



## Solution Overview

# Defining the Cisco ONS 15454 Multiservice Transport Platform

## Transforming Metro and Regional Networks

When Cisco Systems® introduced the Cisco® ONS 15454 Multiservice Provisioning Platform (MSPP) for the metropolitan market in 1999, a clear demarcation was created between what is considered “traditional” optical transport equipment and what is now considered “next-generation.” With a significant leap in technology and product migration, the Cisco ONS 15454 MSPP offered traditional time-division multiplexing (TDM) and SONET/SDH services ranging from DS-1/E1 to OC-192/STM-64, along with SAN, Ethernet, and IP services in a single platform. It was also more scalable and a fraction of the size of bit-rate-specific traditional equipment. In addition to providing additional features and scalability, the Cisco ONS 15454 MSPP saves costs through reduced power requirements and simplified operations. The Cisco ONS 15454 MSPP product line quickly established itself as the market leader.

The global success of the Cisco ONS 15454 MSPP enabled higher bandwidth in metropolitan-area (metro) networks and created the need for a new metro-optimized Multiservice Switching Platform (MSSP) for aggregating and switching higher-bandwidth traffic. This led Cisco to introduce the Cisco ONS 15600 MSSP in 2002. Providing high density, high-bandwidth optical interfaces, ring interoperability, and transparent integration with the Cisco ONS 15454 MSPP, the Cisco ONS 15600 MSSP allows efficient scaling in large metropolitan areas.

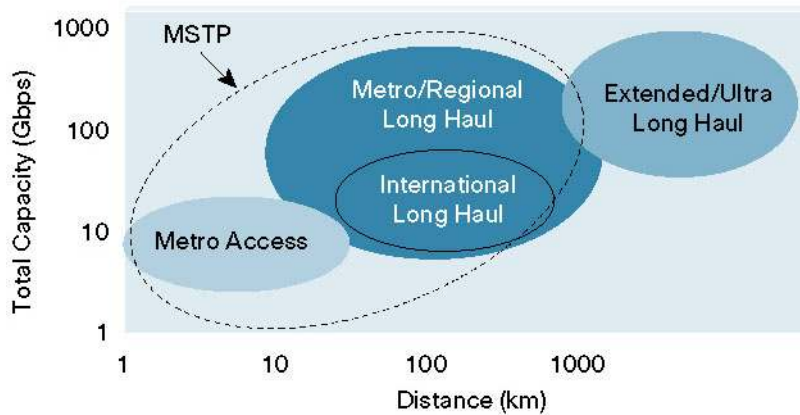
Continuing with its tradition of innovation and leadership in metro optical networking, Cisco introduced the Cisco ONS 15454 Multiservice Transport Platform (MSTP) in 2003, which has transformed metro and regional dense wavelength-division multiplexing (DWDM) networks. Projections indicate that the metro DWDM market will grow at an 11 percent compound annual growth rate (CAGR) through 2009 (Source: DellOro, 2005).

Early deployments of metro and regional DWDM focused primarily on fiber relief and used long-haul DWDM technologies. However, long-haul DWDM products are expensive and operationally inefficient for metro networks. The adoption of DWDM by competitive local exchange carriers (CLECs) and multiple system operators (MSOs) advanced the technology to low-cost-per-bit solutions, but operational efficiency continued to be a problem, particularly with footprint, power, network setup, and optical power management. The emergence of higher-bandwidth services, such as Gigabit Ethernet and storage-area networks (SANs), led to the introduction of multiple “point products,” but for multiple service offerings these solutions continue to be inefficient.

The Cisco ONS 15454 MSTP provides capital and operational efficiency by addressing the increasing demand for multiple services, greater transport capacity, networking flexibility, multiple distance options, and management simplicity in a single platform (Figure 1). With innovative technology, such as reconfigurable optical add/drop multiplexers (ROADM) and wavelength management intelligence, the Cisco ONS 15454 MSTP addresses the needs of both service providers and business customers.

**Figure 1**

Transforming Metro and Regional Networks with the Cisco ONS 15454 MSTP



## Multiservice Transport

The Cisco ONS 15454 MSTP supports a wide range of standards-based wavelength services in a single platform, including multirate 16-Mbps to 10-Gbps transponders and muxponders for TDM (OC-3/STM-1 to OC-192/STM-64), data (Gigabit Ethernet, 10-Gigabit Ethernet LAN, 10-Gigabit Ethernet WAN), SAN (Fibre Channel, Fiber Connectivity, Enterprise Systems Connection), and video wavelength services. Lower-bandwidth services can be aggregated onto a single wavelength with the integrated STS-1/VC-3/VC-4 and VT1.5/VC-11/VC-12 switching matrices for transport bandwidth efficiency. All services are mapped to standard SONET/SDH wavelengths for maximum flexibility and interoperability in today's service provider networks. G.709 digital wrapper technology enables enhanced wavelength management as well as extended optical reach with Enhanced Forward Error Correction (EFEC). The choice of multiservice aggregation, wavelength aggregation, and wavelength transport, combined with integrated, intelligent, ROADM-enabled DWDM transmission in a single platform enables networks to be cost-optimized for any mix of services.

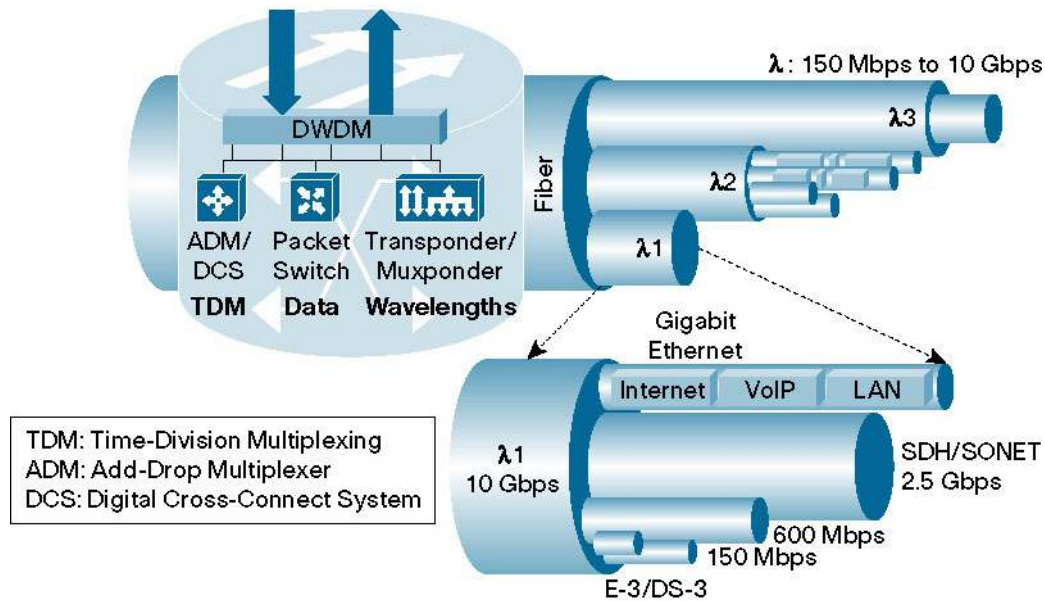
## Design Innovation

Traditional metro DWDM solutions have rigid network architectures and require considerable manual interaction to manage, particularly when new sites are added or network capacity is upgraded. Traditional solutions are optimized for low-cost-per-bit, fixed topologies that cannot efficiently address the operational constraints of metro and regional networks. Metro networks face unique challenges, such as the inherent difficulty in predicting demand for services such as TDM, data, SAN, and video, or service bandwidth at 1-Gbps, 2.5-Gbps, 10-Gbps, and even 40-Gbps rates.

Furthermore, complexities arise when managing metro DWDM network architectures that are typically ring topologies – open ring, multihub ring, closed ring – because of dynamic add/drop traffic patterns. Traditional solutions cannot automatically manage DWDM “analog” variables such as optical noise, dispersion, dynamics of adding and dropping wavelengths, and optical performance monitoring. The Cisco ONS 15454 MSTP has been designed from the start to mitigate these challenges, and the use of ROADMs makes it easy to modify traffic patterns without affecting existing traffic. The Cisco ONS 15454 MSTP can natively transport any service – TDM, data, or wavelengths – over a metro or regional network at a lower cost than traditional wavelength-only DWDM solutions. To summarize, multiservice capabilities simplify service planning and software intelligence simplifies operations. Figure 2 illustrates the general architecture of the Cisco ONS 15454 MSTP.

**Figure 2**

Cisco ONS 15454 MSTP Architecture



## Technology Innovation

The Cisco ONS 15454 MSTP uses advanced photonics technologies, combined with innovative engineering, to address the unique requirements for metro and regional networks:

- Industry-leading 1- to 32-channel ROADMs granularity, supporting ROADMs or channel OADMs, for reduced complexity in network planning and service forecasting
- Scalable, 1 to 64 wavelengths in a single network for superior cost-versus-growth trade-off
- Transport of 16-Mbps to 10-Gbps wavelength services, as well as aggregated TDM, data, and storage services for maximum service flexibility
- Transmission capability from tens to hundreds of kilometers (up to 2000 km) through the use of advanced amplification, dispersion compensation, and EFEC technologies
- Ready-to-deploy card architecture for complete flexibility in configuring DWDM network elements – terminal nodes, optical add/drop nodes, line amplifiers, and dispersion compensation – within amplified or unamplified networks
- High shelf density for high-bandwidth (10 Gbps/40 Gbps) wavelength services
- Option to use buffer-to-buffer credits when transporting Fibre Channel services to maintain line-rate throughput at longer distances
- Integration of pre- and post-amplification
- Use of software-provisionable, Small Form-Factor Pluggable (SFP) and 10 Gigabit SFP XFP client connectors, and wavelength tunability for reduced inventory
- Multilevel service monitoring: SONET/SDH, G.709 digital wrapper, optical service channel for unparalleled service reliability

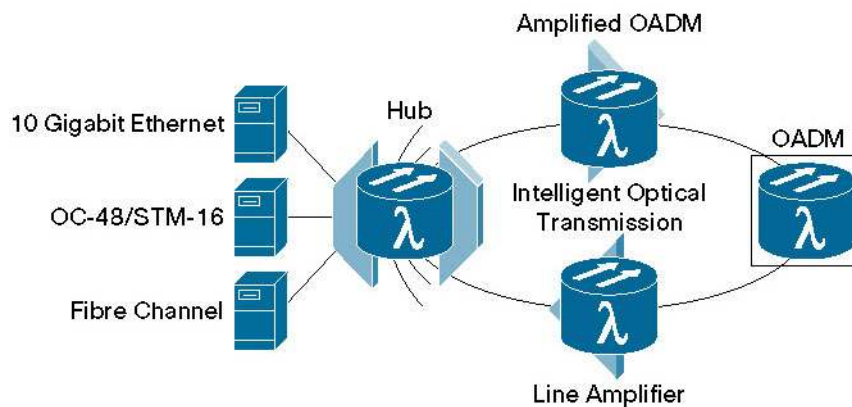
## Intelligence Through Software

The Cisco ONS 15454 MSPP introduced features such as GUIs, A-Z service provisioning, and graphical wizards to simplify operations such as ring provisioning and bandwidth upgrades. The Cisco ONS 15454 MSTP makes use of this architecture to introduce operational simplicity in DWDM networks (Figure 3). Using IP in the optical service channel and MSPP-like software, the Cisco ONS 15454 MSTP supports:

- Network topology auto-discovery
- Node and network, point-and-click setup and regulation for rapid network turn-up
- Software-controlled optical power management for fully automated optical power management, wavelength additions, site additions, and fast transient suppression in the case of a fiber cut
- A-Z wavelength provisioning, eliminating the need for maintenance personnel at intermediate sites

**Figure 3**

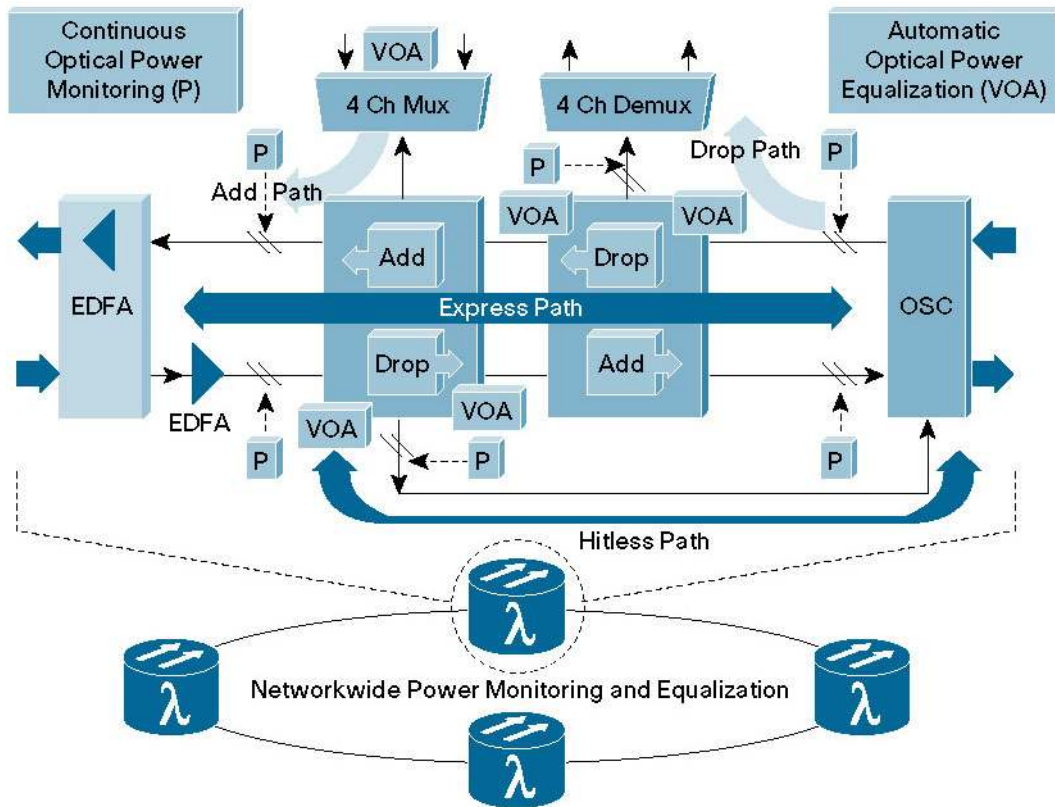
Intelligent Optical Transmission with the Cisco ONS 15454 MSTP



## Automatic Optical Power Management

An important capability of the Cisco ONS 15454 MSTP is automatic optical power management. Traditional DWDM solutions require considerable manual interaction to turn up, manage, and upgrade DWDM networks. Through strategic optical power monitoring and variable optical attenuation (VOA), Cisco ONS 15454 MSTP software is able to dynamically monitor and control optical power, a critical operation in amplified DWDM networks. The Cisco ONS 15454 MSTP software reconstructs a model of the provisioned DWDM network. Software algorithms then automatically provide network-wide optical power management by equalizing channels that are intrinsically unequal, adjusting for optical paths with different insertion losses (add, drop, express, and hitless paths) and maintaining constant power when wavelengths are added or dropped (Figure 4).

**Figure 4**  
Networkwide Power Monitoring and Equalization

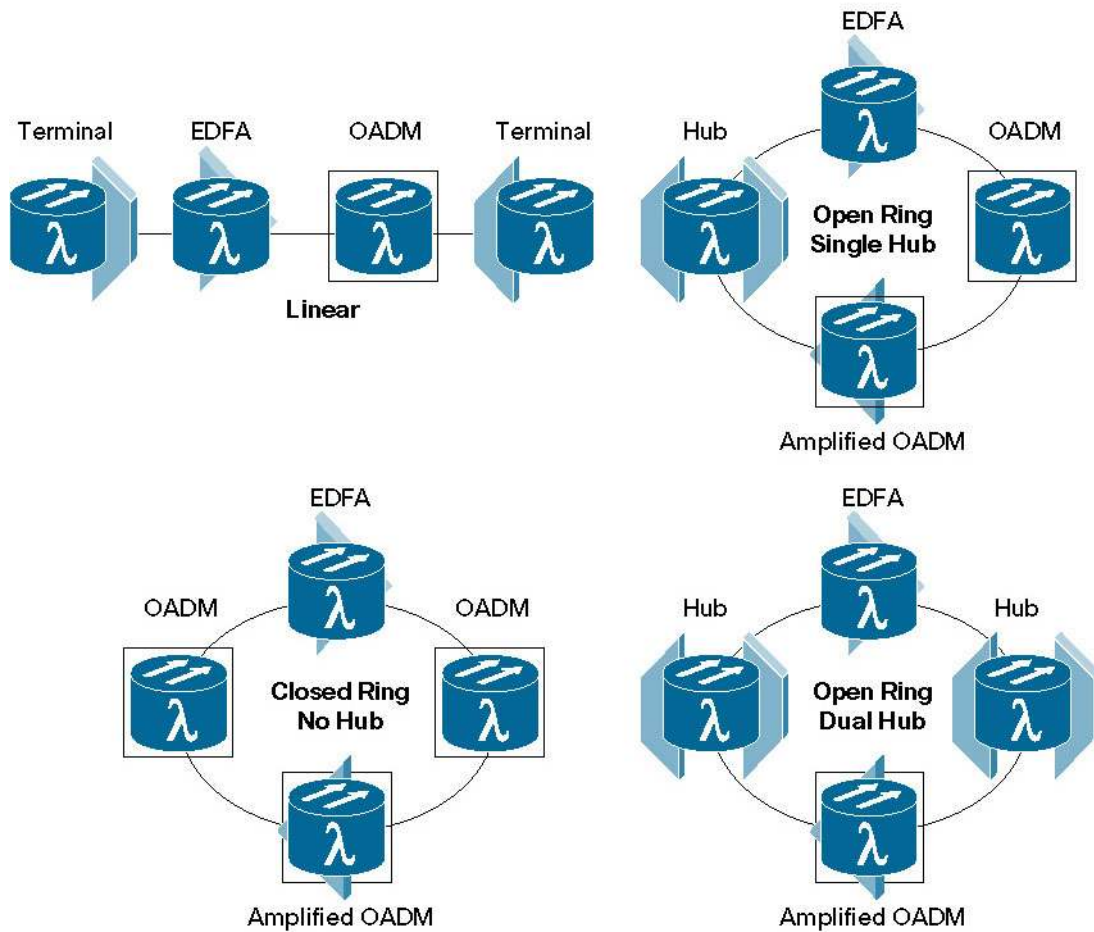


### Topology Flexibility

Traditional DWDM solutions were optimized for point-to-point transmission. Metro and regional DWDM networks require ring topologies with complex traffic patterns. The Cisco ONS 15454 MSTP can be configured to support any metro or regional DWDM topology, as shown in Figure 5.

**Figure 5**

Flexible Networks with the Cisco ONS 15454 MSTP



Target networks include:

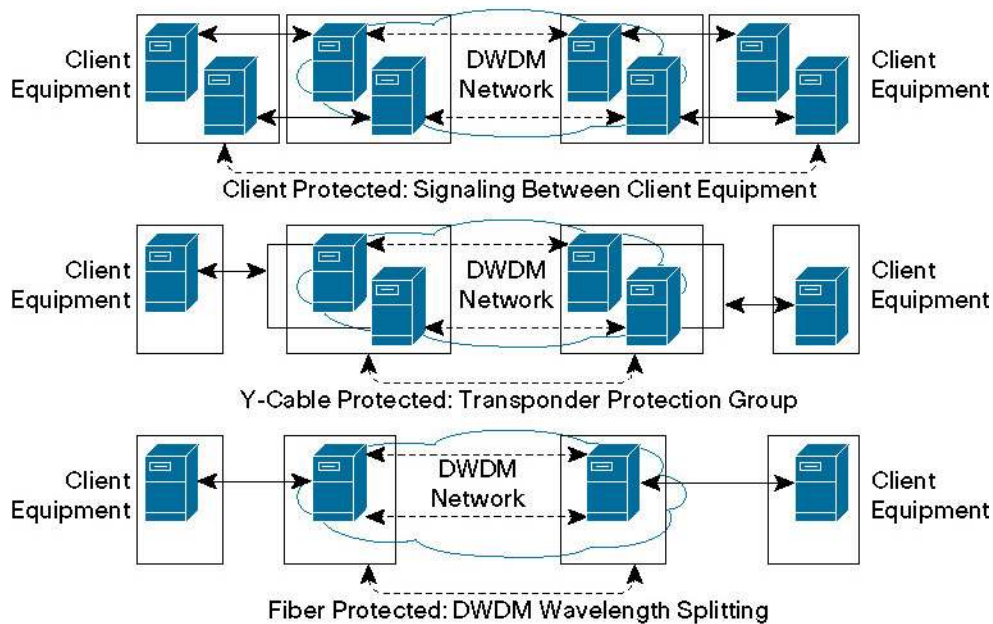
- *Access rings* – To collect traffic from multiple remote sites to a central hub. Capacity per ring is typically low (up to eight wavelengths).
- *Metro inter-office facility (IOF) rings* – To interconnect metro central offices. Ring capacity can be high and the traffic pattern distributed. One or all wavelengths may be dropped/added at intermediate sites using ROADMs.
- *Metro core* – The backbone of large metro networks. Ring capacity is typically high and ring circumferences are large. Wavelength add/drop flexibility is essential, and ROADMs play a critical role in these designs.
- *Long regional spans* – IOF and core rings with long spans that do not have a requirement to add/drop wavelengths at intermediate sites.
- *Dedicated long-haul network alternative* – When traffic capacity is not high, it can be more cost effective to eliminate the long-haul network as a separate layer, and use the free capacity of the interconnected regional networks.

## Multiple Service Protection Options

The Cisco ONS 15454 MSTP provides multiple options for protecting services (Figure 6). Client protection is an option in which signaling is the function of the client equipment. Clients may use linear 1+1, SONET/SDH, or other protection mechanisms; the Cisco ONS 15454 MSTP provides the diverse routes through the intelligent optical network. Y-cable protection is an option in which the client signal is split and diversely routed through the network. Protection is provided by the Cisco ONS 15454 MSTP. A third option is wavelength splitting. Here the DWDM signal is split and diversely routed. In this case, too, protection is provided by the Cisco ONS 15454 MSTP. Protection options will depend on the service agreement and can be combined for maximum reliability.

**Figure 6**

Multiple Service Protection Options



## Networking Flexibility and Growth

One of the main obstacles to the adoption of DWDM technology in metro networks is the inflexibility associated with first-cost and network growth. The Cisco ONS 15454 MSTP has been architected for networking flexibility and growth:

- *Adding wavelengths* – Wavelengths can be added as needed without impacting other wavelengths in the network, and without having to adjust multiple optical parameters across the network.
- *Migration from 2.5 Gbps to 10 Gbps to 40 Gbps wavelengths* – While most wavelengths today have 2.5-Gbps and 10-Gbps bandwidth capacity, it is clear that 40-Gbps wavelengths will be needed in the future. The Cisco ONS 15454 MSTP has been designed for wavelength growth. For example, specially designed amplifiers allow dispersion to be managed without adversely affecting link budgets when wavelength capacity is upgraded.
- *Wavelength add/drop flexibility* – ROADM architecture allows wavelengths to be added/dropped or passed through, allowing configurations that can be changed on a per-wavelength basis without affecting other wavelengths. Furthermore, with ROADMs there is no need to “pre-

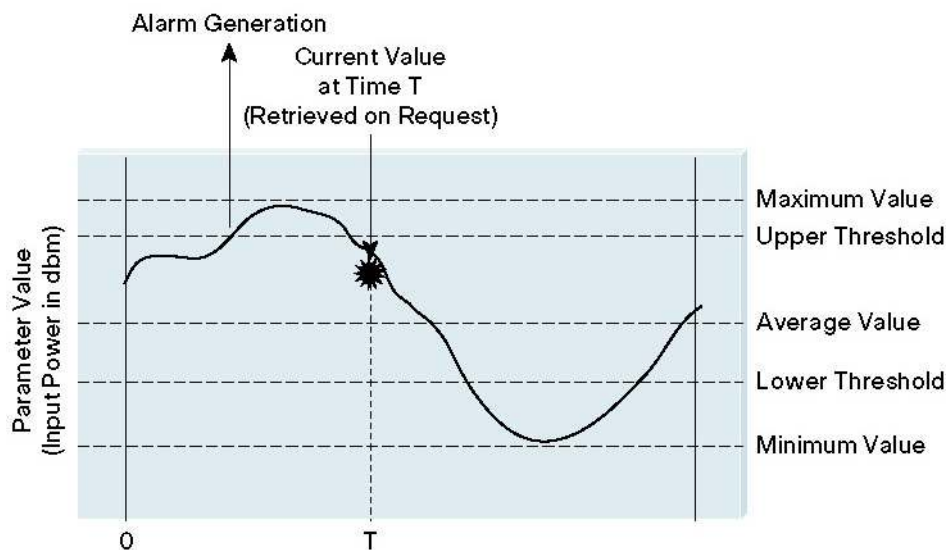
engineer” the locations where wavelengths will be added and dropped. Any service can be dropped at any ROADM site through software control, without pre-planning or interruptions to existing services.

- *Integration with external devices* – Ethernet switches and IP routers are now becoming available that can transmit light directly at ITU G.692-compliant DWDM wavelengths. The Cisco ONS 15454 MSTP is designed to easily manage and support such services, lowering total network costs by eliminating the need for transponders in some applications.

## Simple Management and Monitoring

Cisco ONS 15454 MSTP network management is based on easy-to-use GUIs. Optical service channels are used for communication in the network, similar to the data communications channel (DCC) in the MSPP. Graphical interfaces display a range of views from the network level to the port level for easy provisioning and monitoring. Cisco ONS 15454 MSTP network management also monitors the DWDM “analog” components and generates SONET/SDH-like alarms. Figure 7 is a graphical representation showing the software generating an alarm when a provisioned threshold has been violated. Combined with the “digital-level” monitoring of SONET/SDH and G.709 digital wrapper, the Cisco ONS 15454 MSTP provides unparalleled service reliability. Problems can be discovered and corrected before revenue-generating services are affected.

**Figure 7**  
Power Monitoring and Reporting



## Metro and Regional Networks Transformed

With its multiservice capability, innovative optical technology, automatic optical power management, industry-leading ROADM, and MSPP-like ease of use, the Cisco ONS 15454 MSTP transforms how metro and regional DWDM networks are built and managed. By combining multiple services and intelligent DWDM, the Cisco ONS 15454 MSTP will significantly reduce both capital expenditures and operating expenses for today’s service providers and business users.



## For More Information

For more information visit: <http://www.cisco.com/en/US/products/hw/optical/ps2006/ps5320/index.html>.

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