

## XTM SERIES

## EMXP440 III

### A High-capacity Packet-Optical Transport Switch Delivering Ethernet Services in Packet-Optical Networks

The EMXP440 III packet-optical transport switch is part of the Infinera XTM Series, providing seamless integration of Layer 1 transport and Layer 2 metro Ethernet functionality in packet-optical applications. The EMXP440 III uses pluggable optics for 10 gigabits per second (Gb/s), 100 Gb/s and 200 Gb/s interfaces. An optical frontplane connection to the PTIO-10G traffic unit can be used to expand the number of 10G interfaces from 12 to 24 ports.

The combination of the EMXP440 III with other traffic units such as the PT-Fabric, EMXP II and EMXP IIe range enables cost-efficient metro and regional packet-optical transport, avoiding the need for separate Layer 1 transponders. This is achieved through the use of pluggable WDM optics supporting forward error correction (FEC) and full tuneability within all these traffic units, including the EMXP440 III.

#### Ethernet Transport

The EMXP440 III unit is specially designed to deliver an optimized high-capacity Ethernet transport solution. The unit creates a Layer 2-optimized transport architecture using selective integration of Layer 2 and multi-protocol label switching - transport profile (MPLS-TP) functions. MPLS-TP can be used to scale Ethernet services over larger networks.

Ethernet services can be port-based or fully service-multiplexed based on flexible combinations of customer or service virtual local area networks (VLANs), traffic type and priority on any interface in the system.



#### Key benefits:

- Compact and cost-efficient switching, demarcation and aggregation of Ethernet services
- Full wire-speed 440 Gb/s capacity for all frame sizes and up to 640 Gb/s capacity for average frames of 200 Bytes and above
- Dual pluggable 100 Gb/s/200 Gb/s interfaces for tunable metro WDM transport with 100 Gb/s (QPSK) or 200 Gb/s (16QAM) wavelengths
- Up to 24x 10 Gb/s interfaces through 12 onboard small form-factor pluggables (SFP+), and the option to extend to an additional 12x 10 Gb/s interfaces via a PTIO-10G unit
- Provides Carrier Ethernet 2.0 (CE 2.0)-compliant E-Line, E-LAN, E-Access and E-Tree services
- Ultra low latency and almost zero jitter
- Flexible network resiliency options through ERPS, LAG and MPLS-TP
- Synchronous Ethernet and IEEE 1588 for the efficient frequency and time synchronization essential for mobile backhaul and enabling time-division multiplexing (TDM)-over-packet services
- Low power design ensures low total cost of ownership

A strong classification and policy engine can be used to define flexible Ethernet services based on service-specific requirements and to use quality of service (QoS) classifications for traffic differentiation in the network. Bandwidth profiles allow service providers to offer services with bandwidth regulated to any speed.

The EMXP440 III can perform sub-50 millisecond (ms) protection for Ethernet services over a range of different topologies. This is possible thanks to the built-in support for hardware-based operations, administration and maintenance (OAM) that is used together with the protection capability.

The EMXP440 III provides a flexible toolkit of traffic management features. The toolkit includes features such as strict and weighted scheduling, bandwidth profiles and shaping of bandwidth.

### Carrier Ethernet 2.0 Services

The EMXP440 III provides powerful user-to-network interfaces (UNIs) and external network-to-network interfaces (ENNI), enabling port-based or fully service-multiplexed E-Line, E-LAN E-Access or E-Tree services, compliant with the Metro Ethernet Forum's (MEF) CE 2.0 services.

### SDN-enabled Switching

Together with Infinera's Xceed Multi-layer software defined networking (SDN) platform and the range of Xceed applications, the EMXP440 III enables service providers to create new revenue streams and reduce operational costs by increasing network efficiency. Examples of Xceed applications are on-demand provisioning of MEF-compliant Ethernet services, automatic service restoration and optimization of networks. (See Xceed product literature).

### Pluggable WDM Optics for 100 Gb/s and 200 Gb/s

The EMXP440 III utilizes state-of-the-art technology in the form of C form-factor pluggable (CFP2) optical modules for 100 Gb/s and 200 Gb/s optical transport. These pluggable modules can be used with polarization-multiplexed quadrature phase-shift keying (PM-QPSK)-modulated 100 Gb/s signals or 16 quadrature amplitude modulation (16QAM) on a single channel on the ITU-defined 50 gigahertz (GHz) dense wavelength-division multiplexing (DWDM) grid. The CFP2 modules are tunable over all 80 DWDM channels.

### Frontplane Connection for Interface Expansion

The use of an optical frontplane between the EMXP440 III and the 10 Gb/s line interface module (PTIO-10G) allows additional scaling of the 12 10 Gb/s LAN ports with an additional 12 10 Gb/s ports that support either 10G LAN or OTU2e with the additional benefit of FEC support. The frontplane uses vertical-cavity surface-emitting laser (VCSEL) technology and fiber ribbon cords between the EMXP440 III and the PTIO-10G.

### Resiliency

The EMXP440 III offers various methods to provide resiliency. The simplest method is to utilize IEEE 802.3ad Link Aggregation Group (LAG). Normal LAG as well as N+1 and N+N protection LAG are supported.

Furthermore, LAG can be distributed over two separate EMXP units using multi-chassis LAG, which coordinates information to present a single LAG to the connected system.

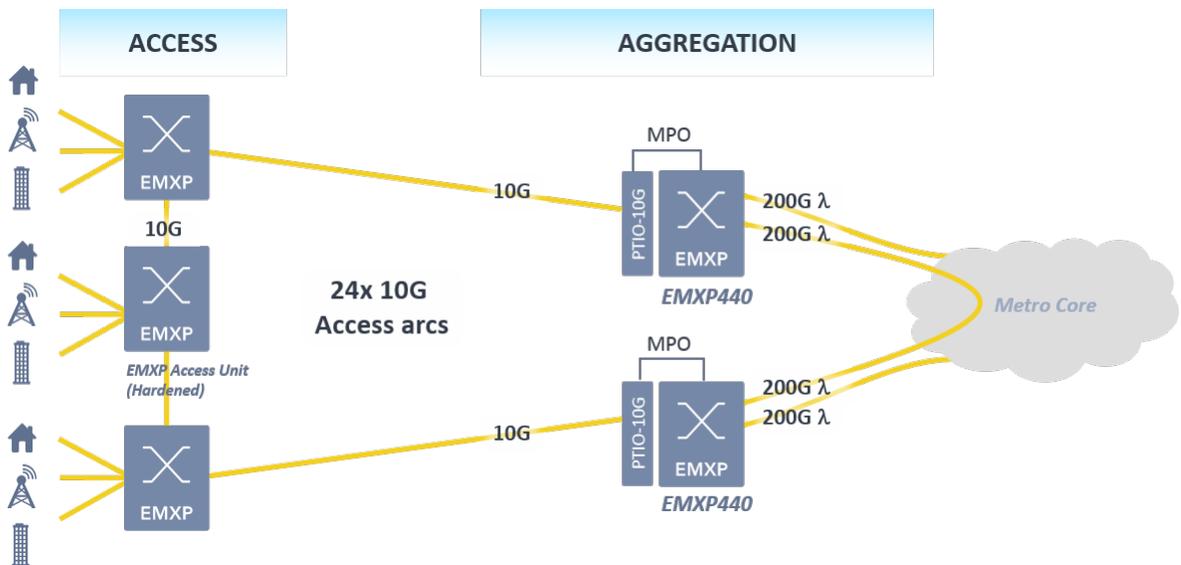


Fig 1. EMXP440 III Used to Aggregate Traffic from up to 24x 10 Gb/s Access Rings into the Metro DWDM Network

If units in the EMXP range are deployed in a ring topology, then ITU-T G.8032v2 Ethernet Ring Protection Switching (ERPS) also becomes an option. G.8032v2 supports multiple logical rings for the flexibility to use different VLANs in different rings, and allows dual interconnect points between rings to eliminate single points of failure. Rings can also be used in combination with LAG to easily scale ring capacity. It is even possible to add or remove links without service interruption.

For Ethernet traffic transported over MPLS-TP pseudowires, the protection function uses pre-defined back-up paths that ensure service continuity if the primary path fails. One of the benefits with MPLS is that it is possible to provide protection over any type of topology, including ring, full mesh or partial mesh, without involving a control plane.

Protection switching is performed with carrier-class sub-50 ms protection using any of these protection schemes.

### Synchronization and Timing

Mobile networks need reliable and accurate frequency synchronization from the mobile backhaul network, and some recent standards, such as Long Term Evolution Advanced (LTE-A), also require phase and time synchronization. Support for distributing both frequency through SyncE and phase and time through Precision Time Protocol (PTP) is built into the EMXP440 III.

The SyncE implemented in the EMXP440 III supports clock selection logic and onboard holdover that significantly exceeds Synchronous Digital Hierarchy (SDH) requirements. Synchronization signaling is used to provide traceability of the synchronization source and to do automatic sync source selection, providing high sync reliability.

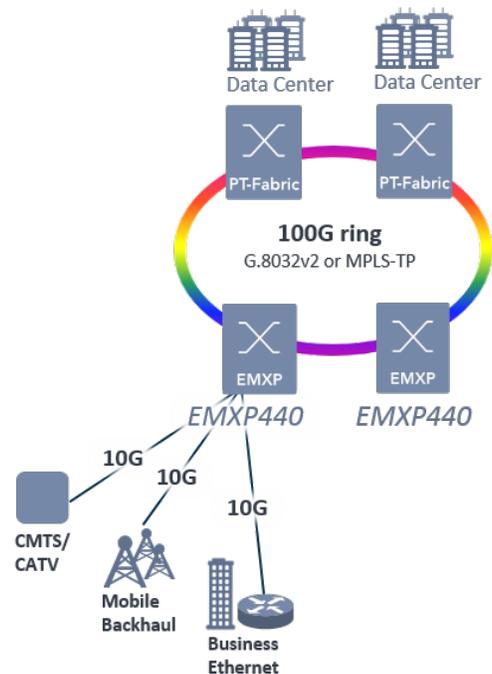
The EMXP440 III also supports IEEE 1588 transparent clock for phase and time synchronization. This function identifies PTP timing packets as close to the line interface as possible and adjusts the timestamps automatically for timing packets that are carried over native Ethernet or encapsulated in SVLANs or inside MPLS pseudowires. Adjusting these timestamps to compensate for the internal delay improves the accuracy of the PTP protocol and allows it to have more switch hops between grandmaster and slave without the need for expensive external references (e.g. from the Global Positioning System).

### Ultra-low Latency in Time-critical Applications

The EMXP440 III has latency of 1.4 microseconds in store-and-forward mode and virtually zero jitter for all packet sizes, regardless of traffic load. This makes the unit ideally suited to Ethernet applications in which latency and jitter are important, such as services for financial institutions, video distribution and LTE backhaul.

### Low Power Design

A fully equipped EMXP440 III with 12 10G Ethernet ports and two 200 Gb/s line interfaces consumes about 0.3 watt (W) per gigabit. Low power consumption, in combination with a small footprint, reduces operational costs and enables more capacity to be handled at sites with restrictions on power consumption, cooling and space.



**Fig 2.** EMXP440 III Used to Aggregate Traffic from up to 24x 10 Gb/s Access Rings into the Metro DWDM Network

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### Specifications

Interfaces	Two CFP2 for 100 Gb/s/200 Gb/s line interfaces. <ul style="list-style-type: none"> <li>• 100 Gb/s QPSK tunable over 80 DWDM wavelengths</li> <li>• 200 Gb/s 16QAM tunable over 80 DWDM wavelengths</li> <li>• 100 Gb/s LR4</li> </ul> 12 SFP+ for 10G Ethernet LAN One MPO connector for fiber ribbon frontplane connection to PTIO-10G.
Interface support via PTIO-10G	10G-LAN mode or OTU2e framing with GFEC, I.4 or I.7 FEC Uncolored multi-mode and single-mode CWDM up to eight channels, DWDM up to 80 channels
Resilience	IEEE 802.3ad Link Aggregation with LACP. Load sharing, N+1 and N+N protection LAG, Multi-chassis LAG ITU-T G.8032 Ethernet Ring Protection v2 Supports Ethernet ring over LAG and in-service adding/removing links MPLS-TP Linear Protection with Protection State Coordination (PSC) RFC6378
Ethernet Services	E-Line (EPL and EVPL), E-LAN (EP-LAN and EVP-LAN), E-Tree (EP-Tree), E-Access CE 2.0-compliant, MEF 9+14
Quality of Service	Policing using bandwidth profiles Flexible traffic classification, e.g. based on DSCP, CoS, port and inner/outer VLAN Eight strict priority queues/ WRR queues, min and max shaping. WRED
OAM	IEEE 802.1ag Continuity Check and Loopback, Port Mirroring Management VLAN for in-band management Port isolation using private VLAN technique Link Layer Discovery Protocol (LLDP)
Synchronous Ethernet and Timing	ITU-T G.8262 Synchronous Ethernet Equipment Clocks (EEC) ITU-T G.8264 Ethernet Synchronization Messaging Channel (ESMC) ITU-T G.781 Synchronization Status Messages (SSM) IEEE 1588v2 Transparent Clock
L2 Switching	Up to 640 Gb/s Ethernet switching for average frame sizes down to 200 Bytes and 440 Gb/s Ethernet switching for 64 Byte frame sizes Selectable learning enabled per VLAN, 4,094 VLAN IDs, 224K MAC-addresses Broadcast storm control IEEE 802.1ad Q-in-Q SVLAN Flexible VLAN tag handling: push, pop, swap, pop-swap, including double tag operations Super jumbo frames up to 9216 Bytes
Power Consumption (Including Optics)	Max 150 W at 55 degrees C and 136 W at 25 degrees C

Specifications and Features Are Subject to Change

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