

Infinera Groove G30 Network Disaggregation Platform

Powering Tomorrow's Cloud Experience

ENABLING CLOUD SERVICES WITH BEST-IN-CLASS CONNECTIVITY

The exponential growth of streaming cloud video delivery and the transition of consumer and business services to the cloud continue relentlessly and pose a challenge for data center connectivity. At the heart of all cloud services is the network, and the success of cloud services is dependent on the transport network that interconnects data centers and the network that connects end-users to the data center hosted services. Infinera enables Internet Content Providers, Communications Service Providers, Carrier Neutral Providers, and enterprises to meet the surging demand for high speed connectivity with comprehensive mobile and fixed connectivity solutions. Infinera interconnect solutions provide the programmable, high speed, secure bandwidth that cloud applications require with best-in-class low power consumption, high density, and flexibility for data center connectivity at the lowest total cost.

BENEFITS OF INFINERA DCI SOLUTIONS

- **Enable** high speed connectivity to and between data centers
- **Enhance** end-user quality of experience with best-in-class connectivity solutions
- **Reduce** total cost of ownership via industry-leading low power consumption and highest density
- **Maximize** optical transmission performance in metro, regional, or long haul applications
- **Accelerate** revenue and service deployment with operational simplicity and open interfaces
- **Improve** service and application performance by extending automation from the data center to the network

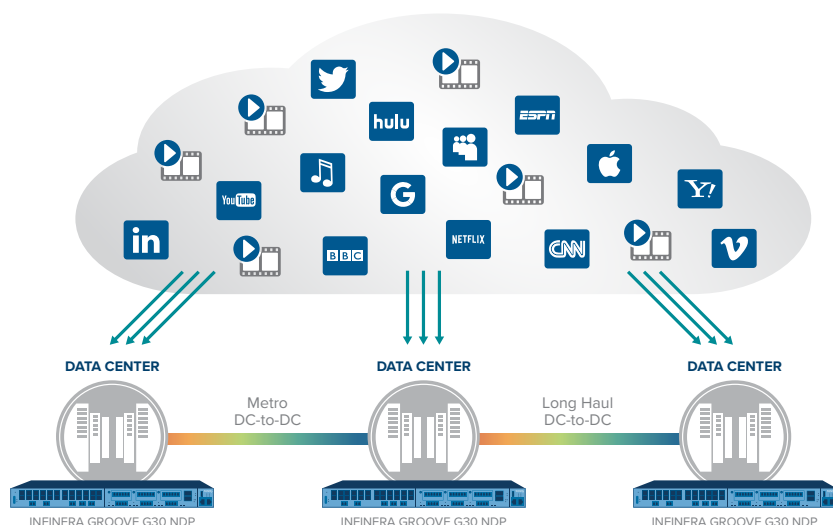


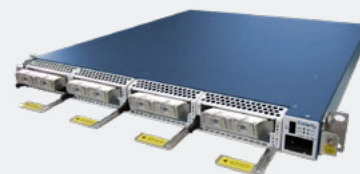
Figure 1: Powering High Performance, Cost-efficient Data Center Connectivity

THE PURPOSE-BUILT INFINERA GROOVE G30 NETWORK DISAGGREGATION PLATFORM

The Infinera Groove G30 Network Disaggregation Platform (NDP) is an innovative 1RU modular open transport solution for cloud and data center networks that can be equipped as a muxponder terminal solution and as an Open Line System (OLS) optical layer solution. Purpose-built for interconnectivity applications, the disaggregated Groove G30 delivers industry-leading density, flexibility, and low power consumption.



Infinera Groove G30 Open Line System (OLS)



Infinera Groove G30 Muxponder (MUX)

With innovative three-tier modular open plug-and-play capabilities, the Groove G30 can be customized for the required application based on the installation of specific modules or sleds and pluggables into the common Groove G30 chassis. Infinera supports a range of modules for DWDM transmission/muxponding terminal applications and modules supporting OLS applications including passive optical multiplexing/demultiplexing and amplification along with additional active optical layer functions. Designed to meet the scalability requirements of network operators now and into the future, the Groove G30 features the industry’s most compelling pay-as-you-grow disaggregated approach that enables the lowest start-up costs, reduced equipment sparing costs, and cost-effective scalability.

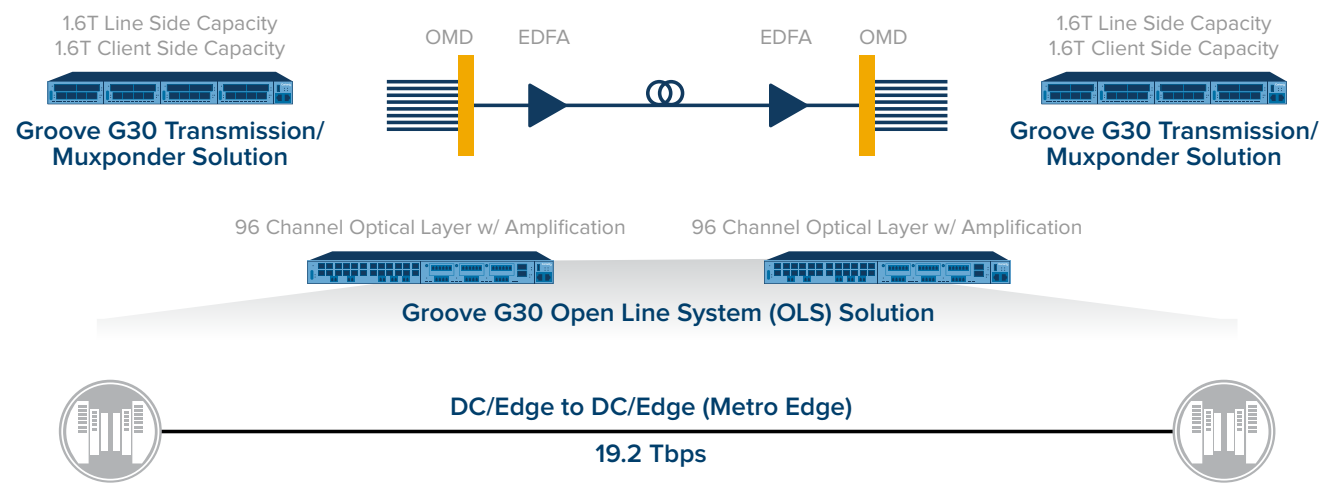


Figure 2: Infinera Groove G30 Network Disaggregation Platform Applications

SUPPORTING MULTIPLE INTERFACES FOR INTEGRATION AND SIMPLIFIED OPERATIONS

The Groove G30 NDP provides standards-based interfaces that simplify integration and operation within cloud and data center environments, including support for open Northbound Interfaces (NBIs) and APIs. The supported interfaces include CLI, Web GUI, SNMP Fault and Performance Management, Syslog, Zero Touch Commissioning (ZTC), NETCONF, RESTCONF, and gRPC machine-to-machine APIs. The Groove G30 OLS provides a set of native YANG models that can map into any industry standard defined or proprietary YANG model. These interfaces enable rapid integration of the Groove G30 NDP into traditional telecommunications environments and data center software defined networking (SDN) environments. The Groove G30 NDP is fully integrated with Infinera planning, management, and control solutions, including the Infinera Transcend Chorus for Transport network management system and the Infinera Transcend Solution. As an open software and hardware platform, the Groove G30 NDP supports rapid introduction and integration within any data center or telecom operating environment and interoperates seamlessly with existing metro or long haul line systems.

Delivering on the Infinera commitment to open solutions and disaggregation, the Groove G30 NDP empowers cloud and data center operators to build their own customized, scalable, and secure transmission and optical line solutions with best-in-class functions, all enabled through open APIs.

GROOVE G30 OPEN LINE SYSTEM SOLUTION

Equipped as the Groove G30 Open Line System (OLS) solution, the Groove G30 NDP delivers an optical layer with industry-leading density and flexibility in a highly compact and modular 1RU form factor. The open, plug-and-play optical layer solution delivers three to five times the density over comparable offerings. With category-defining OLS capabilities, this configuration of the Groove G30 gives network operators the ultimate in configuration flexibility to cost efficiently address diverse Data Center Interconnect (DCI) and metro application demands, including coherent and direct detect (PAM4) interconnect.

With the ability to support up to 96 channels (wavelengths) with full WDM terminal capabilities, including all passive and active functions, the OLS solution for the Groove G30 sets a new benchmark in flexibility and efficiency.

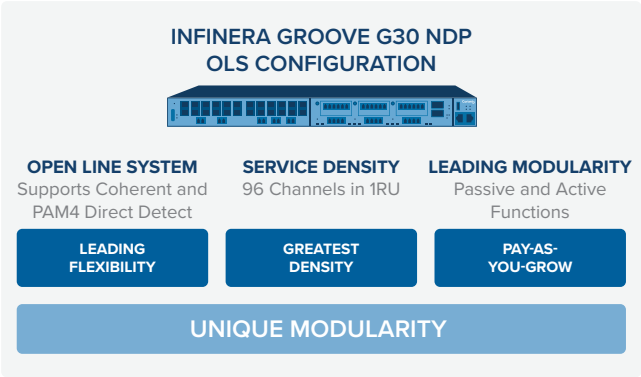


Figure 3: Infinera Groove G30 NDP Open Line System (OLS) Solution

The highly compact and modular optical layer enables network operators to significantly reduce CapEx and OpEx as traffic demands increase, while simplifying service deployment and accelerating OSS integration with open NBIs using YANG model based NETCONF and RESTCONF. The OLS configuration offers an easy-to-use CLI, web based Graphical User Interface (GUI), and support for legacy SNMP.

The Groove OLS solution lowers the cost and removes the uncertainty of evolving optical layer requirements. By providing the ability to mix and match different optical layer functional components – multiplexer/demultiplexer, amplification, optical channel monitoring, optical protection, Optical Supervisory Channel (OSC), OTDR, tunable DCM functions, etc., network operators can customize optical layer deployments without paying for unwanted functionality. As interconnect needs evolve and transmission technologies change, new optical layer functionality can be easily and cost effectively introduced by adding or swapping additional components, while preserving investment in those components that can remain unchanged. The Groove OLS solution is purposely architected to accommodate the requirements of future open optical layer initiatives along with new features and capabilities, enabling operators to cost effectively evolve networks while protecting network investments.

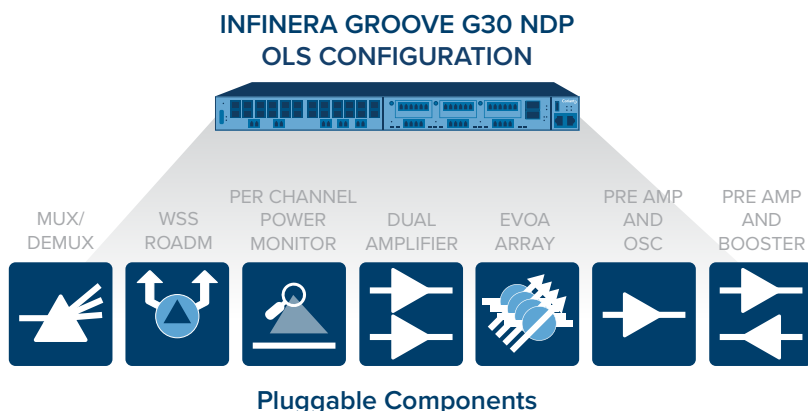


Figure 4: The plug-and-play modular Groove G30 NDP enables customizable DWDM optical open line system support for DCI and metro applications

Delivering Game-Changing Innovation for DCI Optical Layer Optimization

Purpose-built as a disaggregated and compact optical layer to manage surging data traffic volumes, the Infinera OLS solution is based on the Groove G30 NDP and leverages revolutionary Infinera Pluggable Optical Layer innovation. Key benefits of the modular solution include:

- **Open line system** – prevents vendor lock-in by disaggregating the optical layer from the transmission layer and enables the Groove OLS to be paired with either Groove or third-party transponder solutions
- **Industry-leading optical layer density** – supports up to 96 channels in 1RU with full WDM terminal functionality, including passive and active optical layer functions, delivering three to five times the density over comparable solutions and enabling significant OpEx savings via minimized footprint and power efficiencies
- **Unmatched configuration flexibility** – enables “build your own optical layer” based on plug-and-play configurable technology for coherent or direct detect (PAM4) applications including a diverse range of optical layer functions in compact modular pluggable formats such as multiplexing/demultiplexing, preamplifier, booster amplifier, local add/drop amplifier, optical channel monitoring, optical protection, OSC, OTDR, and tunable DCM functions
- **Open management** – shares common YANG model based NETCONF and RESTCONF and other northbound management and control interfaces of the Groove G30 for fast deployment and ease of integration into any OSS environment

THE GROOVE G30 MUXPONDER TERMINAL SOLUTION

Equipped as a muxponder solution, the Groove G30 Muxponder (MUX) solution delivers 3.2 terabits of high-density transport capacity throughput in a compact 1RU form factor with the industry’s lowest power consumption. The Groove G30 MUX enables Wide Area Network (WAN) cloud connectivity services, including 10G, 40G, and 100G client services through modular and pluggable interfaces. Powered by Infinera CloudWave Optics, the Groove G30 MUX supports programmable DWDM line interface bandwidth and performance to optimize high-capacity transmission from 100G to 400G in metro, regional, or long haul applications. Flexible DC and AC modular and field replaceable power supply options are supported.

Delivering Game-Changing Innovation for DCI Optimization

The Groove G30 MUX achieves a leading performance advantage by leveraging the latest innovations in high speed optics, photonic/electrical integration, and silicon photonics. By cost effectively powering a better end-user cloud experience and managing growing data traffic volumes to and between data centers, the Groove G30 MUX sets new benchmarks in network performance, including:

- **High Density** – supports 3.2 Tbps in a compact high-density and scalable platform driving significant space and OpEx savings
- **Lowest Power Consumption** – 0.20W per GbE of duplex traffic, including CFP2-ACO and client optics, enables 50 percent lower power consumption per 100G versus available competing products, dramatically reducing energy costs and offering OpEx savings
- **Lowest First Cost** – simple pay-as-you-grow system design and mix and match pluggable interfaces deliver the industry’s lowest first cost for 10G, 40G, and 100G services, enabling cost-efficient deployment and easy capacity scaling as data center traffic increases, as well as the lowest cost for onsite sparing
- **Leading Programmability/Reach** – powered by Infinera CloudWave Optics, the Groove G30 MUX supports dynamically adjustable modulation formats (16QAM, 8QAM, QPSK) to deliver cost-optimized optical reach in both metro and long haul applications and enable rapid capacity increases as cloud traffic escalates

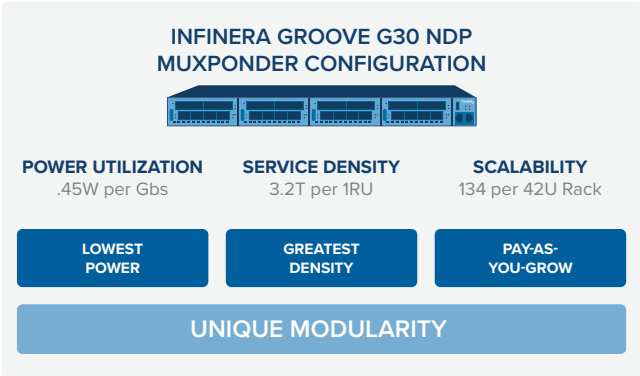


Figure 5: Infinera Groove G30 Muxponder Solution

Ride on Any DWDM with the Freedom to Use Any Optical Line Solution

The Groove G30 NDP prevents vendor lock-in by disaggregating transmission (muxponder) from the optical layer (OLS), and the Groove G30 MUX solution can be paired with Infinera’s optical layer solutions or third-party line systems that support alien wavelengths. This flexibility enables the Groove G30 MUX solution to be deployed with various optical layer line solutions to support high count point-to-point, linear chain and ring or mesh DWDM network architectures. While each situation is case dependent, Infinera offers options for product interworking to support various optical layer networking requirements.

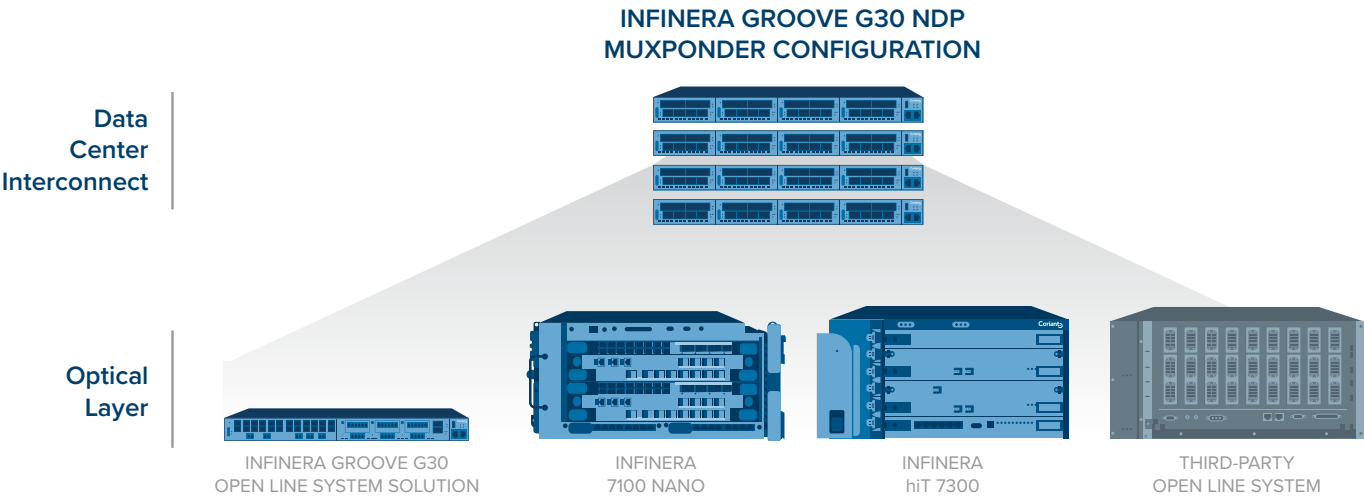


Figure 6: Optical Line Solution Options for use with Infinera Groove G30 Muxponder Applications

The Groove G30 MUX solution can be paired with the Groove G30 OLS solution or with the Infinera 7100 Nano Packet Optical Transport Platform for metro DCI WAN applications, the hiT 7300 Multi-Haul Transport Platform for long haul DCI WAN applications, or third-party line systems.

- **Category-Defining Infinera Groove G30 OLS Solution** – The Groove G30 OLS solution is an ideal optical layer solution to be used with the Groove G30 MUX solution for combined terminal and line system deployments. The small footprint and low power consumption of the Groove OLS combined with the Groove G30 MUX, which supports high-density 10G, 40G, and 100G optical transport, provides a highly cost-effective, low power consumption approach to scaling bandwidth in metro and DCI WAN applications. Using the Groove G30 for both terminal and line functions further enables common operational efficiencies, which reduces operational costs. This combination is optimal for high-capacity point-to-point applications.
- **Best-in-Class Metro Optical Layer with the 7100 Nano** – The 7100 Nano deployed with the Groove G30 MUX solution enables increased network flexibility, efficiency, and resiliency and provides the ideal solution for a complex multi-degree ROADM or a mesh optical networking interconnection of data centers. The 7100 Nano offers the industry's most advanced optical networking solution, supports virtually any metro/regional application, and ensures seamless migration from one configuration to another. When paired with Groove G30 MUX applications, the 7100 Nano offers an industry-leading high-density optical layer solution enabling up to six ROADM degrees in a single 5RU shelf. The 7100 Nano supports the complete integration of all multi-degree ROADM components, including the Wavelength Selective Switch (WSS), input amplifier, output amplifier, OSC, and per channel power monitoring and power balancing in a single slot ROADM module for advanced multi-degree topologies.
- **Highest Performance Long Haul Optical Layer with the hiT 7300** – The hiT 7300 deployed with the Groove G30 MUX solution delivers high performance long haul optical network interconnection. The hiT 7300 is a proven, flexible, and cost-efficient 96-channel platform optimized for high-capacity transport in multi-haul networks. The hiT 7300 combines the highest level of optical layer performance with the greatest optical layer flexibility available in the industry. With diverse configuration options including fixed-grid, flexi-grid, super-channel technology, broadcast and select, route and select ROADM, integrated EDFA, booster and Raman amplifiers, as well as fixed, colorless, directionless, and contentionless add/drop structures, the hiT 7300 system paired with the Groove G30 MUX can be tailored to provide precisely the amount of flexibility and performance required for virtually any long haul application. The hiT 7300 uses a combination of advanced per channel optical power optimization with automated feedback loops with finely tuned digital modulation and signal processing to achieve the best optical performance. The result is a solution that requires the least amount of regenerations, reduces costs, and provides the greatest amount of service resiliency for interconnectivity applications.
- **Third-Party Open Line Systems** – In addition to supporting deployments over any of the Infinera optical layer solutions, the Groove G30 MUX can be paired with third-party open line systems that support alien wavelengths. This interworking enables the advanced transmission benefits of the Groove G30 MUX to be added to existing deployments. The Groove G30 disaggregates transponders/muxponders from the optical layer and provides open line system compatibility to avoid vendor lock-in. Supported northbound management and SDN API interfaces ensure integration into management systems, planning tools, and SDN control ecosystems.

Infinera supports unparalleled flexibility in optical layer choices including Infinera optical layer solutions and third-party open line systems. Pairing the Groove G30 MUX with the category-defining Groove G30 OLS, the best-in-class 7100 Nano metro solution, or the highest optical performance long haul hiT 7300 delivers significant optical layer advantages and leverages the benefits of end-to-end network management and SDN control.

REACHING NEW LEVELS IN DCI AUTOMATION AND SERVICE PERFORMANCE

Infinera network management, planning tools, and SDN control solutions work together with the Groove G30 and Infinera optical layer solutions to enable a new level of network automation, utilization, and service performance. As a foundation for control and management, the Groove G30 provides standards-based interfaces for direct integration into cloud and data center environments, including support for CLI, SNMP fault management, and YANG modeled NETCONF and RESTCONF machine-to-machine APIs. To enhance WAN automation and improve network utilization, Infinera provides an advanced operational toolkit consisting of the Infinera Transcend Symphony multi-vendor SDN Controller, Infinera Transcend Chorus for Transport network management system, and the Infinera TransNet Network Planning Tool. These components work independently or as an integrated group with the Groove G30 and Infinera optical layer solutions.

Deploying the full suite of Infinera solutions not only lowers operational costs and improves network efficiencies but also fully leverages state-of-the-art capabilities in various operational environments.

- **Infinera Transcend Symphony multi-vendor SDN controller** – Provides abstraction and virtualization of resources through open, standards-based SDN interworking and includes an optical impairment aware multi-layer path computation element (PCE). With these advanced capabilities, Transcend Symphony enables automated multi-layer DCI service activation and improves utilization of the WAN.

- **Infinera Transcend Chorus for Transport network management system** – Offers a next-generation platform to unleash the potential of networks with exceptional operational efficiency. With a full suite of end-to-end FCAPS management capabilities, Transcend Chorus supplies the tools to automate and simplify provisioning and efficiently control data center connectivity, which drives lower OpEx and improves service performance.
- **Infinera TransNet Network Planning Tool** – Delivers an optical planning tool that supports the complete planning and installation process of DWDM networks, including comprehensive routing and aggregation algorithms to maximize network resource utilization and support multiple protection schemes to enhance network reliability

For cloud and data center operational environments, Transcend Symphony enables integration of the Groove G30 and the Infinera optical layer solutions into SDN ecosystems to support WAN service activation. Transcend Symphony can help extend the SDN automated environment inside the data center to the DCI WAN and improve end-to-end operational efficiencies, network utilization, and application performance.

In OSS, BSS, and network management operating environments, Transcend Chorus offers provisioning capabilities for the Groove G30 NDP and the Infinera optical layer solutions to automate service activation and provide fault and performance management of the end-to-end WAN network. Infinera can also help to bring automation enabled by SDN to these operating environments through the addition of Transcend Symphony.

Infinera supports diverse operational environments including SDN control, network management, and a hybrid combination of both with partitioning for simultaneous SDN and NMS control. Offering both a complete set of operational and management tools and the opportunity to enable direct open interfaces on the Groove G30 NDP, Infinera delivers the toolkit to drive multi-layer network efficiencies and next-generation service innovation in WAN applications.

POWERING A BETTER CLOUD EXPERIENCE

The Groove G30 NDP enables cloud and data center operators to build their own customized, scalable, and secure transmission and optical line solutions with best-in-class functions, all enabled through open APIs. The Groove G30 NDP reinforces Infinera's commitment to open solutions and delivers on the promise of disaggregation.

Optimized to address the staggering growth in video and DCI traffic, the Groove G30 NDP brings game-changing advantages through the latest innovations to enable an unrivaled connectivity solution and achieve new benchmarks in enhanced network performance. Infinera connectivity solutions power a better cloud experience.