

10-GIGABIT ETHERNET DWDM OPTICAL TRANSPORT NETWORK PIC

Product Overview

Integrating Optical Transport Network (OTN) technology into routers enables the evolutionary next step in a carrier's infrastructure while providing optimal utilization of transport capacity. Layer 3 intelligence ensures prompt responses to topology changes and extends optical capabilities to a router without requiring fixed DWDM termination equipment, allowing providers to offer on-demand services to their customers. The 10-Gigabit Ethernet DWDM OTN PIC uses a single tunable laser to access one of 89 possible International Telecommunication Union (ITU) grid wavelengths across the C band with 50 GHz spacing. Combined with forward error correction (FEC), transmission distances in excess of 2,000 km may be achieved. Wavelengths are configured and reconfigured remotely through the Junos operating system command-line interface (CLI) in response to network dynamics.

Product Description

Juniper Networks router-integrated OTN products support the new requirements of next-generation long haul and metro networks such as the increased flexibility of network design—through the coupling of longer transmission distances with robust Operation, Administration, and Maintenance (OAM)—and single-fiber channel density. Additional benefits are realized by a reduction in CapEx and OpEx, made possible by eliminating third-party optical transponder equipment, including regenerators.

The tunable 10-Gigabit Ethernet Dense Wavelength Division Multiplexing (DWDM) OTN PIC is a Type 3 PIC supported on the Juniper Networks® M120 Multiservice Edge Router and T Series Core Routers. It enables 1024 VLANs and many other Ethernet features.

The ITU-T G.709 PIC provides generic forward error correction (GFEC) and enhanced forward error correction (EFEC), selectable through the CLI. FEC supports longer transmission distances in optical signal to noise ratio (OSNR)-limited applications by reducing the effects of optical noise caused by amplifiers, allowing more amplifiers to be used within a single optical link.

Application in the Metro Network

The following diagram shows how Juniper Networks routers with the tunable 10-Gigabit Ethernet DWDM OTN PICs eliminate the use of bulky and expensive optical transponder equipment. The tunable 10-Gigabit Ethernet DWDM OTN PICs launch ITU-grid signals directly into the WAN via a direct connection to DWDM line systems. Legacy networks can be unburdened through the elimination of transponders sitting between the router and the optical network. Increased transmission distance allows the network architect to create new or additional add/drop configurations without repositioning the transport optics based on expected transmission distance.

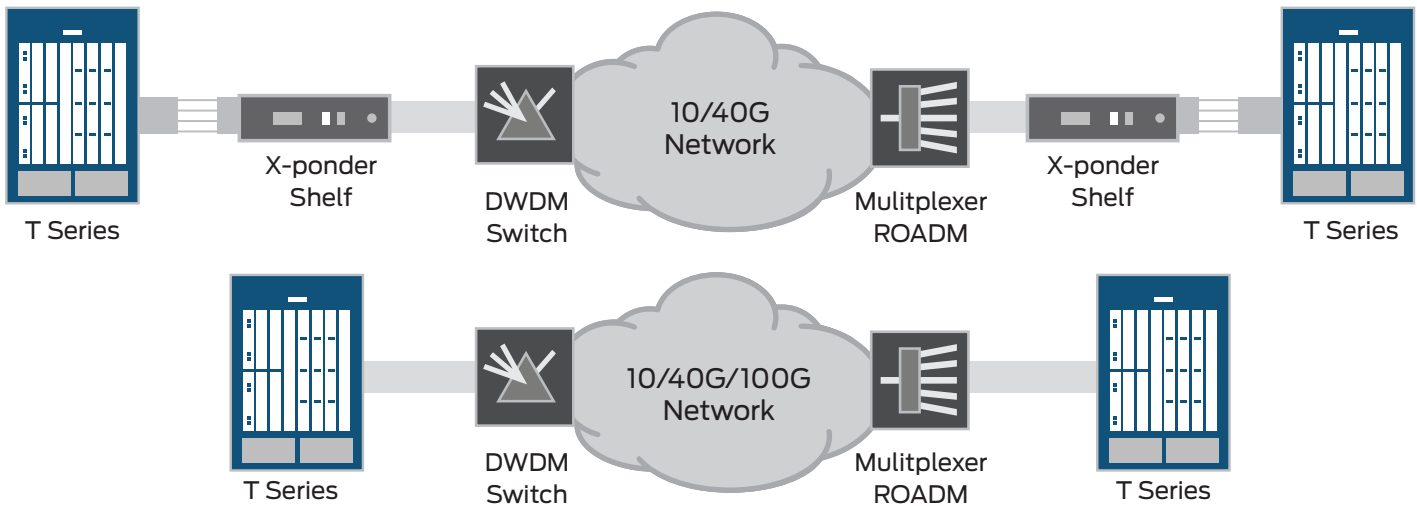


Figure 1: DWDM OTN PIC in the Metro Network

Features and Benefits

Routing Intelligence

Combining routing intelligence with a tunable DWDM is imperative when creating Layer 3 Transmission (L3T) solutions. Operators can leverage the IP intelligence of the Juniper Networks Junos® operating system in routers to determine new paths to destination networks in response to topology changes.

Investment Protection

The 10-Gigabit Ethernet DWDM OTN PIC can be used in a variety of M Series and T Series, each of which generates specific benefits for a network. As an operator scales to new network requirements, the PIC can be reused.

Extended Reach to 2000+ km

The 10-Gigabit Ethernet DWDM OTN PIC is ideally suited for metro and long haul network configurations that require both longer spans and the ability to leverage installed fiber. Supporting transmission distances exceeding 2000 km (1242.74 miles), this Juniper solution delivers maximum flexibility for intra-point of presence (POP), inter-POP, and more distributed mesh configurations.

High Density Configurations

Each 10-Gigabit Ethernet DWDM PIC supports up to a 10 Gbps data transmission and, as the following table demonstrates, Juniper can support up to 128 DWDM OTN PICs in a single system (TX Matrix).

Table 1: Juniper Platform 10-Gigabit Ethernet DWDM OTN PIC Density

Platform	Per Chassis	Per Rack
M120	4	16
T320	16	48
T640	32	64
T1600/T4000	32	64

Scalability

Using OTN, providers can scale services equivalent to the number of ITU-defined channels. Scaling services that support new services or customers means using an available wavelength on existing fiber, thereby reducing or eliminating the need for major network reconfigurations. Multiple end user networks may be connected to different channels in a single strand of fiber, leaving unused channels available for future expansion and scalability.

Specifications

Software Release

- Junos OS 9.4 and later

Description

- One 10-Gigabit Ethernet port
- Power requirements: 0.94 A/48 V @ 45 W
- Supports large Ethernet frame sizes for more efficient throughput across the intra-POP network
- Optical interface support (see Table 2)

Hardware Features

- C-band ITU-grid with 50/100 GHz spacing
- High-performance throughput at speeds up to 10 Gbps
- Full-duplex mode
- Maximum transmission units (MTUs) up to 9192 bytes
- 64 source media access control (MAC) address filters
- 960 destination MAC filters
- 89 individual wavelengths in nanometers (nm)

Software Features

- Enhanced optical monitoring capabilities
- CLI configurable wavelength support
- Virtual Router Redundancy Protocol (VRRP) support
- 802.1Q VLAN support
- 802.3ae link aggregation support
- RMON EtherStats

Cables and Connectors

- Duplex SC/PC connector (RX and TX)

Specifications (continued)

LEDs

Status LEDs, one bicolor:

- Off: PIC is not enabled.
- Green: PIC is operating normally.
- Red: PIC has an error or failure.

Alarms

- Loss of signal alarm (LOS)
- Loss of frame alarm (LOF)
- Loss of multi frame alarm (LOM)
- Wavelength lock alarm (WAVELENGTH-LOCK)
- AIS alarm (OTU-AIS)
- OTU BDI alarm (OTU-BDI)
- OTU TTIM alarm (OTU-TTIM)
- OTU IAE alarm (OTU-IAE)
- OTU bit error rate defect alarm (OTU-SD)
- OTU bit error rate fault alarm (OTU-SF)
- OTU FEC Excessive Errors alarm (OTU-FEC-EXE)
- OTU FEC Degraded Errs alarm (OTU-FEC-DEG)
- OTU BBE Threshold alarm (OTU-BBE-TH)
- OTU ES Threshold alarm (OTU-ES-TH)
- OTU SES Threshold alarm (OTU-SES-TH)
- OTU UAS Threshold alarm (OTU-UAS-TH)
- ODU AIS alarm (ODU-AIS)
- ODU OCI alarm (ODU-OCI)
- ODU LCK alarm (ODU-LCK)
- ODU BDI alarm (ODU-BDI)
- ODU TTIM alarm (ODU-TTIM)
- ODU bit error rate defect alarm (ODU-SD)
- ODU bit error rate fault alarm (ODU-SF)
- ODU BBE Threshold alarm (ODU-BBE-TH)
- OTU ES Threshold alarm (ODU-ES-TH)
- OTU SES Threshold alarm (ODU-SES-TH)
- ODU UAS Threshold alarm (ODU-UAS-TH)
- OPU Payload Mismatch alarm (OPU-PTM)

OSNR Table

Table 2: Optical Performance Table

OSNR	FEC Type	Pre-FEC BER	Post-FEC BER	Input Power (ROP)	CD Tolerance
dB/0.1nm				dBm	ps/nm
33	None	10 ⁻¹²	–NA–	–5 to –24	0
33	None	10 ⁻¹²	–NA–	–5 to –21	±1200
26	None	10 ⁻¹²	–NA–	–8 to –22	0
26	None	10 ⁻¹²	–NA–	–8 to –20	±1000
30	None	10 ⁻¹²	–NA–	–8 to –20	±1200
33	GFEC	8×10 ⁻⁵	10 ⁻¹⁵	–5 to –28	0
33	GFEC	8×10 ⁻⁵	10 ⁻¹⁵	–5 to –25	±1600
15.5	GFEC	10 ⁻⁵	10 ⁻¹⁵	–8 to –20	0
17	GFEC	10 ⁻⁵	10 ⁻¹⁵	–8 to –20	±1200
33	EFEC	10 ⁻⁵	10 ⁻¹⁵	–5 to –28	0
33	EFEC	10 ⁻⁵	10 ⁻¹⁵	–5 to –25	±1600
12	EFEC	7×10 ⁻⁴	10 ⁻¹⁵	–8 to –20	0
14	EFEC	7×10 ⁻⁴	10 ⁻¹⁵	–8 to –20	±1200

Optical Interface Support

Table 3: Optical Interface Support for 10-Gigabit Ethernet DWDM OTN PICs

Parameter	Per Chassis
Optical interface	300-pin MSA
Minimum OSNR to the receiver (+/- 1200 ps/nm residual dispersion)	14 dB/0.1nm
Transmitter wavelength	1528.77 to 1563.86 nm
Average launch power	+3 to +7 dBm
Transmit extinction ratio	11 dB
Minimum receive power	20 dBm (at 14 dB/0.1nm OSNR within +/-1200 ps/nm residual dispersion)

Specifications (continued)

Compliance

Communications

- ITU-T G.709 (OTN)
- 802.3ae (10-Gigabit Ethernet: receiver bandwidth measurement)

Safety Approvals

- CAN/CSA-C22.2 No. 60950-1-03 - UL 60950-1 Safety of Information Technology Equipment
- EN 60950-1 Safety of Information Technology Equipment
- EN 60825-1 Safety of Laser Products - Part 1: Equipment Classification, Requirements and User's Guide

EMC

- AS/NZS CISPR22 Class A (Australia/New Zealand)
- EN55022 Class A (Europe)
- FCC Part 15 Class A (USA)
- VCCI Class A (Japan)

EMI

- AS/NZS 3548 Class A (Australia)
- EN55022 Class A (Europe)
- FCC Class A (USA)
- VCCI Class A (Japan)
- BSMI Class A (Taiwan)

Immunity

- EN-61000-3-2 Power Line Harmonics
- EN-61000-3-3 Voltage Fluctuations and Flicker
- EN-61000-4-2 ESD
- EN-61000-4-3 Radiated Immunity
- EN-61000-4-4 EFT
- EN-61000-4-5 Surge
- EN-61000-4-6 Low Frequency Common Immunity
- EN-61000-4-11 Voltage Dips and Sags

NEBS

- SR-3580 NEBS Criteria Levels (Level 3 Compliance)
- GR-63-CORE: NEBS, Physical Protection
- GR-1089-CORE: EMC and Electrical Safety for Network Telecommunications Equipment

ETSI

- ETSI EN-300386-2 Telecommunication Network Equipment. Electromagnetic Compatibility Requirements

Juniper Networks Services and Support

Juniper Networks is the leader in performance-enabling services that are designed to accelerate, extend, and optimize your high-performance network. Our services allow you to maximize operational efficiency while reducing costs and minimizing risk, achieving a faster time to value for your network. Juniper Networks ensures operational excellence by optimizing the network to maintain required levels of performance, reliability, and availability. For more details, please visit www.juniper.net/us/en/products-services.

Ordering Information

Model Number	Description	Description
10-Gigabit Ethernet Type 3 PIC		
PC-1XGE-DWDM-OTN	89 wavelengths, ITU-grid	M120, T320, T640, T1600, T4000

About Juniper Networks

Juniper Networks is in the business of network innovation. From devices to data centers, from consumers to cloud providers, Juniper Networks delivers the software, silicon and systems that transform the experience and economics of networking. The company serves customers and partners worldwide. Additional information can be found at www.juniper.net.

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