∂infinera®

EMXP IIE

A Packet-Optical Transport Switch Delivering Ethernet Services in Packet-Optical Networks

The EMXP IIe 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 use of enhanced small form-factor pluggable (SFP+) optics for the 10G interfaces, in combination with on-board forward error correction (FEC), enables cost-efficient transport with EMXP-to-EMXP links without requiring the use of additional external transponders.

Ethernet Transport

The EMXP IIe range of units is specially designed to deliver an optimized Ethernet transport solution. The units create a Layer 2-optimized transport architecture using selective integration of Layer 2 and MPLS-TP functions.

Scaling Ethernet services over larger networks can be done by taking advantage of the multi-protocol label switching - transport profile (MPLS-TP) capabilities of the EMXP Family.

The EMXP IIe Range Includes from the Upper Left: EMXP48 IIe, EMXP62 IIe, EMXP120 IIe, EMXP220 IIe and EMXP240 IIe – All with the Same Feature Set and Capabilities, but with Different Interface Configurations.

Key benefits:

■ Compact and cost-efficient switching, demarcation and aggregation of Ethernet services

■ 10 Gb/s interfaces with selectable mode: OTU2e with FEC for enhanced reach, or 10 Gb/s LAN

■ Pluggable 100 Gb/s interface with support for CFP modules for SR10, LR4 and coherent 100 Gb/s with up to 1200 km reach

■ Provides Carrier Ethernet 2.0 (CE 2.0)-compliant E-Line, E-LAN, E-Access or E-Tree services

■ OpenFlow support providing control of switching resources for increased network efficiency and reduced operational costs in SDN-based networks

■ Ultra low latency and almost zero jitter

■ Connection-oriented transport of services through MPLS-TP

■ Flexible network resiliency options through Ethernet ring protection, link aggregation and MPLS-TP

■ Efficient video distribution enabled by source-specific IP multicast in combination with Internet group management protocol (IGMP) snooping

■ Synchronous Ethernet and IEEE 1588 for efficient frequency and time synchronization essential for mobile backhaul and enabling TDM-over-packet services
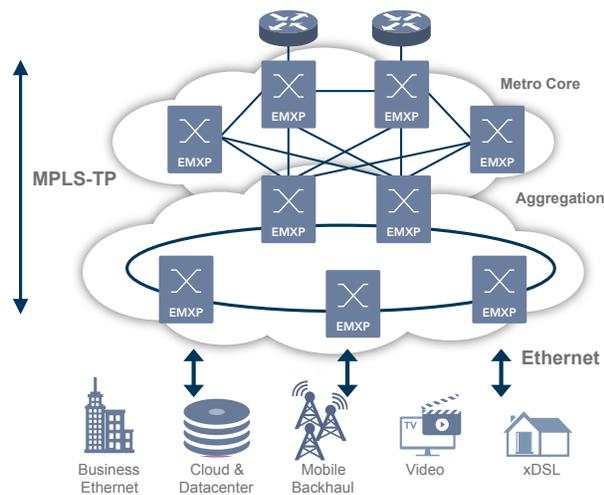
■ Low power design ensures low total cost of ownership

Fig 1. EMXP IIe in an Ethernet Backhaul Network Using MPLS-TP.

Transporting Ethernet over MPLS-TP pseudowires encapsulates the user traffic, allowing services to scale in large networks, and lets the Ethernet service be carried with protection over any type of topology.

Thanks to its built-in support for hardware-based MPLS and Ethernet operations administration and management (OAM), the EMXP IIe units have the capability to perform sub-50 ms protection for MPLS-TP and Ethernet rings.

SDN-enabled Switching

Through the support of an OpenFlow interface option, the EMXP IIe allows switching resources to be controlled over an open interface. This enables migration to software defined network (SDN)-enabled packet-based architectures with separated control plane and forwarding plane. When set to operate in open mode, the EMXP IIe allows an external controller to manage resources in the data plane so that services can be created in a more auto-mated and dynamic way. Furthermore, the SDN-enabled switch-ing provides greater flexibility for multi-layer optimization across layers 1, 2 and 3.

Together with Infinera's Xceed Multi-layer SDN Platform and the range of Xceed Applications, the EMXP IIe enables service provid-ers to create new revenue streams and reduce operational costs by increasing network efficiency. Examples of Xceed Applications are on-demand provisioning of Metro Ethernet Forum (MEF)-compliant Ethernet services, automatic service restoration and optimization of networks. (See Xceed product literature).

Pluggable Coherent Optics Providing 100 Gb/s Ethernet

The EMXP220 IIe utilizes state-of-the-art technology in the form of pluggable coherent C form-factor pluggable (CFP) optical modules. These pluggable modules are used in the 100 Gb/s interface of the EMXP220 IIe to provide a PM-QPSK-modulated 100 Gb/s signal on a single channel on the ITU-defined 50 GHz DWDM grid. The coherent CFP modules are tunable over all 80 DWDM channels.

The CFP modules provide the possibility of addressing multiple requirements with differentiated performance and optimized cost and reach per application. This is because the 100 Gb/s interface can also use non-coherent lower cost optical modules such as SR10 and LR4. This unique design reduces footprint and power requirements as well as spare parts and operational costs in general.

Carrier Ethernet 2.0 Services

The EMXP IIe units provide powerful UNI and E-NNI interfaces, enabling port-based or fully service-multiplexed E-Line, E-LAN E-Access or E-Tree services, compliant with the Metro Ethernet Forum's CE 2.0 services.

The EMXP IIe units offer a strong classification and policy engine to define extended and flexible Ethernet services and quality of service (QoS) classifications.

There are bandwidth profiles allowing service providers to offer services with bandwidth regulated to any speed.

Hitless Software Upgrade

The EMXP IIe units are designed for in-service upgrades, which allows easy introduction of new features in the network. Customer traffic is completely hitless when Carrier Ethernet services are upgraded, and the upgrades are done independently of service window scheduling. This significantly reduces the work involved in introducing new releases compared to many other Ethernet switching products.

Operations Administration and Management

The Ethernet services provided by the EMXP IIe are constantly monitored for interruption and performance with Ethernet service OAM, and the MPLS paths are monitored with bidirectional forward direction (BFD).

The built-in standards-based performance management functions use Y.1731 performance monitoring (PM) to measure and report loss delay and delay variation of different services. These performance metrics are exported to the Digital Network Administrator for XTM Series (DNA-M), and can be visualized for customers via the DNA-M Portal.

Quality of Service

The EMXP IIe units provide a flexible toolkit of traffic management features. The toolkit includes features such as strict and weighted scheduling, bandwidth profiles and shaping of bandwidth. Traffic can be classified either per port (for EPL, EP-LAN and EP-Tree services), or it can be classified per VLAN for service-multiplexed services (EVPL and EVP-LAN).

Resiliency

The EMXP IIe units offer 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 IIe units that coordinate information to present a single LAG to the connected system. This is called multi-chasses LAG.

If the EMXP units are deployed in a ring topology, then ITU-T G.8032v1 and v2 Ethernet ring protection switching also becomes an option. V2 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. Ring can also be used in combination with LAG so that the capacity of the ring can be easily scaled. It is even possible to add/remove links without service interruption.

For Ethernet transported over MPLS-TP pseudowires, the protection function uses pre-defined back-up paths that will 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 the protection schemes detailed in the table below.

Synchronization and Timing

Mobile networks need reliable and accurate frequency synchronization from the mobile backhaul network, and some recent standards, such as 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 EMXP IIe.

The implemented SyncE in the EMXP IIe supports clock selection logic and on-board holdover that 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 reliability of the sync.

All EMXP IIe units support 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 the protocol to have more switch hops between grandmaster and slave without the need for expensive external references (e.g. from GPS).

Source-specific Multicast for Video Distribution

The EMXP IIe units offer IGMPv3 and source-specific multicast (SSM), features that are unique in transport networks. These features allow the distribution of video traffic to be highly optimized and efficient as a destination only receives the traffic intended for it.

Ultra Low Latency in Time-critical Applications

The EMXP IIe units have a latency of two microseconds and virtually zero jitter for all packet sizes, regardless of traffic load. This makes them 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 EMXP220 IIe with 12 gigabit Ethernet ports and one 100 Gb/s Ethernet port consumes about 0.5 watt 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.

Specifications (Valid for EMXP48 IIe, EMXP62 IIe, EMXP120 IIe, EMXP220 IIe and EMXP240 IIe):

Interfaces	EMXP48 IIe: 4x10 Gb/s + 8xGbE EMXP62 IIe: 4x10 Gb/s+22xGbE EMXP120 IIe: 12x10 Gb/s EMXP220 IIe: 1x100 Gb/s+12x10 Gb/s EMXP240 IIe: 24x10 Gb/s	GbE/FE interfaces (SFP): • Uncolored multi mode and single mode • CWDM up to 16 channels or DWDM up to 80 channels • Single-strand fiber solution • Electrical 10/100/1000BASE-T 10 Gb/s interfaces (SFP+): • 10 Gb/s-LAN mode or OTU2e framing with GFEC, I.4 or I.7 FEC • Uncolored multi mode and single mode • CWDM up to 8 channels, DWDM up to 80 channels 100 Gb/s interfaces (CFP): • OTU4 coherent PM-QPSK ~1200 km reach tunable over 80 DWDM wavelengths with SD-FEC • 100 Gb/s LAN on LR4 and SR10
Resilience	IEEE 802.3ad Link Aggregation with LACP. Normal LAG, N+1 and N+N protection LAG, Multi-chassis LAG MPLS over LAG including RFC6391 flow label ITU-T G.8032 Ethernet Ring Protection v1 and 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	
Latency (using RFC1242 store and forward metric)	EMXP48 IIe, EMXP62 IIe, EMXP120 IIe, EMXP240 IIe: • Ethernet 2.4 µs • OTU2e 6.2 µs (GFEC), 32 µs (I.4), 65 µs (I.7) EMXP220 IIe: • Ethernet 2.0 µs • OTU2e 5.8 µs (GFEC), 32 µs (I.4), 65 µs (I.7) • OTU4 8.0 µs (SD-FEC)	
Performance Monitoring and OAM	IEEE 802.1ag Continuity Check and Loopback, Port Mirroring MPLS G-ACh channel for OAM RFC5586 BFD for MPLS Label Switched Paths (LSPs) RFC5884 Management VLAN for in-band management Port isolation using private VLAN technique Y.1731 Loss Measurements and Delay Measurements 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	
Source-specific Multicast	RFC4607 Source-Specific Multicast for IP RFC4541 IGMP Snooping	
L2 Switching	Selectable learning enabled per VLAN, 4,094 VLAN IDs, 128K MAC-addresses Storm control IEEE 802.1ad Q-in-Q SVLAN Flexible VLAN tag handling: push, pop, swap, pop-swap Super jumbo frames up to 10248 Bytes OpenFlow 1.3 control of switching resources (for EMXP IIe in "open" mode)	
MPLS	LER and LSR operation 512 LSPs, 4096 pseudowires MPLS Transport Profile RFC5960 Sub 50 ms protection for 64 protected tunnels with BFD in hardware	
TDM over Ethernet	STM-1 and OC-3 via circuit emulation over Ethernet in iSFP-TDM155 STM-4 and OC-12 via circuit emulation over Ethernet in iSFP-TDM622 E1 via circuit emulation over Ethernet in iSFP-E1	
Power Consumption (Including Optics)	EMXP48 IIe: Max 56 W EMXP62 IIe: Max 77 W EMXP120 IIe: Max 77 W EMXP220 IIe: Max 116 W EMXP240 IIe: Max 123 W	

Specifications and Features Are Subject to Change

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