

The confluence of AI and scalable hybrid cloud and multicloud networking has created an insatiable demand for high-capacity, performance-driven networking that can meet the requirement for efficient and massive data processing at scale.

Wavelength Networking Services Meet the Growing Demand for AI-Driven High-Capacity and Low-Latency Networking

August 2025

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Introduction

In today's rapidly evolving digital landscape, enterprises are increasingly reliant on high-capacity connectivity solutions to support their growing data needs. According to IDC, *30% of enterprises are experiencing bandwidth demand increases of more than 50% annually* (see IDC *FutureScape: Worldwide Enterprise Connectivity 2025 Predictions*, IDC #US52633824, October 2024).

Enterprises face the challenge of integrating advanced connectivity solutions to support AI and multicloud environments, with *43% of organizations recognizing the transformative impact of GenAI on their connectivity strategy* (source: IDC's *Future Enterprise Resiliency and Spending Survey, Wave 6*, June 2024).

By 2027, *70% of enterprises will adopt cloud-native networking for digital and AI workflows* (see IDC *FutureScape: Worldwide Enterprise Connectivity 2025 Predictions*, IDC #US52633824, October 2024). Wavelengths offer an approach to modernize core network infrastructure through scalable, high-capacity connectivity that supports the demands of modern digital and AI ecosystems, far surpassing traditional networking architectures.

This document explores the current landscape and future potential of enterprise network infrastructure, emphasizing the adoption of wavelength services and their transformative impact on high-performance connectivity fabrics.

AT A GLANCE

KEY STAT

IDC forecasts robust growth in wavelength beyond 100G, with 70% enterprise adoption of 400G and 800G by 2030.

KEY TAKEAWAY

AI-enabled workflows will surpass and disrupt traditional approaches to connectivity. Wavelength networking offers dedicated, scalable solutions that will support large-scale distributed workloads for the foreseeable future.

Definitions

Wavelength Connectivity

Wavelengths provide high-capacity, point-to-point optical connectivity that delivers dedicated bandwidth using specific frequencies of light transmitted through fiber-optic networks.

Using dense wave-division multiplexing (DWDM) technology, this service functions like renting a private lane on a superfast data highway, where capacity is 100% dedicated to the customer and data remains contained within the wavelength's boundaries. With available speeds of up to 400G (soon to be 800G!), wavelengths enable organizations to build robust digital infrastructure that supports everything from cloud connectivity to AI model training and edge computing workloads. So why is wavelength connectivity gaining in popularity and demand? Partly, this is because it is always the first network solution to advance up the bandwidth continuum, making it a perfect fit for interconnecting datacenters and cloud instances so that data-intensive workloads can move unconstrained in a distributed environment.

Today's DWDM line systems can achieve aggregate bandwidth capacities that far exceed today's Ethernet and configurations. As the requirements for AI workloads continue to grow rapidly, continued advancements such as the adoption of 400G and 800G will provide the necessary capacity to sustain the performance of AI networking.

Benefits

Transformative Digital Infrastructure Economics

The economic advantages of wavelength services extend far beyond simple cost-per-bit calculations. For enterprises building out distributed IT infrastructure, wavelength connectivity offers superior economics of scale that become increasingly compelling at higher bandwidth requirements. A 10Gbps wavelength circuit may cost similarly to carrier Ethernet solutions, but the value proposition becomes dramatic at 100Gbps+, where wavelength services deliver significantly higher capacity and flexibility.

This economic efficiency is particularly important for organizations investing in AI infrastructure, where the cost of inadequate connectivity can bottleneck expensive compute resources. Datacenters supporting AI workloads require consistent, high-bandwidth connections that can scale quickly — capabilities that wavelength services deliver more cost effectively than traditional alternatives.

Modern AI operations require seamless dataflows spanning hybrid cloud and multicloud environments. AI workloads that leverage large-scale GPU clusters require low-latency, high-capacity networking to handle the massive amount of data that the training of large language models (LLMs) generates. This is essential for applications across a diverse range of industries leveraging natural language processing, computer vision, and real-time analysis and decision-making.

Wavelength services also provide complete protocol transparency, allowing organizations to run Ethernet, IP, and other protocols over the same wavelength infrastructure. This flexibility is crucial for organizations that need to support diverse high-intensity storage and compute architecture. Unlike Carrier Ethernet solutions that operate at higher network layers, wavelength services offer direct control over the optical layer, enabling organizations to optimize performance for specific applications and workloads. In addition, some carriers offer enhanced features, such as topology viewers that map wavelength paths, facilitating the ability to switch paths and toggle between protected and unprotected paths.

Other features may include the ability to conduct laser diagnostics and AI-enabled networking monitoring that predicts equipment failures and notifies of fiber cut risks.

Scalability and Low Latency

Wavelength services provide a clear evolutionary path for growing digital infrastructure demands. Technology continuously expands capacity from 10Gbps to 100Gbps, 400Gbps, and beyond, ensuring that today's infrastructure investments remain relevant as bandwidth requirements grow. This scalability is particularly valuable for organizations building AI infrastructure, where model complexity and training data set sizes continue to expand exponentially.

The modular nature of wavelength services allows organizations to start with current requirements and scale capacity incrementally, avoiding the over-provisioning common with traditional connectivity solutions. This approach optimizes both capital expenditure and operational efficiency while ensuring that infrastructure can adapt to future technological advances.

Modern AI infrastructure demands unprecedented bandwidth and ultralow-latency connectivity. AI training clusters require bandwidths ranging from 800Gbps to 1.6Tbps between nodes, capabilities that wavelength networks can reliably deliver. Many network operators are scaling up their infrastructure, with over half expecting 1.6Tbps connectivity to become a standard requirement.

The deterministic performance characteristics of wavelength services make them ideal for AI model training, where consistent bandwidth and predictable latency directly impact training efficiency and model quality. For inference workloads, particularly those deployed at the edge, wavelength connectivity ensures that AI applications can deliver real-time responses regardless of geographical distribution.

Seamless Cloud Connectivity

As organizations adopt multicloud strategies and hybrid infrastructure models, wavelength services provide the high-performance backbone needed to connect on-premises datacenters with public cloud resources. The connectivity fabric extends beyond traditional datacenter boundaries to include cloud on-ramps, creating a seamless hybrid infrastructure that treats cloud resources as natural extensions of private datacenters.

This unified connectivity fabric supports cloud-native applications that require consistent performance across hybrid environments, enabling workloads to span private and public infrastructure while maintaining predictable network characteristics. The dedicated nature of wavelength circuits ensures consistent performance for cloud-native applications, data replication, and backup operations, while the scalability of DWDM technology allows organizations a level of bandwidth agility as cloud workloads evolve.

Security and Reliability

In an era of increasing cybersecurity threats and compliance requirements, wavelength services provide inherent security advantages through their dedicated, private nature. Unlike internet-based transmission methods, wavelength circuits offer isolated data paths that significantly reduce attack surfaces and ensure data integrity for sensitive workloads. As an additional security measure, customers can opt to implement optical layer encryption to further ensure their data is not compromised. Future evolution of "in flight" encryption capabilities will weave in quantum base security, such as post-quantum cryptography and/or quantum key distribution.

Enabling Edge AI

The distributed nature of edge computing requires connectivity solutions that can deliver consistent performance across diverse geographical locations. Coherent optics technology, integral to modern wavelength services, enables high-speed connections that support AI processing at edge locations. This capability is essential for applications requiring ultralow-latency inferencing, such as autonomous vehicles, industrial IoT, and real-time analytics.

Trends and AI Use Cases

The convergence of AI, 5G, and multicloud networking is creating unprecedented demand for high-capacity connectivity solutions. Hybrid cloud and multicloud strategies that require consistent performance across diverse infrastructure environments have energized cloud-native networking, which leverages cloud-based infrastructure to provide scalable, flexible, and automated connectivity solutions.

Organizations are increasingly migrating from traditional MPLS and Ethernet solutions to wavelength services, driven by two critical factors: superior capacity scaling and economic advantages. While legacy solutions typically max out at 10Gbps for most implementations and 100Gbps for premium Ethernet services, wavelength circuits offer security and low-latency bandwidth scaling to 800Gbps and beyond. At every bandwidth tier above 10Gbps, wavelength services deliver superior price-per-gigabit economics while providing future-proof scalability.

In detail:

- » **Distributed AI networking:** The rapid growth of AI training and inferencing, especially for LLMs such as ChatGPT, is driving unprecedented demand for ultrahigh-speed connectivity. Modern AI workloads now routinely involve training models with hundreds of billions of parameters distributed across thousands of GPUs located in multiple datacenters. This distributed computing paradigm, which brings computation and data storage closer to the data source, is essential for minimizing latency and enabling real-time data processing.
- » **Financial services:** Financial services companies rely on the processing and transactions of massive data sets for high-frequency trading and analytics where milliseconds of network latency can determine the loss or gain of millions of dollars.
- » **Retail/digital commerce:** Retail companies rely on billions of interactions and transactions per day that require instantaneous analysis identity verification and fraud mitigation and predictive analysis for product catalogs and personalization to meet hundreds of various demographics.
- » **Media transmission:** Wavelength circuits are ideal for transmitting high-definition video in professional media and broadcasting. They offer high bandwidth, low latency, and reliable performance for the storage and distribution of HD broadcast video content.
- » **Healthcare segment:** Healthcare organizations with multiple locations, including large hospitals and smaller clinics, leverage imaging centers for highly distributed and secure networking across campus and wide area networks. They depend on ultrahigh-speed dedicated networking. Increasingly, these institutions are looking to wavelength-based services to meet the growing demand for bandwidth — driven by data-intensive applications such as medical imaging, vaccine research and LLM training, radiology, and electronic health records.

As AI computing shifts from LLM training to AI inference, datacenter interconnects must balance the connectivity needs of edge and core datacenters, supporting latency-sensitive inferencing at the edge while central hubs manage compute-intensive model training. Wavelength networks ensure seamless data transfer between these distributed facilities.

Network service providers are rapidly expanding wavelength service offerings to meet growing enterprise demand. Initially driven by hyperscalers, datacenter operators, and cloud providers, wavelength services are experiencing significant growth in enterprise adoption. Providers are now offering 400Gbps wavelength services as standard, with 800Gbps services gaining market traction and positioned for substantial uptake by 2026, according to IDC projections.

Technology/Vendor Profile

Lumen is a leading networking provider with 340,000 global fiber route miles and over 400 locations providing 400G connectivity, making it North America's largest ultralow-loss intercity fiber network. The company has deployed 78,300 next-generation 400G wavelength route miles and continues to expand this capability. It offers a broad range of metro and long distance networking services, including IP, Ethernet, and wavelength networking, as well as edge networking and cloud services. Lumen offers a Private Connectivity Fabric for AI-ready network capacity, including dedicated access to existing and new fiber routes between datacenters. The network offers access to over 2,200 global on-net third-party datacenters. It has 163,000 on-net fiber buildings.

Lumen Wavelength Solutions are intended to provide high-capacity, low-latency connectivity for enterprises with demanding data needs. The company has designed these solutions to improve operational efficiency by optimizing network resources and reducing costs. The platform is scalable, allowing businesses to expand their network capacity as needed. The solutions include the following key aspects:

- » Designed to support AI and multicloud environments, they offer dedicated fiber-optic connections for seamless data transfer.
- » They provide network security with advanced encryption and protection measures.
- » They support real-time data processing and latency-sensitive applications.
- » They provide robust connectivity for enterprises across various industries, including healthcare, finance, and media.

Challenges

It's important for enterprises to have a good understanding of capacity requirements so the appropriate optical infrastructure and technology can be implemented based on the required bandwidth. The complexity of establishing dynamic connectivity for wave paths and routing can be daunting and should be done in close consultation with a service provider. Enterprises should consider the security of the network as well as cost drivers, such as distance, scalability, and redundancy.

Enterprise consumption of data is growing at an average of 25% per year, with 30% of North American enterprises experiencing growth of over 50% per year in data traffic on enterprise networks. It is essential to map out the availability of current and future capacity based on the layout of the enterprise network. The availability of scalable capacity up to 800G that can be deployed dynamically on demand is currently only available from or planned by a small number of network operators, such as Lumen, and should be a major consideration for enterprises.

Finally, redundant wavelength paths and enforceable SLAs from the service provider are good insurance against equipment failure. Transparency of the recent history of network performance is also important.

Conclusion

The insights provided in this document highlight the critical role of wavelength solutions in addressing the connectivity needs of modern enterprises. As businesses continue to navigate the complexities of digital transformation, the adoption of advanced connectivity solutions will be essential for maintaining competitiveness and achieving operational excellence. The trends and benefits outlined the importance of strategic investment in connectivity infrastructure to support future growth and innovation.

Based on the required application, enterprises should work with the network service provider to chart a road map of migration and adopt high-speed wavelength service. This requires some understanding of future capacity requirements, as well as the enterprise architecture, whether campus or wide area, and the requisite availability of nearby on-net fiber ramps. Enterprises should also consider access to cloud regions to provide seamless hybrid cloud and multicloud networking, if that is a requirement. Companies such as Lumen are aggressively implementing wavelength capacity and partnering with cloud service providers and colocation providers to meet a diverse array of enterprise requirements.

Additional issues to consider when identifying current and future AI workloads include the following:

- » What type and volume of workflows will traverse the network? Will complex models be deployed for deep learning, NLP, and real-time and predictive analysis?
- » What capacity bandwidth will be required in the medium-term to long-term future? Does your network partner scale from 10Gbps to 100Gbps and 400Gbps, and how fast can capacity be deployed?
- » Are redundant networking and SLAs available to guarantee low latency and MTTR?
- » Does the provider offer proximity to cloud on-ramps?
- » Is the connectivity partner able to facilitate efficient optical power equipment, network management, and visualization tools to map wavelength paths and automate risk detection and fault mitigation?

As businesses continue to navigate the complexities of digital transformation, the adoption of advanced connectivity solutions will be essential for maintaining competitiveness and achieving operational excellence.

About the Analyst



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Courtney Munroe is responsible for supporting IDC's continuous research on global telecommunications, cloud communications, and datacenter services trends. His core research includes the implementation of digital infrastructure by networking and colocation providers and analysis of API-based customer engagement solutions by cloud communications platform providers. His research focus also includes consumer and enterprise networking requirements and demand models and analysis of the communications service provider strategies as they transform to implement new business models.

MESSAGE FROM THE SPONSOR

Lumen is a global network solutions provider that enables enterprise data connectivity and digital infrastructure. Its service portfolio includes metro and long-haul fiber connectivity—delivered through wavelength services supporting up to 400 Gbps and a private connectivity fabric that integrates wavelengths, ethernet, dark fiber, and optical switching for dedicated, low-latency transport. Additional offerings include edge cloud, security, managed services, and a digital orchestration platform. These capabilities are designed to support distributed architectures and high-performance applications, including AI workloads and digital transformation initiatives. Learn more about [Wavelength Solutions | Lumen](#).



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