

INFINERA DTN-X FAMILY

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Offering service providers multi-terabit network scalability, operational simplicity and superior network efficiency

Why Choose the DTN-X Family

In a world where cloud services are growing quickly and high-bandwidth connectivity is paramount, service providers must scale, simplify and increase the efficiency of their networks. As cloud infrastructure expands and networks migrate to a new architecture of Layer C (cloud services) and Layer T (intelligent transport), service providers need their Layer T networks to adapt to new traffic flows and to support smooth scale-out expansion. These cloud scale networks allow service

providers to efficiently address both large N x 100 Gigabit Ethernet (GbE) linear connectivity requirements driven by web scale operators and diverse mesh connectivity requirements driven by more traditional telco enterprise and residential customers.

Scalable photonics is the foundation of Layer T and must provide more bandwidth per line card and system while simplifying the network—fewer boxes, fibers and modules, less space and power, and fewer manual processes. Infinera believes that to achieve sufficient

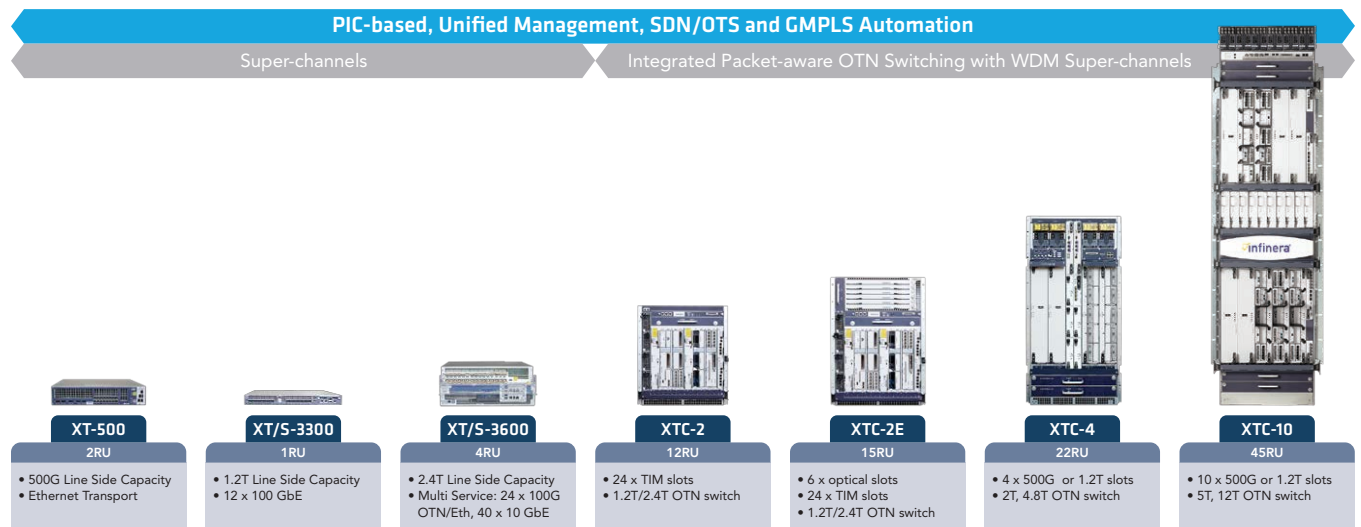


Figure 1: Infinera DTN-X Family

optical scale, photonic integrated circuits (PICs) are integral to the evolution of the transport network, and that PICs provide significant benefits when integrated into a packet-optical wavelength-division multiplexing (WDM) transport system for an efficient Layer T, ultimately allowing Layer C to thrive.

Infinera's Infinite Capacity Engine powers the DTN-X Family, integrating the advanced electronics of Infinera's next-generation Flex-Coherent® processor and the cutting-edge photonics of Infinera's fourth-generation PIC. The engine helps deliver the **next generation of coherent optical innovations**, such as:

- **Multi-terabit super-channels:** enabling massive network scale up to 2.4 terabits per second (2.4T) per super-channel on a single platform provisioned in one operational motion
- **Sliceable photonics:** tune and route any wavelength as small as 100 gigabits per second (100G) within a super-channel, or N x 100G super-channels in multiple separate directions, each with its own coherent modulation profile. Sliceable photonics reduce requirements for traffic modules in networks by up to 81% while delivering tremendous flexibility, resulting in up to 56% lower total cost of ownership (TCO)
- **Infinera Advanced Coherent Toolkit:** featuring breakthrough technology innovations such as Nyquist subcarriers and soft-decision forward error correction (SD-FEC) gain sharing, delivering up to 60% more capacity-reach performance for submarine and terrestrial networks
- **Multi-terabit encryption:** designed to support in-flight Layer 1 wire-speed encryption (encryption software license required for activation), which can be enabled per service or in bulk mode using hardware-specific, strong 256-bit Advanced Encryption Standard (AES) key and integrating hitless key exchange and cryptographic mechanisms.
- **Instant Bandwidth:** the ability to activate only a portion of the super-channel and then to activate additional wavelengths (combined with sliceability) on demand, as additional capacity is needed.

The Infinera DTN-X Family provides multi-terabit WDM transport and is designed to offer a combination of scale and efficiency while simplifying network operations. By combining plug-and-play automated turn-up, software-defined network (SDN)-enabled intelligence and service automation, the DTN-X Family provides a simpler system design to deliver the next generation Intelligent Transport Network.

DTN-X Family Overview

The Infinera DTN-X Family is a family of next-generation multi-terabit transport network platforms, comprising the DTN-X XTC Series, the DTN-X XT Series and the DTN-X XTS Series.

The DTN-X XTC Series provides integrated packet-aware digital switching with WDM super-channels, high programmability and open interfaces for subsea, long-haul, regional and metro networks. The XTC Series includes the following platforms:

- **XTC-10:** 45 rack units (45RU), 10 universal slots, up to 12T capacity
- **XTC-4:** 22RU, four universal slots, up to 4.8T capacity
- **XTC-2E:** 15RU, 24 interface slots, six open optical line system slots, 1.2T (2.4T future) capacity
- **XTC-2:** 12RU, 24 interface slots, 1.2T (2.4T future) capacity

The DTN-X XT Series delivers multi-terabit super-channel bandwidth in a compact form factor and is optimized for delivery of cloud scale network services over long-haul and regional networks spanning thousands of kilometers (km). The DTN-X XT Series combines muxponder technology with sliceable photonics to deliver hyperscalability up to 2.4T along with fine-grained granularity for optical mesh networks. The server-like XT Series platforms are the industry's first meshponder platforms, and were developed based on Infinera's experience in the web scale market. The DTN-X Series platforms seamlessly interoperate with the chassis-based DTN-X XTC switching platforms. The XT Series includes the following platforms:

- **The XT-3300** meshponder platform delivers 1.2T line-side capacity for metro, regional, long-haul and data center interconnect (DCI) networks in 1RU. The XT-3300 provides a reach up to 6,000 km in an ultra-compact form factor at 600 millimeter (mm) rack depth, with low power consumption.
- **The XT-3600** meshponder platform delivers 2.4T of line-side capacity for metro, regional and long-haul networks in 4RU. With redundant controller, 470 mm rack depth, a mix of OTU4, 100 GbE, 10 GbE client interfaces and Optical Transport Network (OTN) multiplexing, the XT-3600 supports a reach of 6,000 km.
- **The XT-500** delivers a 500 gigabit per second (500G) super-channel output with 10 GbE or 100GbE clients in 2RU of rack space with low power consumption.

The DTN-X XTS Series is designed to power cloud scale networks for subsea operators. Similar to the XT Series, the XTS Series combines 2.4T super-channels with sliceable photonics and is designed to support in-flight line-rate Layer 1 encryption (encryption software license required for activation) in a compact and lower-power form factor. In addition, the XTS Series features subsea-optimized modulation formats such as matrix-enhanced phase shift keying (ME-PSK) and 3QAM (quadrature amplitude modulation), as well as Infinera's Advanced Coherent Toolkit featuring the industry's first commercially-available Nyquist subcarriers to enhance capacity-reach performance. It delivers

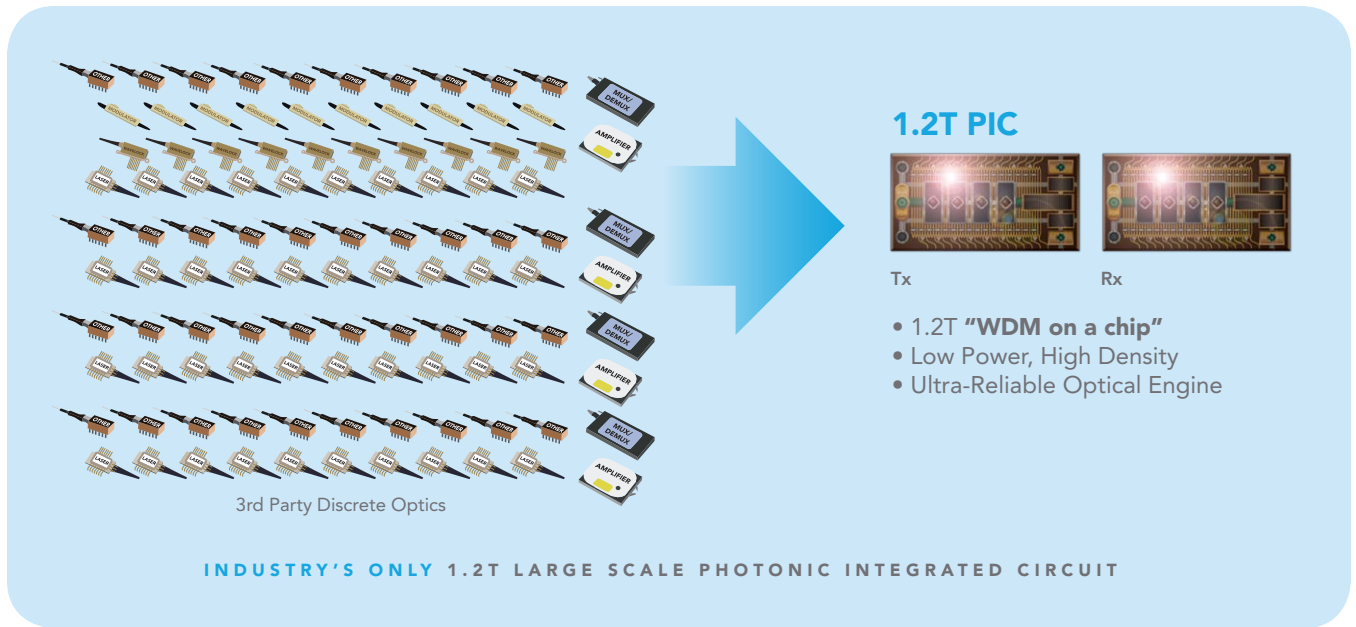


Figure 2: Photonic Integrated Circuit (PIC) Technology

multi-terabit super-channel bandwidth in a compact form factor and at the same time enables super-channels to be sliced, so each wavelength can be tuned across the C-band, modulated and then routed to the appropriate destination. The XTS Series is designed to support new subsea software tools for open networking, which enhance Infinera's open architecture by allowing subsea operators to partition and monetize valuable fiber spectrum so that it can be safely and securely shared with multiple customer tenants, independent of both cable and submarine line terminal equipment (SLTE) suppliers. Mission-critical subsea link performance data is available in real time on demand via open SDN application programming interfaces (APIs). This enables subsea operators to monitor transmission health as well as identify opportunities for capacity adjustments. The DTN-X XTS Series seamlessly interoperates with the DTN-X XTC and XT Series, providing a unified end-to-end Intelligent Transport Network portfolio, and when combined with Infinera's Instant Bandwidth it allows for instant end-to-end network reconfiguration covering subsea, long-haul, metro and data center interconnect applications.

The XTS Series includes the following platforms:

- **The XTS-3300** meshponder delivers up to 1.2T of line-side capacity in 1RU and provides enhanced capacity and reach for subsea applications in an ultra-compact form factor at 600 mm rack depth, with low power consumption.
- **The XTS-3600** meshponder delivers 2.4T of line-side capacity in 4RU. With redundant controller, 470 mm rack depth, a mix of OTU4, 100 GbE, 10 GbE client interfaces and OTN multiplexing, the XTS-3600 provides a multi-service platform for subsea applications.

The DTN-X Family provides network service intelligence and is positioned to meet the needs of service providers seeking to offer new and innovative services in a simple, scalable, and efficient manner.

Simple

The DTN-X Family is highly scalable and is simple to install, operate and troubleshoot. Services can be quickly and easily provisioned and transported over a common WDM layer. The key enablers of network simplicity include the ability to convert the network into a pool of services available to any service, anywhere. Also, generalized multi-protocol label switching (GMPLS)-based automated control plane enables automated topology discovery and service provisioning. Moreover, the DTN-X Family is highly programmable, supporting industry-standard open APIs for SDN control.

Scalable

Infinera is the industry's leading manufacturer of monolithic large-scale PICs. Infinera continues to prove this key technology with network deployments around the world. PICs are designed to improve network reliability and reduce power and space by integrating hundreds of optical functions onto a single chip. The DTN-X Family uses PICs and a clean sheet design to offer multi-terabit scale performance. For example, the XTC-10 scales up to 1.2T per slot, delivering a total of 12T of non-blocking packet-optical transport network (P-OTN)

switching per bay and 24T of non-blocking P-OTN switching in a dual-bay configuration. The non-blocking switching capacity is always available on the XTC Series without any sacrificing switching or WDM bandwidth, whether operating as a pure switch, as an integrated switch with WDM optics, or in pure WDM configuration. The XT Series also uses PICs to deliver up to 2.4T high bandwidth in mesh and point-to-point interconnects that can be rapidly provisioned.

Efficient

Infinera's Infinite Capacity Engine-based WDM line module consolidates hundreds of key optical functions and provides a foundation that enables space and power efficiencies. The DTN-X Family provides dense input/output (I/O) bandwidth per rack and a dense non-blocking switch fabric on the XTC Series, saving rack space. The DTN-X Family realizes power savings for a green footprint by using the lower power Infinera Capacity Engine.

An Architecture Without Compromise

The DTN-X Family leverages the latest generation of PIC and digital signal processor (DSP) technology built into Infinera's Infinite Capacity Engine to deliver multi-terabit scale with high efficiency.

The universal interface slots in the XTC Series accept client-side and line-side modules. Client interfaces include Synchronous Digital Hierarchy/Synchronous Optical Networking (SONET/SDH), ITU G.709 OTN, Ethernet, storage area network (SAN) and transparent clear-channel services, from 1G to 100G (and 400 GbE in the future).

Terminal, junction or optical cross connect (OXC) configuration for the XTC Series: Flexible universal interface slots and integrated switching with sliceable photonics allow each platform to be deployed in any configuration from a terminal node to multi-degree junction node with any add/drop ratio. The XTC Series can therefore be configured as a terminal node (mix of client and line modules), a junction/digital reconfigurable optical add/drop multiplexer (ROADM) (all line modules) or a multi-terabit OXC (all client modules).

High-bandwidth mesh and point-to-point configurations for the XT Series: Flexible reach, sliceable photonics, easy operation and a compact stackable design allow the XT Series to be configured for a variety of applications such as rings, spurs, long-haul data center interconnect, and hub-and-spoke.

Complete investment protection: The XTC Series supports a common set of line and client modules that are compatible among the different platforms. This simplifies inventory management while protecting investments in networking equipment.

- Seamless non-service-impacting upgrade from 5T to 12T (XTC-10) and 2T to 4.8T (XTC-4)
- Mix and match any line or client card, co-existence of 500G and 1.2T super-channel cards

Line system interoperability: The DTN-X Family interoperates seamlessly over the Infinera open flexible grid optical line system FlexILS. The Infinera line system includes the 20-port super-channel FlexROADM and is L-band-ready for increased flexibility, reach and bandwidth with fiber capacity of over 50T.

FlexCoherent

Infinera's next-generation FlexCoherent technology enables service providers to optimize network performance across a wide range of applications using a number of software-programmable advanced modulation formats. These include binary phase-shift keying (BPSK), ME-PSK, quadrature phase-shift keying (QPSK), 3QAM, 8QAM and 16QAM.

Instant Bandwidth

Infinera's Instant Bandwidth technology on the DTN-X Family enables service providers to adopt a cashflow-efficient business model, deploying additional bandwidth rapidly with a few mouse clicks when demand arises, without the need to order, install and deploy additional equipment.

Instant Network

Infinera Instant Network amplifies the power of Infinera Instant Bandwidth on the DTN-X Family and is the next step on the path to cognitive networking. Instant Network shrinks the time to engineer and deploy optical capacity by activating software defined capacity (SDC) as and when revenue-generating services demand it. It enables service providers to accelerate service delivery and lower operational expenditure (OpEx) by automating optical capacity engineering and reducing truck rolls.

FastSMP™

Infinera's FastSMP shared mesh protection technology on the XTC Series combines mesh restoration bandwidth efficiencies with sub-50 millisecond (ms) recovery. Using shared protection bandwidth

reduces the network bandwidth needed for protection since it is more efficient with network resources than 1+1 protection.

Infinera's FastSMP shared mesh protection uses pre-planned and pre-signaled protection circuits. GMPLS is used as the control protocol. The pre-signaled protection circuit reserves resources only in the control plane, and does not commit any resource in the data plane.

Packet Services

Infinera's packet services technology on the XTC Series provides advanced packet features and quality of service (QoS). It directly maps Ethernet and multi-protocol label switching (MPLS) services with QoS from the edge of the network to core transport services using OTN, creating a highly efficient packet-optical network.

GMPLS

Service providers can simplify optical network operations with the extensive automation capabilities incorporated into the Infinera IQ Network Operating System (IQ NOS) on the DTN-X Family. IQ NOS includes a GMPLS control plane that dynamically automates network topology discovery and enables end-to-end routing and provisioning. IQ NOS also enables plug-and-play capabilities for rapid system and network turn-up and bandwidth expansions. IQ NOS improves network manageability with embedded digital maintenance, digital performance monitoring and troubleshooting capabilities for rapid fault isolation.

Carrier-class Network Management and Control

The DTN-X Family is managed by the Infinera Management Suite, a collection of robust carrier-class applications and toolsets, including:

- The Infinera Graphical Node Manager (GNM): Full-featured graphical element manager

- The Infinera Digital Node Administrator (DNA): Graphical user interface (GUI)-based element and network management system
- The Infinera Network Planning System (NPS): Offline engineering, planning and optimization tool
- The Infinera XML Integration SDK and SNMP Fault Integration Server: Facilitates customer operations support system (OSS) integration

Designed for multi-layer networks and unified SDN control across the entire Infinera portfolio, Infinera's Xceed Software Suite is powered by Open Daylight and interfaces with third-party solutions via open APIs to provide revenue-ready applications for agile, assured orchestration of new services. Xceed makes bandwidth more dynamic and flexible. Xceed combines an open, multi-layer SDN control platform with modular, commercially-deployable applications that enable new revenue sources while increasing network efficiency. The Xceed Multi-layer SDN platform seamlessly interoperates with the Infinera Management Suite, enhancing Infinera's robust portfolio of software solutions to control and manage subsea, long-haul, metro and data center interconnect networks.

An optimal combination of scale and long-term network value is critical to the success of any transport network. The Infinera DTN-X Family combines customer-proven technologies such as large-scale PICs to offer scalability, simplicity and efficiency. As the network infrastructure transforms to the new model of Layer C and Layer T, the Infinera DTN-X Family offers a foundation for what the network will be.

[Contact us](#) to learn more.

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