

PORTFOLIO

INFINERA SOLUTIONS PORTFOLIO

Profitably Deliver the Next Wave of Services

Building and operating a connectivity network is a perpetual cycle of growth, evolution and transformation. Network bandwidth continues to grow at a substantial rate, wireless networks are evolving to 5G and cable networks are changing to a distributed access architecture (DAA). Meanwhile, end-user services must simultaneously evolve to support virtual and augmented reality, the tactile internet and new Internet of Things (IoT) applications such as autonomous driving. To tackle these challenges and embrace this progression, network operators need a trusted partner to ensure their networks are built with solutions that leverage the latest technologies. By offering innovative solutions and deep vertical integration, Infinera is in a unique position to provide network operators with the differentiation they require to remain ahead of their competition and achieve their business objectives.

Built on industry-leading technologies, from Infinite Capacity Engine (ICE) optics to multi-layer orchestration, Infinera solutions span access, metro, long-haul and subsea domains. They are designed

to help network operators grow revenues with new 5G- and DAA-enabled services and a broad range of enterprise services while reducing costs, as shown in Figure 1. Infinera software platforms enable intelligent automation that decreases operational expenditure (OpEx) and optimizes network assets while enabling an evolution to self-organizing and self-optimizing networks powered by machine learning and artificial intelligence, delivering on Infinera’s vision for cognitive networking. Converged multi-layer switching maximizes network efficiency, enables network operators to quickly adapt to changing traffic patterns and service demands, simplifies operations and speeds network rollout. Innovative optical technologies minimize the cost per bit of transmission, while disaggregated solutions reduce vendor lock-in and accelerate innovation. Infinera subsea solutions maximize the return on subsea cable investments with record-breaking spectral efficiency. Infinera also offers a wide range of professional services to assist in optimizing existing networks and transforming legacy networks.

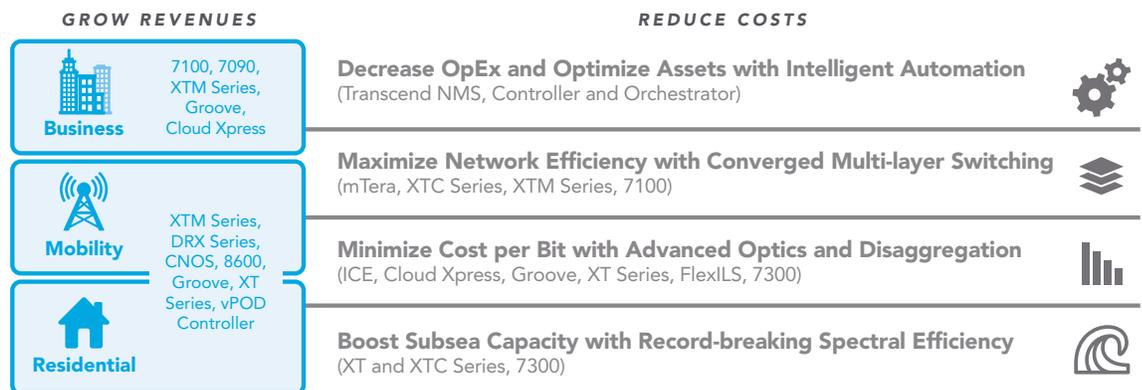


Figure 1: Enabling Revenue Growth While Reducing Costs

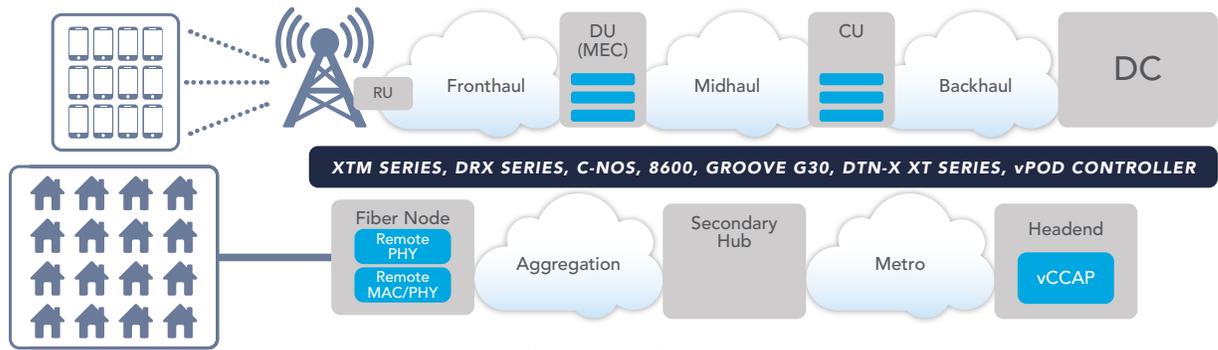


Figure 2: Infinera Solutions for 5G and DAA

Enabling Revenue Growth with 5G, DAA and Enterprise Services

Optimized for key areas of industry growth, including enterprise services, 5G and cable multiple-systems operator (MSO) evolution to DAA, Infinera solutions enable a wide range of network operators to launch new services, differentiate their existing offerings and grow revenues.

Facilitating 5G with Innovative Transport and Edge Compute Solutions

5G will transform mobile and fixed wireless services, providing up to, and potentially above, 1 gigabit per second (Gb/s) to users, a 1,000-fold increase in the capacity per unit area, a significant increase in IoT scale and the enhanced reliability and ultra-low latency required for applications such as autonomous driving and remote surgery. Enabling network operators to deliver on the promise of 5G, Infinera provides differentiated and innovative solutions for fronthaul, midhaul, backhaul and multi-access edge computing (MEC). Solution highlights include eCPRI (Common Public Radio Interface) support, software-defined networking (SDN)-enabled sliceability, industry-leading synchronization, disaggregated routing with stacking and fabric-based multi-unit scaling, a compact and waterproof cell site router and a virtual POD (vPOD) controller for MEC PODs.

Powering Cable MSO Network Evolution with Solutions for DAA

Cable MSOs are evolving their access networks to DAA and converged interconnect network (CIN) to support ultra-high-definition video, to grow revenues with new IoT and cloud-based services for consumers and wholesale transport services for mobile operators and to prevent threats including over-the-top (OTT) video and cord-cutters. To address these challenges and push fiber deeper into the access network, Infinera solutions for cable MSOs leverage the same

XTM Series	High-density, low-power packet-optical platforms with industry-leading synchronization, eCPRI interfaces for fronthaul and automated wavelength tuning for fiber deep access networks. Part of the XTM Series, the 1 rack unit (1RU) EMXP XH800 is optimized for 5G and DAA, provides 800 Gb/s of packet aggregation within a hardened street-cabinet-deployable device
DRX Series	Packet switching white boxes with capacities from 300 Gb/s to 9.6 terabits per second (Tb/s) provide carrier-class redundancy and synchronization features and environmentally hardened options
Converged NOS	Network operating system (NOS) leveraging proven 8600 Series IP/Multiprotocol Label Switching (MPLS) code that runs on DRX Series or third-party white boxes to provide a scalable disaggregated router solution
8600 Series	IP/MPLS routers with industry-leading synchronization and power consumption, scaling from a compact and hardened/waterproof 3 Gb/s cell site device to a 1.2 Tb/s aggregation chassis
Groove Series	1RU open transport platform that can be equipped as a muxponder terminal solution with up to 4.8 Tb/s line capacity (8 x 600 Gb/s wavelengths) and less than 0.2 watts per Gb/s, and as an open line system with optical layer sleds and pluggables
XT Series	Compact, sliceable meshponders leveraging the ICE4 optical engine to deliver 1.2 Tb/s in 1RU and 2.4 Tb/s in 4RU, with maximum reach and low power consumption
vPOD Controller	Available with the Transcend Orchestrator, it provides control and visualization of all resources in a POD-based MEC, including end-to-end service management and stitching, as a single entity

Table 1: Key Infinera Products for 5G and DAA

products that support 5G, as shown in Table 1. These solutions enable the transition to technologies including Full Duplex DOCSIS 3.1, DAA, Remote PHY and Remote MAC/PHY and Head End Re-architected as a Data Center (HERD). Solution highlights include industry-leading power consumption (<0.2 watts per Gb/s), carrier-class disaggregated routing, compact high-capacity packet aggregation and Auto-Lambda tuning to simplify access network installation.

Growing Enterprise Revenues with a Wide Range of Differentiated Services

Business services continue to be an important part of many network operators' business models. To facilitate internet connectivity, point-

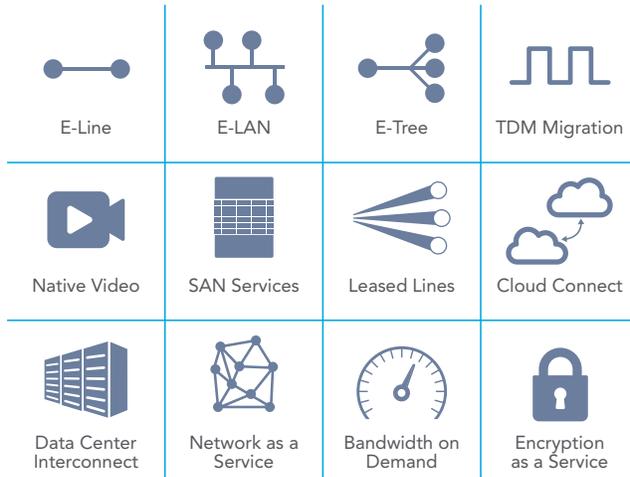


Figure 3: Addressing a Wide Range of Enterprise and Wholesale Services

to-point private line services, virtual private networks and connectivity to and between data centers, network operators need solutions that keep pace with the variety and scale of enterprise services. Infinera solutions enable our customers to take the lead over their competition with a wide range of differentiated enterprise and wholesale services, as shown in Figure 3.

Infinera solutions, enabled by the products in Table 2, can provide a full range of Metro Ethernet Forum (MEF) Ethernet services including E-Line and E-LAN services, storage area network (SAN) services including Fibre Channel and InfiniBand and native video services such as serial digital interface (SDI) and high-definition SDI (HD-SDI). These solutions enable data center interconnect and cloud connect services ranging from tens of megabits per second (Mb/s) to hundreds of Gb/s. High-margin time-division multiplexing (TDM) leased line revenues can be maintained while migrating to packet or Optical Transport Network (OTN) technologies. Next-generation services such as network as a service and bandwidth on demand can be delivered by combining flexible transport switching, SDN

control and graphical user interface (GUI)-based customer portals. Additional enterprise service capabilities include wire-speed data plane encryption and ultra-low-latency transport.

Reduce Costs with Scalable and Efficient Multi-layer Transport

While Infinera solutions for 5G, DAA and enterprise services enable network operators to grow revenues with new and differentiated services, profitable revenue growth also requires delivering these services cost effectively. To address this requirement, Infinera solutions leverage intelligent automation that reduces OpEx and optimizes network assets, offer converged multi-layer transport that maximizes network efficiency, provide advanced optical technology and disaggregation that minimize the cost per bit and facilitate subsea connectivity with record-breaking spectral efficiency.

Decrease OpEx and Optimize Network Assets with Intelligent Automation

Leveraging open architectures based on SDN principles, Infinera software solutions are designed to provide a platform for automation that reduces operational costs, optimizes network assets, speeds time to revenue and maximizes network and service availability. Intent-based automation translates service requests into optimized multi-layer (Layers 0 to 3) network configurations, while closed loop automation proactively monitors network state and service performance and takes action to assure service quality when appropriate. Further, the Transcend software architecture offers a DevOps environment enabling customized network programmability for operators. Future enhancements embracing artificial intelligence, machine learning and predictive analytics will deliver on the Infinera vision of a truly cognitive network.

7100 Series	Enables a wide range of enterprise services including wavelength services, Synchronous Optical Networking (SONET)/Synchronous Digital Hierarchy (SDH)/OTN leased lines, encrypted services, MEF Carrier Ethernet (CE) 2.0 Ethernet services, SAN services and native video
XTM Series	Enables enterprise services including MEF CE 2.0 Ethernet, SAN, ultra-low-latency services, TDM leased lines and wholesale mobile transport; also ideal for private enterprise networks
7090 Series	Includes compact customer-premises equipment (CPE)/network interface devices (NIDs) and a range of Multiprotocol Label Switching-Transport Profile (MPLS-TP) switches; ideal for MEF CE 2.0 Ethernet services and emulated TDM leased lines from E1/T1 to STM-16/OC-48 delivered over packet
Cloud Xpress	1RU Cloud Xpress 2 leverages ICE technology to deliver a 1.2 Tb/s super-channel and provides a cost-effective option for interconnecting enterprise data centers
Groove Series	1RU modular open transport solution can be equipped as a muxponder or OLS and can be used as a high-capacity CPE and for interconnecting enterprise data centers

Table 2: Key Infinera Products for Enterprise Services

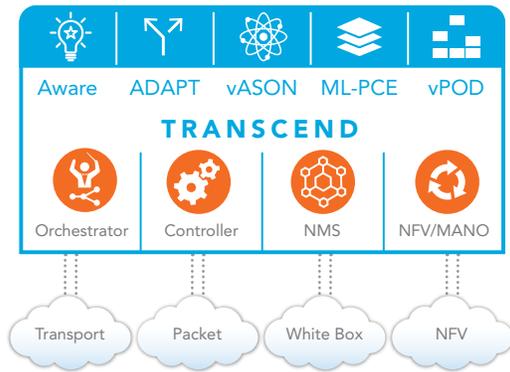


Figure 4: Automation with the Transcend Solution

Components of Infinera software solutions multi-domain Transcend Orchestrator, multi-vendor SDN Transcend Controller and Transcend Network Management System (NMS), including Digital Network Administrator (DNA) for network management. Virtual network function (VNF) management is enabled through NFVi support by the Transcend Orchestrator and ETSI-based open source management and network orchestration (MANO). Additional solution highlights include DevOps-style programmability, open interfaces (Representational State Transfer [REST], Representational State Transfer Configuration [RESTCONF], gRPC, Optical Internetworking Forum [OIF]/Open

Networking Foundation [ONF] Transport Application Programming Interface [T-API], MEF Lifecycle Services Orchestration [LSO]), GUI-based portals and Instant Bandwidth, which provides the ability to deploy, move and retire bandwidth using licenses.

Transcend Orchestrator	Provides multi-domain, multi-layer and multi-vendor orchestration, including NFVi, covering planning and simulation, deployment and configuration, service provisioning, monitoring and optimization
Transcend Controller	Enables the end-to-end provisioning and monitoring of services within a single technology domain using transport and packet SDN controllers
Transcend NMS	Provides full fault, configuration, administration, performance and security (FCAPS) management functionality and automates network operation tasks from commissioning to service activation testing
ETSI-based Open Source MANO	Offers powerful tools for the management of VNFs, including the definition of services, fault and performance management and monitoring

Table 3: Transcend Software Suite

Maximize Network Efficiency with Converged Multi-layer Switching

OTN switching, supported on the XTC Series and mTera Universal Transport Platform (UTP), provides a cost-effective and spectrally efficient solution for distributed traffic patterns while also providing efficient client interface flexibility, operational simplicity, fast service provision-

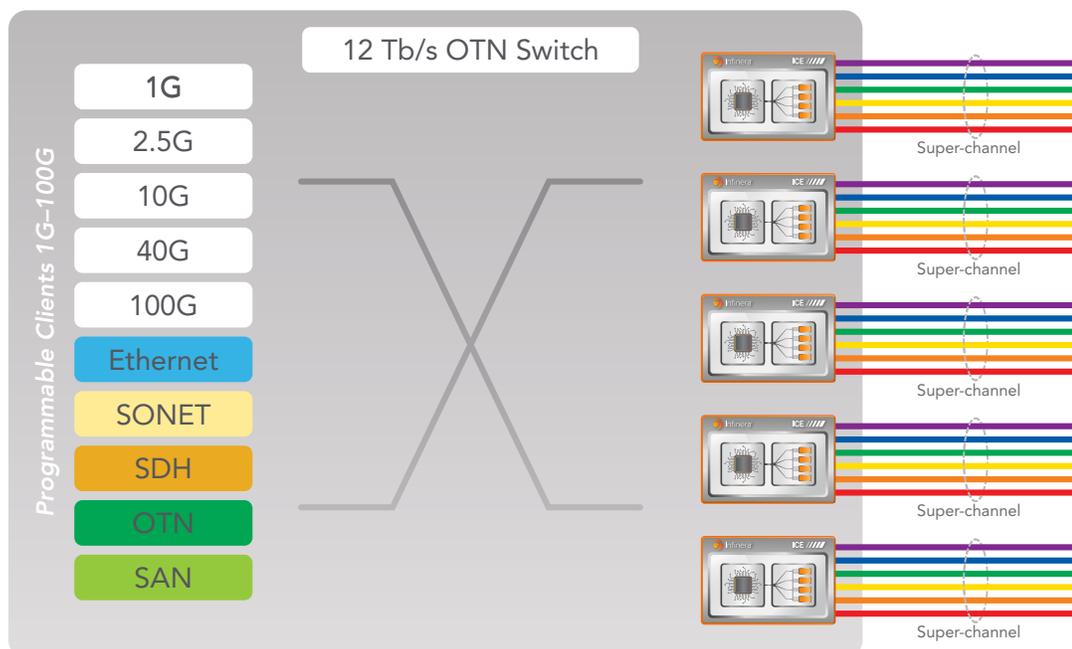


Figure 5: XTC Series: OTN Switching with ICE

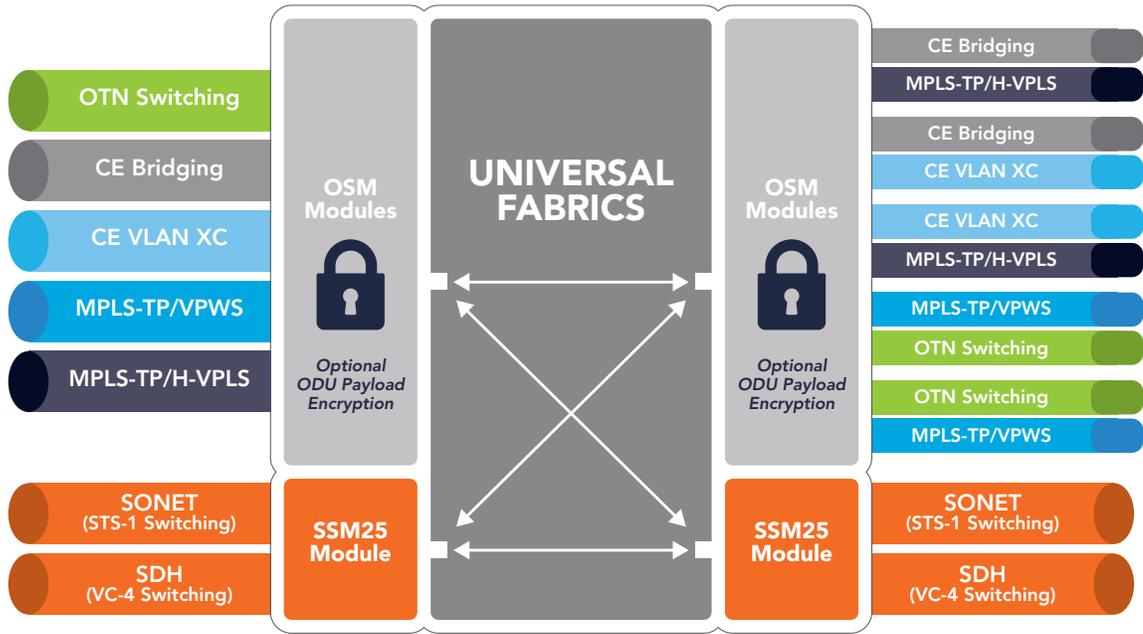


Figure 6: mTera UTP Universal Switching

mTera Series	Combines up to 12 Tb/s of universal switching with a next-generation optical layer based on route-and-select reconfigurable optical add/drop multiplexer (ROADM)-on-a-blade with colorless-directionless (CD) and colorless-directionless-contentionless (CDC) add/drop, Raman and optical time-domain reflectometer (OTDR) options
XTC Series	Offers 12 Tb/s of OTN switching with interfaces leveraging ICE technology, delivering operational simplicity and network efficiency
7100 Series	Compact metro platform supporting ROADM-on-a-blade, optical pluggables (Pluggable Optical Layer), 10 gigabit (10G) and 100G muxponders/transponders and up to 1.2 Tb/s fabricless switching

Table 4: Multi-layer Switching Platforms

ing times and the ability to deliver new services based on virtualized bandwidth. Supported on the mTera UTP, universal switching further offers the ability to define any interface/virtual interface for OTN switching, MPLS-TP or Carrier Ethernet switching, enabling network operators to adapt to changing traffic patterns and service demands while also supporting flexible options for migrating legacy TDM-based networks and services to packet and/or OTN.

Furthermore, universal switching provides highly efficient native grooming of OTN, packet and SONET/SDH onto the same high-speed wavelengths. Complementing the mTera and XTC Series, the

7100 Packet Optical Transport Solutions provide up to 1.2 Tb/s of cost-effective fabricless switching leveraging a meshed backplane. Both the mTera UTP and 7100 Series enable converged electrical and optical switching in the same platform with capital expenditure (CapEx) savings of up to 25 percent, power consumption reductions of up to 40 percent and footprint reductions of over 30 percent, relative to the alternative of separate systems. Converged platforms can also simplify operations and speed network rollout.

Minimize Cost per Bit with Advanced Optical Technology and Disaggregation

Regardless of the location, whether in the metro or long-haul, between large data centers or under the sea, the need for cost-effective, dense, power-efficient, high-capacity point-to-point transport is everywhere. Infinera ICE technology combines advanced digital

Cloud Xpress Series	Optimized for 100 GbE data center interconnect, the 1RU Cloud Xpress 2 leverages the ICE4 optical engine to deliver a 1.2 Tb/s super-channel with up to 27.6 Tb/s per fiber pair
Groove Series	1RU open transport platform that can be equipped as a muxponder terminal solution with up to 4.8 Tb/s line capacity (8 x 600 Gb/s wavelengths) and less than 0.2 watts per Gb/s, and as an open line system with optical layer sleds and pluggables
XT Series	Compact, sliceable meshponders leveraging the ICE4 optical engine to deliver 1.2 Tb/s in 1RU and 2.4 Tb/s in 4RU, with maximum reach and low power consumption

Table 5: Minimizing the Cost Per Bit

FlexILS Series	Open line system combining flexible grid super-channel ROADM with C, CD and CDC add/drop and coherent-optimized C- and L-band next-generation amplifiers that enable ultra-long reach
hiT 7300 Series	Coherent optical transport system that maximizes reach, capacity and network availability in regional, long-haul and ultra-long-haul networks

Table 6: Open Flexible Optical Line Systems

signal processing and state-of-the-art photonic integration to help minimize the total cost for these applications by maximizing the optimal combination of wavelength speed, spectral efficiency and reach while minimizing footprint and power consumption. Available today on the Cloud Xpress and XT Series, the 1.2 Tb/s ICE4 optical engine delivers six wavelengths of up to 200 Gb/s with advanced features including sliceable super-channels, Nyquist subcarriers and soft-decision forward error correction (SD-FEC) gain sharing. Infinera’s sixth-generation 1.6 Tb/s optical engine, ICE6, will deliver two wavelengths of up to 800 Gb/s, leveraging ultra-high baud rates (88-100 gigabaud) with additional advanced features including second-generation probabilistic constellation shaping (PCS) and dynamic bandwidth allocation (DBA).

While Infinera platforms such as the mTera UTP, 7100 Series and XTM Series provide the option of converged packet-optical transport, Infinera also provides industry-leading solutions for network operators with a preference for open, disaggregated solutions that break vendor lock-in and speed innovation. Examples include the Groove Network Disaggregation Platform (NDP), Cloud Xpress and XT Series meshponders.

Boost Subsea Capacity with Record-breaking Spectral Efficiency

As the global demand for bandwidth continues to explode due to the rise of cloud-based services, existing submarine cable systems are rapidly running out of capacity. Infinera subsea solutions address this requirement for terabit scale and dynamic subsea capacity in three form factors. First is the subsea-optimized version of the XT Series

XT Series	Subsea-optimized sliceable meshponders that deliver record-breaking spectral efficiency enabled by Nyquist subcarriers and subsea-optimized modulations (ME-PSK, 3QAM, 8QAM)
XTC Series	Combines record-breaking spectral efficiency, enabled by Nyquist subcarriers, and subsea-optimized modulations with up to 12 Tb/s of OTN multiplexing, switching and service protection

Table 7: Key Products for Subsea

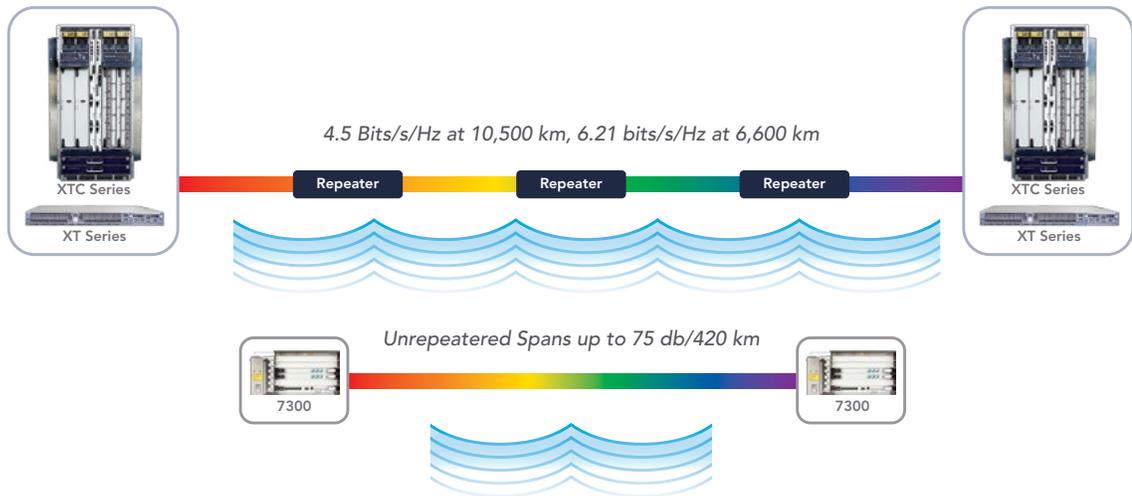


Figure 7: Infinera Subsea Solutions

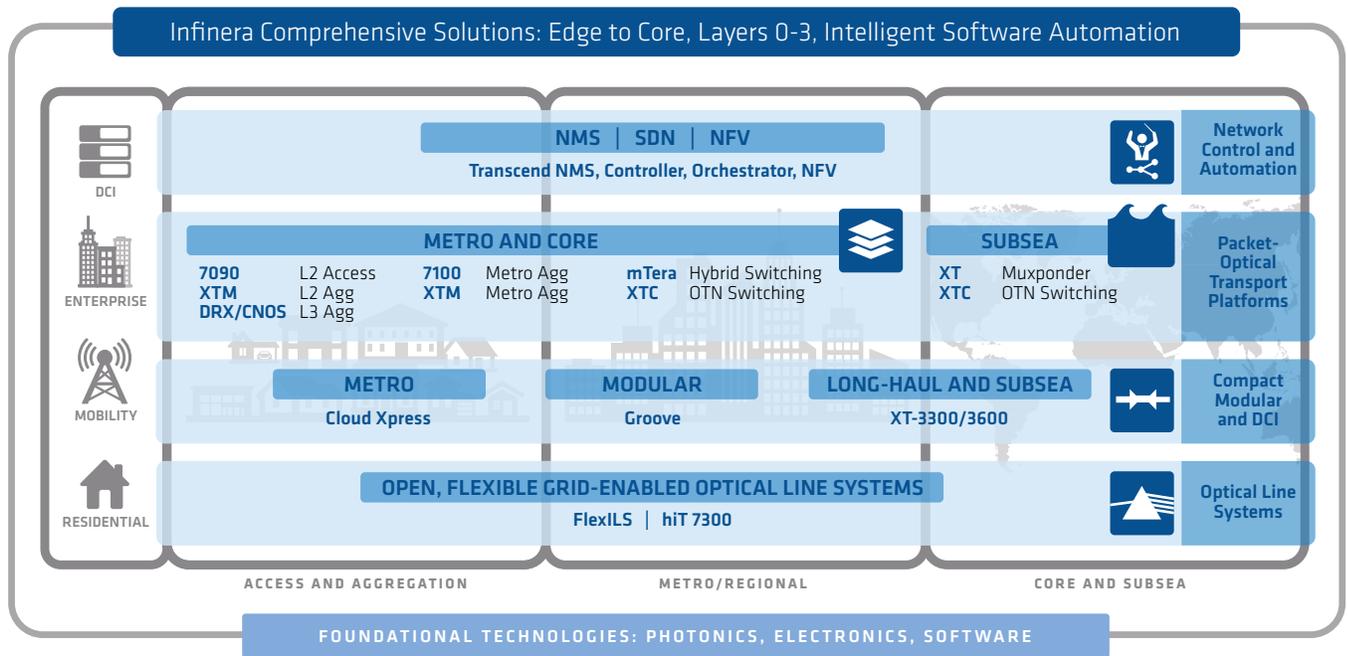
platforms, providing up to 2.4 Tb/s of line capacity and 2.4 Tb/s of client capacity in a low-power, compact form factor optimized for subsea applications. Second is the XTC Series, with subsea-optimized line cards that also deliver integrated OTN multiplexing, switching and service protection. Both form factors support subsea-optimized modulation formats including matrix-enhanced phase shift keying (ME-PSK) and 3 quadrature amplitude modulation (3QAM). In addition, both of these form factors support the industry's first commercially available Nyquist subcarriers, which helped to set subsea spectral efficiency records for both trans-Pacific (4.5 bits/second [s]/hertz [Hz] = 18.2 Tb/s per fiber pair at 10,500 kilometers [km]) and trans-Atlantic (6.21 bits/s/Hz = 24 Tb/s per fiber pair at 6,600 km) distances. The third form factor is the hiT 7300 Multi-Haul Transport

Platform, which provides an industry-leading solution for long, un-repeated single-span and festoon networks with spans of up to 75 decibels (dB)/420 km.

About Infinera

Infinera is a vertically integrated optical equipment vendor with global reach delivering a powerful suite of innovative, end-to-end packet-optical network solutions that leverage over 2,000 patents. With a presence in more than 45 countries and over 500,000 network elements deployed, Infinera serves over 600 internet content provider (ICP), service provider and enterprise customers, including nine of the top 10 global service providers and all of the top six global ICPs. To learn more, visit www.infinera.com.

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