

## Gigabit Carrier Ethernet DWDM XPonder Card for the Cisco ONS 15454 MSTP

The Cisco® ONS 15454 Multiservice Transport Platform (MSTP) features a radical new approach to Ethernet over dense wavelength-division multiplexing (DWDM) transport and aggregation. The Cisco ONS 15454 Gigabit Ethernet XPonder card includes DWDM transmission functions and Layer 2 switching functions (Figure 1).

**Figure 1.** Cisco ONS 15454 Gigabit Ethernet XPonder Card



### Background

Metro transport networks must support numerous service demands, from low-rate DS-1/T1, DS-3/E3, 10/100BASE-T, and OC-3/STM-1 to higher-rate OC-12/STM-4, Gigabit Ethernet, OC-48/STM-16, OC-192/STM-64, and 10 Gigabit Ethernet services. As the importance of broadband data services continues to increase and Ethernet becomes an essential protocol, service providers need more integration between Ethernet switching and transport to optimize capital investment and reduce operating costs.

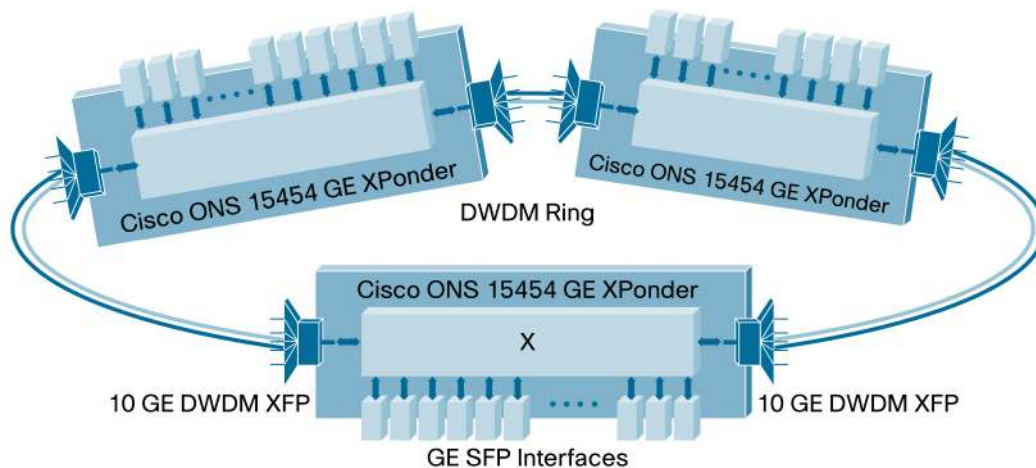
Industry trends indicate that DWDM is the technology being used to transport the huge amount of bandwidth that broadband services are consuming. Thus, DWDM needs to evolve from simply offering management capabilities for Layer 1 (where optical wavelengths are dispatched across the network) to offering Layer 1 and Layer 2 capabilities that provide wavelength connection in addition to VLAN management; quality of service (QoS); and multicast, broadcast, and unicast services – all with reliability comparable to or better than that of older time-division multiplexing (TDM) technologies.

## Product Overview

The Cisco ONS 15454 Gigabit Ethernet XPonder card portfolio includes two options: an XPonder card and an enhanced XPonder card. The portfolio provides a complete solution with the basic XPonder card optimized for Ethernet access applications; the enhanced XPonder card provides additional capabilities for Ethernet aggregation rings.

An XPonder card is a dual-slot Cisco ONS 15454 MSTP board providing 20 Small Form-Factor Pluggable (SFP)-based Gigabit Ethernet client ports and two 10 Gigabit SFP (XFP)-based trunk ports supporting G.709 digital wrappers and Enhanced Forward Error Correction (E-FEC) capability. You can equip trunk ports with a DWDM XFP port developed to meet wavelength-division multiplexing (WDM) filter specifications; this port provides the XPonder card with the DWDM interface. You can equip the 20 client ports with different Gigabit Ethernet SFPs: SX, LX, ZX, coarse wavelength-division multiplexing (CWDM), DWDM, or electrical (RJ-45). Figure 2 shows a Layer 2 logical scheme, and Figure 3 shows a Layer 1 physical scheme.

**Figure 2.** Cisco ONS 15454 Gigabit Ethernet XPonder Card Layer 2 Logical Scheme

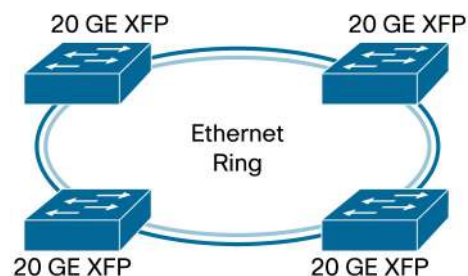


## Operating Modes

You can configure boards to operate in three operating modes:

- Layer 2 switch: In this operating mode, the Cisco ONS 15454 Gigabit Ethernet XPonder card behaves like a Layer 2 switch. The tagged VLAN mechanism makes it possible to build an Ethernet ring over a DWDM wavelength. All Layer 2 packet forwarding as well as multicast replication is performed at wire speed. The two trunk ports equipped with DWDM XFPs are used as Layer 1 substratum Network-to-Network Interface (NNI) ports for an Ethernet distribution ring built by various clients shared on the XPonder cards belonging to that wavelength.

**Figure 3.** Cisco ONS 15454 Gigabit Ethernet XPonder Layer 1 Physical Scheme



#### Layer 2 switch support:

- XPonder with MAC address table with up to 16,000 entries
- Enhanced XPonder with MAC address table with up to 32,000 entries<sup>1</sup>
- 802.1D virtual bridged LANs and VLAN tagging support according to IEEE 802.1Q (up to 4096 VLAN IDs on all ports)
- 801.1AD S-TAG (or outer tag, or Q-in-Q) support
- All Layer 2 packet forwarding and multicast replication performed at wire speed
- Per-VLAN MAC address enable-disable<sup>1</sup>

#### QoS ingress policing:

- Ingress port-based rate limiting<sup>1</sup>
- Per-stacked VLAN (SVLAN)-based ingress rate limiting<sup>1</sup>
- Flow control available (frame pause)
- Policing-based bandwidth metering per port:
  - Single rate: Three-color marker (RFC 2697)
  - Bandwidth profile based on committed-information-rate (CIR), committed-burst-size (CBS), and excess-burst-size (EBS) parameters
  - Color-blind implementation

#### Additional QoS functions on the enhanced XPonder include:

- Add double tag and Add + Translation
- Add SVLAN +Translate combat-vehicle LAN (CVLAN)<sup>1</sup>
- Per-CVLAN-to-SVLAN ingress class of service (CoS)

#### QoS egress policing:

- CoS-based
- One Strict Priority and seven Weighted Round Robin (WRR) queues (weight can go from 0 to 15), with tail drop to control congestion; when zero is configured, the queue is managed as a Strict Priority queue
- Bandwidth limitation per queue (you can also configure bandwidth per port)
- For each port, configuration of up to eight queues

#### Multicast and Video Broadcast

The Cisco ONS 15454 XPonder supports both push and pull models for video broadcast or multicast applications. The SVLAN-based drop-and-continue approach is used for the push model, where all multicast and video broadcast traffic is dropped at each site. With Internet Group Management Protocol Version 2 (IGMPv2)<sup>1</sup> capability, the XPonder provides a pull model where a multicast stream or a video channel is pulled on to the network with a join from the end customer. Multicast VLAN registration (MVR)<sup>1</sup> further enhances network flexibility for video applications where a multicast VLAN is reserved for the network independent of the VLAN on which the service is delivered on each port. The translation from multicast VLAN to customer VLAN happens at the client port.

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<sup>1</sup> Marked features require system software Release 9.0 or later.

### HyperDense Gigabit Ethernet Muxponder

In this operating mode, the Cisco ONS 15454 Gigabit Ethernet XPonder card does not provide any Layer 2 functions. This mode provides a cost-optimized Ethernet transport solution. Equipping the 10 Gigabit Ethernet port with DWDM XFP allows it to support a point-to-point DWDM configuration than can support oversubscription at the 10 Gigabit Ethernet layer. All the ports are configured with a default CIR of 500 Mb, but you can reconfigure this value (at individual port granularity). Flow control is also available as a selectable option.

### Full-Rate 10 Gigabit Ethernet Muxponder

In this operating mode, 10 times Gigabit Ethernet ports are mapped to one 10 Gigabit Ethernet port while the other 10 times Gigabit Ethernet ports are mapped into the other 10 Gigabit Ethernet port. All 20 Gigabit Ethernet clients are transparently transmitted at full line speed (the two ports have a throughput of 99.9 percent). You can equip each of the 10 Gigabit Ethernet ports with DWDM XFP to allow the direct interconnection of the unit with the DWDM layer.

### Enhanced FEC Capability

An important feature of the Cisco ONS 15454 Gigabit Ethernet XPonder card is the capability to configure FEC in three modes: NO FEC, FEC, and E-FEC. The output bit rate varies:

- 10.3125 Gbps for 10 Gigabit Ethernet LAN physical interface (PHY)
- 11.095 Gbps for 10 Gigabit Ethernet LAN PHY (overclocking mode)

You can provision error-coding performance:

- NO FEC: No FEC
- FEC: Standard G.975 Reed-Salomon algorithm
- E-FEC: Standard G.975.1 two orthogonally concatenated block code (BCH) super FEC codes
- this FEC scheme contains three parameterizations of the same scheme of two BCH codes, with the constructed code decoded iteratively to achieve the expected performance

### PDH over Ethernet Functions

Cisco ONS 15454 MSTP Release 9.1 offers four new pluggables on the Gigabit Ethernet Enhanced XPonder card; the new pluggables target a smooth migration between TDM and Layer 2 switched networks. The four new pluggables are based with a standard Plesiochronous Digital Hierarchy (PDH) copper interface:

- E1/T1 SFP featuring circuit emulation (PW) PDHoFE
- E3/T3 SFP featuring circuit emulation (PW) PDHoFE

The Pseudo Wires mechanism is used to map E1, E3, T1, T3, DS-1, and DS-3 services directly over a Fast Ethernet frame on the Enhanced Xponder.

- E1/T1 SFP featuring General Frame Procedure (GFP) for Ethernet-over-PDH transport
- E3/T3 SFP featuring GFP for Ethernet-over-PDH transport

A GFP mechanism is used to map Fast Ethernet-over-PDH signals.

### Flexible Protection Mechanisms

The Cisco ONS 15454 Gigabit Ethernet XPonder card provides flexible protection capabilities for both client and DWDM line interfaces, supporting numerous network configurations to deliver the various service-level agreements (SLAs) required by the customer application.

For multiple transponder configurations, the XPonder card supports the following:

- Unprotected client and line: This configuration has no client terminal interface, transponder card, or DWDM line protection. The client signal is transported over a single unprotected transponder card. This configuration is suitable for transporting client payloads over a DWDM network that is being protected by a Layer 2 or Layer 3 protocol.
- Y-cable client interface: This configuration provides transponder equipment protection without client terminal equipment interface protection. A single client interface is split into two transponder cards using a Y-protection device.

The XPonder also offers redundancy with no single point of failure in a ring configuration:

- For ring protection, the XPonder provides a revolutionary new level of Ethernet protection through the G.709 Rapid Resilient Ring Ethernet Protection (GR3) mechanism, integrating G.709 messaging with an Ethernet VLAN mechanism when configured as Layer 2 switches to provide reliability comparable to older TDM systems. A recovery time of 50 ms (including detection time) can be achieved. The protection mechanism uses a mix of Layer 1 and Layer 2 functions, with fault detection and failure propagation performed through the G.709 bytes (failure propagation is performed at the hardware level) while traffic is flooded, for each protected VLAN on all 10 Gigabit Ethernet WDM rings. One node is identified (through user configuration) as the master node (or port). This node is responsible for opening and closing the Layer 2 VLAN loop if failure occurs.
- The XPonder provides client and card redundancy with SONET/SDH-like 1 + 1 card protection in either the same or a different shelf (within the same multi-shelf management domain)<sup>1</sup> with following protection models:
  - The active port is enabled while the standby port stays disabled.
  - Both active and standby ports are enabled; only the active port forwards, whereas the standby port drops all ingress-egress traffic.
- A GR3 protection mechanism is required.
- The Layer 2 XPonder also supports "Y-cable bidirectional-like" switching where two cards in 1 + 1 protection are connected through a Y-cable to a single client.<sup>2</sup>
- Link aggregation (LAG) (802.3ad) protection:<sup>3</sup> You can use the Link Aggregation Control Protocol (LACP) to provide local point-to-point resiliency between the co-located router or switch and the XPonder. LAG cannot provide the 50-msec switching that 1 + 1 client protection can, but it allows load balancing and

<sup>2</sup> Requires system software Release 9.0 or later

<sup>3</sup> Requires system software release 9.2 or later

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increased bandwidth. In addition, XPE allows a LAN extension scenario, where it is possible to achieve higher bandwidth usage at either 10 Gigabit Ethernet or at 10/100/1000 Mbps.

- Resilient Ethernet Protocol:<sup>3</sup> The Resilient Ethernet Protocol (REP) was introduced to handle the growth of Ethernet Layer 2 topologies and the resulting consequences of large spanning-tree domains, the increased number of Layer 2 switches, and the increased number of subscribers (increased number of VLANs and MAC addresses). The increased size of Ethernet networks increases the complexity of operations and management. Carrier Ethernet requires fast convergence in access and aggregation networks. Release 9.2 introduces REP on the XPonder for fast and predictable Layer 2 convergence.

## Management

The Cisco ONS 15454 provides comprehensive management capabilities to support operations, administration, maintenance, and provisioning (OAM&P) capabilities through the integrated Cisco Transport Controller Craft Interface with support from the Cisco Transport Manager Element Management System (EMS). The XPonder card incorporates provisionable digital-wrapper (G.709) functions, providing per-wavelength performance-management capabilities, especially for services being transported transparently across the network. Without the digital-wrapper functions, a carrier transporting a service transparently would be unable to identify network impairments that may degrade the transported signal and exceed SLA requirements.

The generic communications channel (GCC) of the digital wrapper allows a separate communications channel on a per-wavelength basis. This GCC allows the Cisco ONS 15454 MSTP to extend its advanced network autodiscovery capabilities to DWDM-based services. The integrated Cisco ONS 15454 MSTP Transport Controller Craft Manager and the Cisco Transport Manager EMS give you OAM&P access for the system.

## End-to-End Circuit EVC Provisioning<sup>2</sup>

The XPonder card provides service and network provisioning with Cisco Transport Controller. You can use Cisco Transport Controller to provision the XPonder ring and SVLAN-based Ethernet virtual circuits (EVCs). Both point-to-point and multipoint EVC provisioning are supported.

## QoS Provisioning<sup>2</sup>

The Cisco ONS 15454 Ethernet XPonder card provides QoS provisioning with Cisco Transport Controller. You can define and independently apply standard system-level QoS profiles on a per-EVC basis.

The XPonder provides remarkable management capabilities for service and QoS provisioning for Carrier Ethernet services.

## VLAN Database

The XPonder card enables you to provision a VLAN database. The Cisco Transport Controller can retrieve all the VLANs available in the network. VLAN retrieval allows you to view the WDM ring based on the XPonder card and the EVC or VLAN circuit. You can perform this retrieval on a per-VLAN basis; retrieval requires the creation of optical channel trails (OCH-Trails) between the XPonder cards. VLAN retrieval results are categorized as follows: Green: Selected VLAN is configured on both ends of the link

- Orange: Selected VLAN is configured only on one end of the link
- Gray: Selected VLAN is not configured on either end of the link

## VLAN Profiling<sup>2</sup>

You can provision all SVLAN-associated parameters using predefined profiles.

### Multicast VLAN Registration<sup>3</sup>

The Multicast VLAN Registration (MVR) feature on the XPonder is used to separate Layer 3 multicast traffic from the SVLANs carrying data on all the client interfaces of the XPonder. Any IGMP snooped packet with a valid Layer 3 multicast address is placed into a user-defined SVLAN dedicated to multicast traffic.

### IGMP Snooping<sup>3</sup>

IGMP Snooping is a nonintrusive Layer 3 monitor for Layer 3 multicast traffic received on the client ports of the XPonder. The Layer 3 packets with Class D IPv4 addresses are snooped per SVLAN if MVR and IGMP are provisioned.

### Ethernet OAM<sup>3</sup>

The increasing adoption of Carrier Ethernet (CE) in IP Next-Generation (IP NGN) networks as an accepted transport mechanism for next-generation Ethernet services, including Ethernet private line (EPL), Ethernet virtual private line (EVPL), Ethernet LAN (E-LAN), and Ethernet virtual private LAN (EV-PLAN), has resulted in the need for service providers to monitor the health of the services, enforce SLAs, and provide SONET/SDH-like OAM functions. Release 9.2 of the Cisco ONS 15454 introduces Ethernet OAM (E-OAM) functions for the XPonder family of cards to complement their

Carrier Ethernet transport functions and provide interworking functions for existing access, edge, and core Layer 2/3 devices.

The XPonder in Release 9.2 supports the following E-OAM family of protocols as defined in IEEE and ITU-T. The XPonder provides Provider Bridge functions (per port or per VLAN).

- IEEE 802.1ag (Draft 8.1): Connectivity Fault Management (CFM)
- IEEE 802.3ah-2005, Clause 57: Ethernet in the First Mile (EFM)
- ITU-T Y.1731: XPonder support for E-OAM functions that are common between IEEE 802.1ag/802.3ah and Y.1731; in addition, Ethernet-Advanced IP Services (E-AIS) and locked signal (LCK) support for link integrity since Release 9.0

### Performance Monitoring

The performance-monitoring capabilities of the Cisco ONS 15454 Gigabit Ethernet XPonder card support Ethernet signal transport. Standard performance parameters for transmit and receive signals are based on RFCs 3635, 2358, 2233, and 1757. Each digital-wrapper channel is monitored according to ITU-T digital-wrapper requirements (G.709). Optical parameters on the SFP and XFP interfaces are supported, including laser bias, transmitter optical power, and receiver optical power. Performance-monitoring data is calculated and accumulated in 15-minute and 24-hour intervals.

The Cisco ONS 15454 Gigabit Ethernet XPonder cards incorporate faceplate-mounted LEDs to allow a quick visual check of the operating status of the card. An orange circle printed on the faceplate indicates the shelf slots in which the card can be installed.

### Link Integrity<sup>2</sup>

The XPonder supports link integrity using Y.1731 Ethernet OAM-AIS message per SVLAN. You can enable or disable squelching on a per-port basis.

### Cisco IOS Software-Like CLI<sup>2</sup>

The XPonder supports a Cisco IOS<sup>®</sup> Software-like command-line interface (CLI) for management purposes, allowing customers with Cisco IOS Software-based networks to manage the XPonder in a familiar fashion.

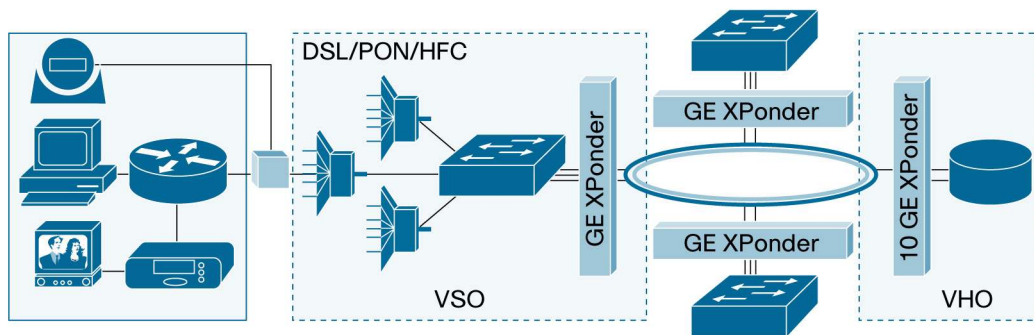
## Application Description

The XPonder card adds several new applications to the already-flexible Cisco ONS 15454 MSTP. Cards have been developed to meet the needs of many different network applications, from DWDM point-to-point to EVPN services in Metro Ethernet environments. When configured as DWDM Ethernet muxponders, XPonder cards perfectly meet the incremental demand for Ethernet bandwidth at ever-lower prices. The availability of pluggable optics for DWDM also dramatically increases the density of 10 Gigabit Ethernet, reducing the per-port cost.

The Layer 2 switching configuration addresses applications requiring huge bandwidth and high flexibility:

- Video distribution: Video-hub topology fits perfectly in the XPonder architecture (Figure 4). Two approaches are supported:
  - Gigabit Ethernet XPonder-only DWDM ring, where the only Ethernet switching units connecting the DWDM ring are the XPonders: Many Gigabit Ethernet XPonders connect to the video-switching-office (VSO) location, and 10 Gigabit Ethernet XPonders connect to the video-hub-office (VHO) location. This topology provides a huge advantage in that it supports GR<sup>3</sup> Ethernet protection.

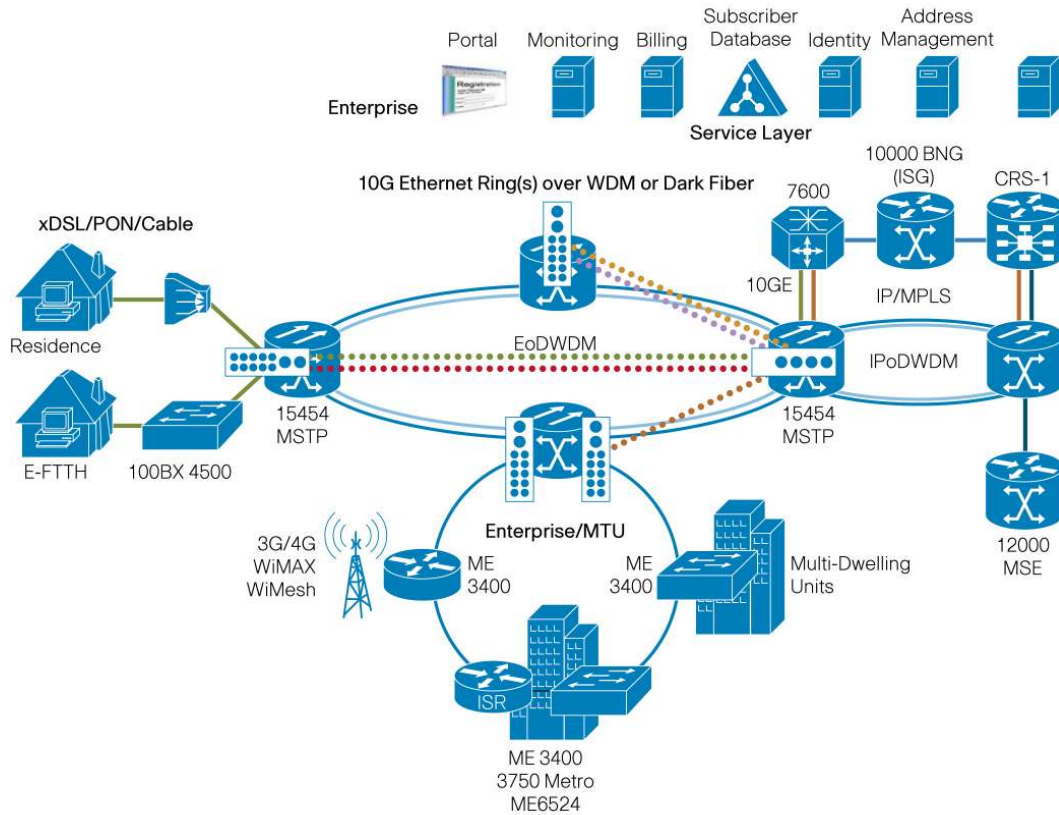
**Figure 4.** Gigabit Ethernet XPonder-Only DWDM Ring



- Access-independent Carrier Ethernet aggregation architecture with IP over DWDM (IPoDWDM) or dark fiber (Figure 5): This solution enables network convergence with Ethernet transport for both business and residential services. Point-to-point and multipoint Metro Ethernet Forum (MEF) standards-based services are supported. In addition, this solution provides SONET-like resiliency for Ethernet transport. With Ethernet-enabled DWDM, the solution is scalable and provides a “pay-as-you-grow” model. You can start with a 10 Gigabit Ethernet ring over dark fiber or add a wavelength to an existing DWDM ring. As traffic demand grows, you can add new 10 Gigabit Ethernet wavelengths and scale up to 800 Gb on a pair of fiber strands.

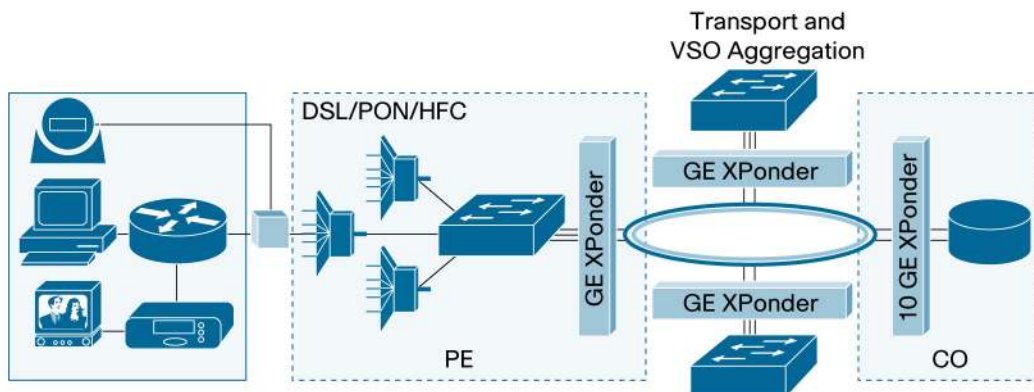
The ring topology allows the XPonder to add and drop Ethernet traffic at a sub-lambda level. Ethernet-enabled DWDM with its ring topology enables an intelligent DWDM network, eliminating the need for unintelligent transponding on a transport network.

**Figure 5.** IP over DWDM (IPoDWDM) Architecture



- Cost-optimized Ethernet distribution ring for managed services: This architecture provides the flexibility to aggregate Ethernet on a virtual Ethernet ring in place of many point-to-point transponder-based connections, dramatically reducing network capital expenditures (CapEx) investment (Figure 6).

**Figure 6.** Cost-Optimized Ethernet Distribution Ring for Managed Services



- Metro Ethernet application: The MEF9 and MEF14 certification environment, with EVPL and ELAN, provides full support for Ethernet carrier applications and support for business services as well as for real video, voice, and data services.

## The Cisco Advantage

The Cisco ONS 15454 Gigabit Ethernet XPonder card complements and extends the service capabilities of the Cisco ONS 15454 MSTP. The XPonder card allows carriers to take advantage of their existing fiber plant and installed base of Cisco ONS 15454 systems while providing a new way to transport and manage Ethernet over the same Cisco ONS 15454 platform.

The Cisco ONS 15454 optical transport solution offers significant advantages over traditional network elements offering 10-Gbps interfaces, including the following:

- Outstanding service densities: The Cisco ONS 15454 platform supports up to 120 Gigabit Ethernet interfaces per shelf. When this platform is installed in a typical central-office bay frame, a bay can support up to 480 Gigabit Ethernet interfaces.
- Common line cards and chassis: Optical line cards are not dependent on restoration type, so sparing costs and technician confusion are reduced. Additionally, as networks and customer interface demands evolve, you can easily redeploy optical circuit packs as necessary.
- Single software load: One software load supports all restoration types, eliminating unnecessary guesswork when ordering. All protection configurations are covered by a single right-to-use software license. After you purchase the software, all features and functions are available to you.
- Common chassis: A common chassis supporting all optical interface speeds allows the technician to spend time deploying bandwidth and services instead of learning about multiple equipment platforms. Many equipment vendors offer optical-line-speed-specific platforms (for example, OC-3/STM-1 or OC-12/STM-4) and categorize platforms by restoration mechanisms (for example, UPSR/SNCP, 2F-BLSR/MS-SPR, and 4F-BLSR/MS-SPR). This approach causes ordering confusion and brings into question whether the inventoried equipment will accommodate the functions required to support the desired application. The line-rate and restoration flexibility of the Cisco ONS 15454 platform makes ordering and deployment quick and easy.
- Multiservice interface selection: DS-1/E1 through OC-192/STM-64, Ethernet, Fast Ethernet, Gigabit Ethernet, and 10 Gigabit Ethernet interfaces are all supported, thus eliminating the “missing interface” problem that occurs with many vendors’ bit-rate-specific product offerings.

The Cisco ONS 15454 MSTP, the industry’s leading metro optical transport platform, delivers supercharged SONET/SDH transport, integrated optical networking, superior multiservice interfaces, and competitive economic benefits.

## Cisco ONS 15454 Gigabit Ethernet XPonder Card Features and Specifications

### Compact Design

- Single-width card slot design for high-density, 10 Gigabit Ethernet solutions
- Up to 6 cards per shelf assembly (120 Gbps) on the Cisco ONS 15454 Platform
- Up to 3 cards per shelf assembly (60 Gbps) on the Cisco ONS 15454 M6 Platform
- Up to 1 card per shelf assembly (20Gbps) on the Cisco ONS 15454 M2 Platform

### Flexible Restoration Options

- Layer 2 GR<sup>3</sup> Ethernet protection: G.709 Rapid Resilient Ring Ethernet Protection mechanism
- Client Y-protection
- Unprotected (0 + 1)

- Protected  $(1 + 1)^2$

## Regulatory Compliance

Table 1 lists regulatory compliance information. All compliance documentation may not be completed at the time of product release. Please check with your Cisco sales representative for countries outside of Canada, the United States, and the European Union.

**Table 1.** System Requirements

| Component                 | Cisco ONS 15454 ANSI                                                                | Cisco ONS 15454 ETSI                                                   | Cisco ONS 15454 M6I                                  | Cisco ONS 15454 M2                                   |
|---------------------------|-------------------------------------------------------------------------------------|------------------------------------------------------------------------|------------------------------------------------------|------------------------------------------------------|
| <b>Processor</b>          | TCC3 <sup>1</sup> , TCC2P and TCC2                                                  | TCC3 <sup>1</sup> , TCC2P and TCC2                                     | TNC, TSC, TNC-E <sup>2</sup> , or TSC-E <sup>2</sup> | TNC, TSC, TNC-E <sup>2</sup> , or TSC-E <sup>2</sup> |
| <b>Cross-connect</b>      | All (not required)                                                                  | All (not required)                                                     | –                                                    | –                                                    |
| <b>Shelf assembly</b>     | 15454-SA-HD or 15454-SA-HD-DDR shelf assembly with CC-FTA version fan-tray assembly | 15454-SA-ETSI shelf assembly with SDH CC-FTA version fan-tray assembly | 15454-M6-SA shelf assembly                           | 15454-M2-SA shelf assembly                           |
| <b>System software</b>    | Release 9.0 or later                                                                | Release 9.0 or later                                                   | Release 9.2 ANSI/ETSI or later                       | Release 9.2 ANSI/ETSI or later                       |
| <b>Slot compatibility</b> | 1 to 6 and 12 to 17                                                                 | 1 to 6 and 12 to 17                                                    | 2-7                                                  | 2-3                                                  |

1. The TCC3 card is supported on the Cisco ONS 15454 DWDM systems from Rel 9.2 onwards. However, it is backward compatible with software Release 9.1 and earlier releases. In the Release 9.1 and earlier releases, the TCC3 card boots up as the TCC2P card in the Cisco ONS 15454 DWDM systems.

2. The TNC-E and the TSC-E cards are supported on the Cisco ONS 15454 M6 and M2 DWDM systems from Rel 9.3 onwards.

Table 2 lists DWDM pluggable wavelengths, Table 3 lists card specifications, and Table 4 provides ordering information.

**Table 2.** Supported Wavelengths on DWDM Pluggable Units – C Band

| xx.x | λ (nm)  | Cisco ONS DWDM XFP (ONS-XC-10G-xx.x=) | Cisco ONS DWDM SFP (ONS-SC-2G-xx.x=) |
|------|---------|---------------------------------------|--------------------------------------|
| 28.7 | 1528.77 |                                       | X                                    |
| 30.3 | 1530.33 | X                                     | X                                    |
| 31.1 | 1531.12 | X                                     | X                                    |
| 31.9 | 1531.90 | X                                     | X                                    |
| 32.6 | 1532.68 | X                                     | X                                    |
| 33.4 | 1533.46 | X                                     | X                                    |
| 34.2 | 1534.25 | X                                     | X                                    |
| 35.0 | 1535.04 | X                                     | X                                    |
| 35.8 | 1535.82 | X                                     | X                                    |
| 36.6 | 1536.61 | X                                     | X                                    |
| 37.4 | 1537.40 | X                                     | X                                    |
| 38.1 | 1538.19 | X                                     | X                                    |
| 38.9 | 1538.98 | X                                     | X                                    |
| 39.7 | 1539.77 | X                                     | X                                    |
| 40.5 | 1540.56 | X                                     | X                                    |
| 41.3 | 1541.34 | X                                     | X                                    |
| 42.1 | 1542.14 | X                                     | X                                    |
| 42.9 | 1542.94 | X                                     | X                                    |
| 43.7 | 1543.73 | X                                     | X                                    |
| 44.5 | 1544.53 | X                                     | X                                    |

| xx.x | $\lambda$ (nm) | Cisco ONS DWDM XFP (ONS-XC-10G-xx.x=) | Cisco ONS DWDM SFP (ONS-SC-2G-xx.x=) |
|------|----------------|---------------------------------------|--------------------------------------|
| 45.3 | 1545.32        | X                                     |                                      |
| 46.1 | 1546.12        | X                                     | X                                    |
| 46.9 | 1546.92        | X                                     | X                                    |
| 47.7 | 1547.72        | X                                     | X                                    |
| 48.5 | 1548.51        | X                                     | X                                    |
| 49.3 | 1549.31        | X                                     | X                                    |
| 50.1 | 1550.12        | X                                     | X                                    |
| 50.9 | 1550.92        | X                                     | X                                    |
| 51.7 | 1551.72        | X                                     | X                                    |
| 52.5 | 1552.52        | X                                     | X                                    |
| 53.3 | 1553.32        | X                                     |                                      |
| 54.1 | 1554.13        | X                                     | X                                    |
| 54.9 | 1554.94        | X                                     | X                                    |
| 55.7 | 1555.75        | X                                     | X                                    |
| 56.5 | 1556.55        | X                                     | X                                    |
| 57.3 | 1557.36        | X                                     | X                                    |
| 58.1 | 1558.17        | X                                     | X                                    |
| 58.9 | 1558.98        | X                                     | X                                    |
| 59.7 | 1559.79        | X                                     | X                                    |
| 60.6 | 1560.61        | X                                     | X                                    |
| 61.4 | 1561.41        | X                                     |                                      |

**Table 3.** Card Specifications

| Specification                                                                                                                       |                                              |
|-------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|
| <b>Management</b>                                                                                                                   |                                              |
| Card LEDs                                                                                                                           |                                              |
| <ul style="list-style-type: none"> <li>Failure (FAIL)</li> <li>Active or standby (ACT or STBY)</li> <li>Signal fail (SF)</li> </ul> | <div></div> Red<br>Green or yellow<br>Yellow |
| Client port LEDs                                                                                                                    |                                              |
| <ul style="list-style-type: none"> <li>Active input signal</li> </ul>                                                               | Green                                        |
| DWDM port LEDs                                                                                                                      |                                              |
| <ul style="list-style-type: none"> <li>Active input signal</li> <li>Output wavelength</li> </ul>                                    | Green<br>Green                               |
| <b>Power</b>                                                                                                                        |                                              |
| Card power draw with pluggable optics                                                                                               |                                              |
| <ul style="list-style-type: none"> <li>Typical</li> <li>Maximum</li> </ul>                                                          | 132W<br>137W                                 |
| <b>Operating Environment</b>                                                                                                        |                                              |
| Temperature                                                                                                                         | 23 to 131°F (–5 to 55°C)                     |
| Humidity                                                                                                                            | 5 to 95% noncondensing                       |

**Table 4.** Ordering Information (For pluggable software release support, please refer to [http://www.cisco.com/en/US/prod/collateral/optical/ps5724/ps2006/brochure\\_c02-452560.html](http://www.cisco.com/en/US/prod/collateral/optical/ps5724/ps2006/brochure_c02-452560.html))

| Part Number                     | Description                                                                        |
|---------------------------------|------------------------------------------------------------------------------------|
| 15454-GE-XP=                    | Ethernet 20-GE / 2-10GE Crossponder                                                |
| 15454-GE-XPE= <sup>1</sup>      | 20 GBE Enhanced Crossponder                                                        |
| ONS-XC-10G-xx.x= <sup>2</sup>   | OC-192/STM64/10 Gigabit Ethernet, XFP, 15xx.xx (see Table 6), 100 GHz, LC          |
| ONS-XC-10G-EPxx.x= <sup>2</sup> | 10G MR, XFP, Edge Performance 15xx.xx (see Table 6), 100 GHz, LC                   |
| ONS-XC-10G-C=                   | 10G Multirate Full C Band Tunable DWDM XFP, 50 GHz, LC                             |
| ONS-XC-10G-S1=                  | 10 Gigabit SFP OC-192/STM-64/10 GE/10-Gbps Fibre Channel, 1310 SR-SM LC connectors |
| ONS-XC-10G-I2=                  | XFP – OC192/STM64/10GE – 1550 IR/SH2 – SM LC                                       |
| ONS-XC-10G-SR-MM=               | XFP – Ultra Short Reach MM – 10GE BASE SR                                          |
| ONS-XC-10G-1470=                | OC192/10GE/OTU2, CWDM, 1470nm, XFP C-Temp, 40km range                              |
| ONS-XC-10G-1490=                | OC192/10GE/OTU2, CWDM, 1490nm, XFP C-Temp, 40km range                              |
| ONS-XC-10G-1510=                | OC192/10GE/OTU2, CWDM, 1510nm, XFP C-Temp, 40km range                              |
| ONS-XC-10G-1530=                | OC192/10GE/OTU2, CWDM, 1530nm, XFP C-Temp, 40km range                              |
| ONS-XC-10G-1550=                | OC192/10GE/OTU2, CWDM, 1550nm, XFP C-Temp, 40km range                              |
| ONS-XC-10G-1570=                | OC192/10GE/OTU2, CWDM, 1570nm, XFP C-Temp, 40km range                              |
| ONS-XC-10G-1590=                | OC192/10GE/OTU2, CWDM, 1590nm, XFP C-Temp, 40km range                              |
| ONS-XC-10G-1610=                | OC192/10GE/OTU2, CWDM, 1610nm, XFP C-Temp, 40km range                              |
| ONS-SE-ZE-EL=                   | SFP – 10/100/1000 Ethernet BASE-T Multirate Copper RJ-45                           |
| ONS-SC-E3-T3-PW=                | SFP – E3/DS3 PDH over FE Pseudowire – Commercial Temp                              |
| ONS-SC-E1-T1-PW=                | SFP – E1/DS1 PDH over FE Pseudowire – Commercial Temp                              |
| ONS-SC-EoP1=                    | SFP – FE over DS1/E1 – Commercial Temp                                             |
| ONS-SC-EOP3=                    | SFP – FE over DS3/E3 – Commercial Temp                                             |
| ONS-SC-2G-xx.x=                 | OC-48/STM-16, SFP, 15xx.xx, 100 GHz, LC                                            |
| ONS-SC-Z3-1470=                 | SFP – OC-48/STM-16/GE, CWDM, 1470 nm                                               |
| ONS-SC-Z3-1490=                 | SFP – OC-48/STM-16/GE, CWDM, 1490 nm                                               |
| ONS-SC-Z3-1510=                 | SFP – OC-48/STM-16/GE, CWDM, 1510 nm                                               |
| ONS-SC-Z3-1530=                 | SFP – OC-48/STM-16/GE, CWDM, 1530 nm                                               |
| ONS-SC-Z3-1550=                 | SFP – OC-48/STM-16/GE, CWDM, 1550 nm                                               |
| ONS-SC-Z3-1570=                 | SFP – OC-48/STM-16/GE, CWDM, 1570 nm                                               |
| ONS-SC-Z3-1590=                 | SFP – OC-48/STM-16/GE, CWDM, 1590 nm                                               |
| ONS-SC-Z3-1610=                 | SFP – OC-48/STM-16/GE, CWDM, 1610 nm                                               |
| ONS-SE-G2F-LX=                  | SFP – GE/1G-FC/2G-FC/HDTV – 1310 nm – SM – LC – Ext Temp                           |
| ONS-SI-GE-ZX=                   | SFP – 1000BASE-ZX Gigabit Ethernet, 1550 nm, SM, I-Temp                            |
| ONS-SI-100-LX10=                | SFP – 100 Mbps Long Reach – 1310 nm – SM – LC, ITEMP                               |
| ONS-SI-100-FX=                  | SFP – 100 Mbps Short Reach – 1310 nm – MM – LC, ITEMP                              |
| ONS-SE-GE-BXU=                  | SFP – 1000BASE-BX U – GE Bidirectional Upstream – Ext Temp                         |
| ONS-SE-GE-BXD=                  | SFP – 1000BASE BX D – GE Bidirectional Downstream Ext Temp                         |

1. Requires Release 9.0 software.
2. xx.x wavelength noted in Table 2.



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