

Lumen is committed to expanding its network infrastructure, with plans to reach 47 million fiber miles by 2028. Lumen's infrastructure ensures that enterprises benefit from optimal proximity for low-latency performance, whether operating on-premises, across metros, or nationwide. With direct access to Lumen's fully redundant, low latency network, and approximately 340,000 global route miles of fiber, enterprises gain seamless connectivity across diverse environments and workloads. Guided by Lumen's team of experts, your business can confidently architect, deploy, and evolve its network to address immediate demands and seize future opportunities.

By choosing Lumen's Dark Fiber & Colocation services, enterprises are empowered to innovate and grow securely, knowing their foundation is ready for the next wave of digital transformation.

YOUR TRANSFORMATIONAL GROWTH JOURNEY STARTS HERE

Frost & Sullivan's Growth Pipeline Engine, transformational strategies and best-practice models drive the generation, evaluation, and implementation of powerful growth opportunities.

Is your company prepared to survive and thrive through the coming transformation?

Join the journey. 

FROST  SULLIVAN