White Paper

Using Cisco Prime Performance Manager for Comprehensive Service Assurance and Cost Control

Executive Summary

Administrators of IP/MPLS, Carrier Ethernet, mobile backhaul, and video networks face specific challenges such as maintaining an excellent customer experience - service assurance - and reining in costs in the face of ever-increasing network complexity. They need data on the performance of systems and piece parts and on the quality of service for multiple simultaneous service offerings within their networks to identify network problems and usage trends and to plan for future capacity expansions. Cisco Prime™ Performance Manager, a comprehensive, highly scalable, and easy-to-use program, provides a way for IP next-generation network service providers to visualize network performance and obtain actionable information.

Needed: Visibility into Complex Networks

The convergence of mobile data, video, residential, and business services is creating broad opportunities for communications service providers (CSPs). With those opportunities come challenges - IP next generation network (NGN) service architectures are increasingly complex to operate, and the explosive growth of IP traffic is levying greater demands on transport networks. Today's ultracompetitive marketplace is one in which service assurance is vital for success, yet it must be constantly balanced against operating expenses (OpEx). In short, CSPs need ways to deliver high-quality services at the lowest possible price.

But imposing disjointed management solutions on complex networks increases the cost of operations and diminishes the amount of information available on them. To introduce new services rapidly, plan effectively for network extensions, and optimize capacity, service providers and enterprises that operate carrier-scale networks need a clear understanding of network performance and resource availability. To obtain this clarity, they need an information solution that unifies the management of complex services, rather than offering disconnected visibility on some aspects of the network. Ideally, they need an efficient, comprehensive management system that makes network and service performance transparent and also provides tools for capacity planning. Also ideally, the management system will help CSPs forestall customer problems and missed service-level agreements (SLAs). It should help identify network problems that are degrading service and quality of service (QoS) for customers but have not yet led to actual service outages or faults on devices. In such cases, operators need to be able to see a problem and put the appropriate remediation in place before it becomes an emergency.

Capacity Planning and Cost Management

Moreover, since these issues typically indicate that a service provider needs to add capacity or adjust priority levels for other services - either on internal devices, or in the bandwidth for which the service provider has contracted with a customer - the provider should have the information with which to do so. The appropriate management system helps enable CSPs to provision the correct amount of capacity - without costly overprovisioning.

The importance of minimizing OpEx is brutally clear in this observation from Patrick Kelly, research director at Analysys Mason: “In developed regions, revenue per gigabyte will fall from US$23.21 in 2010 to US$4.27 in 2015.” Moreover, he adds, the combination of high traffic growth and slow revenue growth is putting pressure on operators’ profit margins. CSPs must work even harder to manage costs, while still improving the customer experience.

To effectively introduce new services and help ensure the quality of existing services, CSPs must be able to:

- Manage critical technologies and solutions such as Carrier Ethernet, IP/Multiprotocol Label Switching (MPLS), video monitoring, and mobile backhaul
- Obtain actionable information for network service and element use to help them identify potential performance and reliability issues before these issues can result in service degradation
- Gain visibility into usage and usage trends with which to perform capacity planning that has a high level of precision

For CSPs that operate IP/MPLS, Carrier Ethernet, mobile backhaul, or video networks, the following sections provide more specific information on how Cisco Prime Performance Manager can provide value for each type of network.

Cisco Prime Performance Manager

As a highly scalable, integrated application that spans core, aggregation, and access networks, Cisco Prime Performance Manager offers users a rich set of prepackaged reports that give them actionable information. It provides visibility into service assurance and capacity planning for their IP next-generation networks.

In addition, the solution cuts OpEx in two ways:

- Making it possible for network administrators to run a leaner network that still delivers the QoS that customers demand
- Reducing administrative expenses

Cisco Prime Performance Manager automatically collects raw data on network performance and services from up to 50,000 devices and millions of interfaces. After it analyzes and processes the data, it generates any of over 3000 prepackaged standard reports as well as custom ones that can include domain-specific views. Customized reports can specify what to poll, how to process the data, and how to display the data in the GUI.

Among the categories of reports are:

- **Application traffic:** Authentication, authorization, and accounting (AAA), Simple Network Management Protocol (SNMP), Transmission Control Protocol (TCP), User Datagram Protocol (UDP), RADIUS, and so on
- **Availability:** Interfaces, MPLS networks, Pseudowires, Internet Control Message Protocol (ICMP) ping, SNMP ping, Layer 2 VPN, and so on
- **Compute:** Hyper-V, KVM, VMware, Cisco UCS cluster, Xen, and so on
- **IP QoS:** Committed access rate (CAR), class map, Ethernet flow point, video monitoring, and so on
- **IP Protocols:** Border Gateway Protocol (BGP), ICMP, Open Shortest Path First (OSPF), Intermediate System to Intermediate System (IS-IS), and so on
- **Layer 2 Protocols:** Multiple Spanning Tree Protocol (MSTP), Rapid Spanning Tree Protocol (RSTP), Virtual Local Area Network (VLAN), and so on

- **IP SLA:** Ethernet Operations, Administration, and Management (Ethernet OAM), FTP, HTTP, MPLS OAM, ICMP jitter, round-trip time, TCP connection, UDP echo, UDP jitter, video, voice over IP (VoIP) delay, VoIP RTP, Y1731, and so on
- **Mobile IOS:** Content Services Gateway (CSG), Gateway GPRS Support Node (GGSN), Policy and Charging Rules Function (PCRF), Packet Data Network Gateway (PDNGW), Serving Gateway (SGW), Server Load Balancing (SLB), Serving Gateway/PDN Gateway (SPGW), and so on
- **Mobile StarOS:** Access Point Name (APN), card, context, Diameter Credit Control Application (DCCA), DPCA, GPRS Tunneling Protocol (GTP), GTPP, Enhanced Charging Service (ECS), IP Pool, Local Mobility Anchor (LMA), MGA, peer to peer (P2P), Packet Data Gateway (PDG), Packet Data Network Gateway (PGW), SGW, port, RADIUS, SAEGW, eGTP-C, and so on
- **NetFlow:** NetFlow metrics, NetFlow statistics, and so on
- **Network services:** Load balancing, Symmetricom, virtualization, and so on
- **Resources:** Buffers, central processing unit (CPU), memory, disk, sensors, users, swap space, and so on
- **Security:** Firewall, IPsec, PVLAN, VPN, and so on
- **Storage:** EMC, Fibre Channel, NetApp, VSAN Zoning, and so on
- **Transport statistics:** Interface, ATM interface, Asynchronous Transfer Mode (ATM) Permanent Virtual Circuits (PVCs), Ethernet virtual connection (EVC) interfaces, Ethernet flow point interface, Carrier Grade NAT (CGN), cable, Ethernet first mile, Layer 2 VPN, Layer 3 VPN, MPLS, optical, PE-CE interface, PWE3, RMON, TDM interface, VPDN, and so on
- **Video broadcast:** Conditional access, Digital Broadband Delivery System (DBDS), satellite signals, Cisco TelePresence®, and so on

By default, all Cisco Prime Performance Manager dashboards are enabled depending on the reports defined, delivering a consistent experience across the network. The web-based GUI minimizes complexity and the learning curve for network staff and forestalls the need to install Cisco Prime Performance Manager on multiple operating systems or clients. In addition, it is designed to present data from different operating systems that may run on network elements, again reducing administrative expense.

Network operators can request reports at 1-, 5-, and 15-minute, hourly, daily, weekly, and monthly intervals. Prepackaged reports on a wide range of network services, technologies, and devices, from core, aggregation, and access networks are automatically generated, saving time and OpEx. See Table 1.

Table 1. Monitoring Support for Multiple Technologies

Network Resource Monitoring	Network Service Monitoring	Network Congestion Monitoring
Device utilization	Pseudowire	Class-based QoS
Interface utilization storage	Ethernet OAM	Traffic Engineering (TE) Tunnels
Availability	IP SLA	Application
Environmental	MPLS segments Label Distribution Protocol (LDP) Video monitoring	Protocol

Cisco Prime Performance Manager runs on several platforms, including Cisco Unified Computing System™ (Cisco UCS®), Linux with VMware, and Solaris with Solaris VM Server. It uses an embedded database that requires no administration and can be deployed on single or multiple servers.

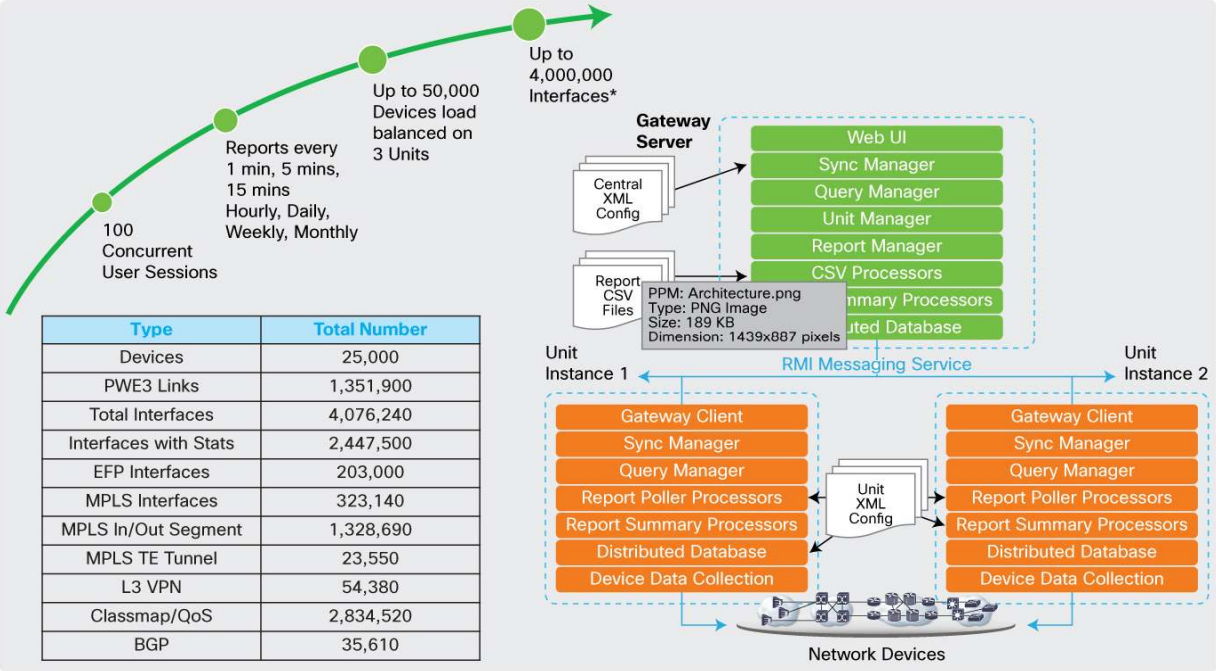
In addition to supporting existing network devices and services, Cisco Prime Performance Manager makes it easy to support new ones. One example of the benefits: Providers can obtain reports on just-provisioned services, speeding time to market.

Providers must deal with volumes of services that are growing exponentially. Cisco Prime Performance Manager helps them sustain acceptable costs of deployment and maintain average rates of revenue per user. It allows service providers to adapt quickly to changing market dynamics and adjust service offerings, increasing business agility, without upgrading the management software.

Physical Architecture

As shown in Figure 1, the Cisco Prime Performance Manager architecture comprises a gateway server that manages unit servers, which are dedicated to polling network elements for performance data through SNMP management information bases (MIBs). These unit servers store the performance data in local databases and then process it and present it to network staff through a secure web interface or through data exports to external operations support systems using comma-separated values (CSVs) and HTML, transmitted through the server's northbound interface. The distributed architecture provides reliability, flexibility in deployment, and horizontal scaling so it can grow with the network.

Figure 1. Cisco Prime Performance Manager: Physical Architecture



Type	Total Number
Devices	25,000
PWE3 Links	1,351,900
Total Interfaces	4,076,240
Interfaces with Stats	2,447,500
EFP Interfaces	203,000
MPLS Interfaces	323,140
MPLS In/Out Segment	1,328,690
MPLS TE Tunnel	23,550
L3 VPN	54,380
Classmap/QoS	2,834,520
BGP	35,610

Support for IP over MPLS Networks

Internet Protocol running on an MPLS network is the transmission workhorse for many, if not most, service providers, and it is certainly their choice for NGNs. But IP/MPLS networks bring their own concerns for service providers, such as being able to monitor Level 2 virtual private networks (VPNs), Level 3 VPNs, TE tunnels, pseudowires, and other technologies - all of which increase complexity in the IP/MPLS network and thus increase the challenges of delivering high QoS and of troubleshooting.

Network operators need to be able to see whether, for example, gateway devices are applying the appropriate labels for the various technologies, whether internal devices are routing packets correctly, whether labels are dropped when specified, whether loads are shared efficiently - in short, whether SLA connectivity is maintained for all types of traffic.

Cisco Prime Performance Manager monitors a variety of metrics pertaining to IP/MPLS networks, such as:

- Availability of services
- Availability of devices
- Correctness of IP protocols
- Resource utilization
- Transport statistics

Examples of the aspects of an IP/MPLS network that may be included in these reports include:

- IP QoS, CAR, and EVCs
- IP protocols: BGP, ICMP, OSPF, IS-IS, VRF
- Fulfillment levels of IP SLAs, ICMP jitter, round-trip time, UDP jitter
- Transport statistics such as MPLS TE tunnels, in-out segment LDP, and PWE3s

In addition, network administrators can use Cisco Prime Performance Manager for visibility into a multitude of other network characteristics such as device types, device status, data collection by device, alarms and events - well, anything pertaining to IP/MPLS transport that can be collected from those tens of thousands of network devices.

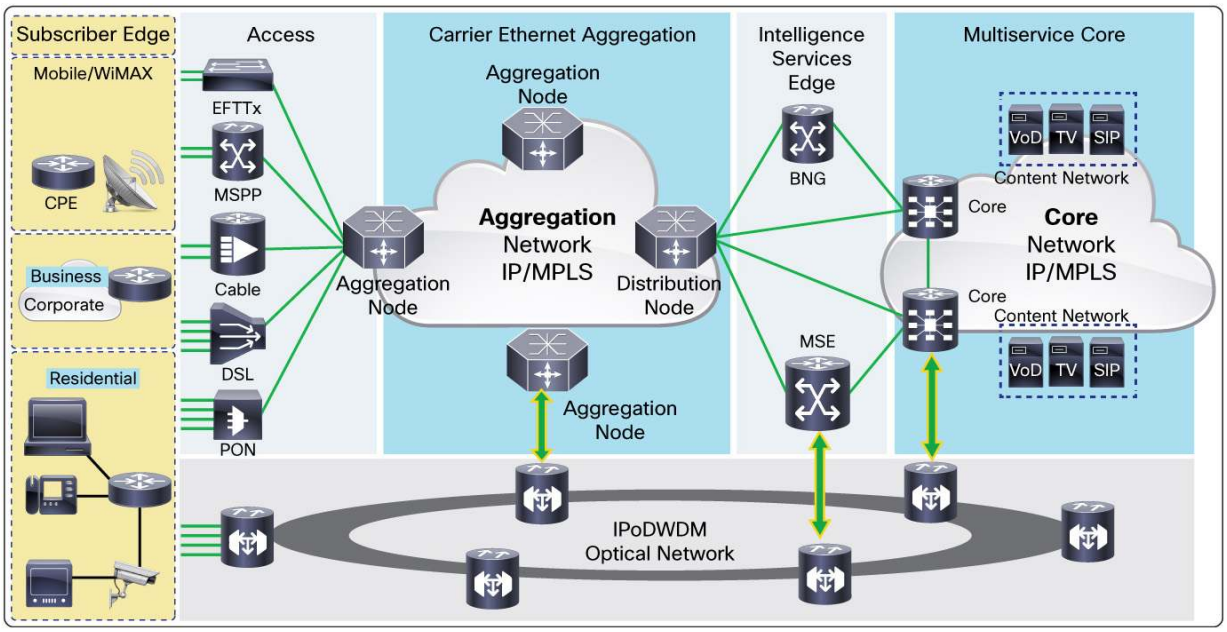
Support for Carrier Ethernet

Service providers of all types are turning to Ethernet technology for their next-generation metro-area networks (MANs) and wide area networks (WANs) for its simplicity and cost-efficiency, frequently running it over an IP/MPLS network. Among their reasons:

- Ethernet is ubiquitous and IT organizations are familiar with it so deployment is streamlined, helping companies reduce OpEx.
- Carrier Ethernet provides rich connectivity services such as Ethernet private line and Ethernet virtual private line (also known as E-line services), multipoint to multipoint Ethernet Virtual Connection (also known as E-LAN), and point to multipoint E-LAN with leaves (also known as E-Tree).
- Carrier Ethernet can easily scale to provide high bandwidth, low latency, and high-quality delivery both for entertainment content and for business-grade, time-sensitive data.
- It makes use of existing infrastructure, improving overall network return on investment (ROI) and helping to contain costs.

A typical Carrier Ethernet network, as part of IP NGN, is shown in Figure 2. Cisco Prime Performance Manager provides visibility and reporting across the Carrier Ethernet network from the network level on down to the device level, as shown in Figure 3.

Figure 2. Carrier Ethernet in Cisco IP NGN



Cisco Prime Performance Manager is designed to support the OAM tools designed specifically for Ethernet transmission. Making use of connectivity fault management and link-level protection, Ethernet OAM tools help deliver end-to-end service assurance across the IP/MPLS core, the Ethernet MAN or WAN, and out to the customer premises.

In tandem with these tools, Cisco Prime Performance Manager gives providers detection and monitoring capabilities they need to help ensure service availability, increase service velocity, autoprovision equipment, and deploy services end to end.

It also provides a set of prepackaged reports that help enable network operators and administrators to verify end-to-end connectivity. In addition, the reports monitor service performance metrics such as frame loss, delay, response time, and jitter.

Cisco Prime Performance Manager also supports several reports that provide additional information for monitoring the Carrier Ethernet network health. These reports include:

- QoS reports for EVCs
- Transport statistic reports for EVCs
- Pseudowire availability reports

The system of reports and the intelligence they convey help enable Ethernet operations teams to act proactively to protect QoS. For example, if a cable network service provider's IP network is congested, there may be jitter or packet loss on the link, resulting in customers experiencing pixilation on their video screens. Help-desk operators who receive the customers' calls can use reports generated by Cisco Prime Performance Manager to view

historical topologies from the entire Carrier Ethernet network and identify specifically where the problems occurred.

This information not only helps solve the immediate problem for customers, but also helps operations teams plan and manage capacity. Service providers can use this information to identify an area where their infrastructure needs expansion. The CSP's ability to solve problems quickly leaves the customer with a positive experience, and improved visibility into capacity planning protects the service provider from costly over-provisioning of bandwidth.

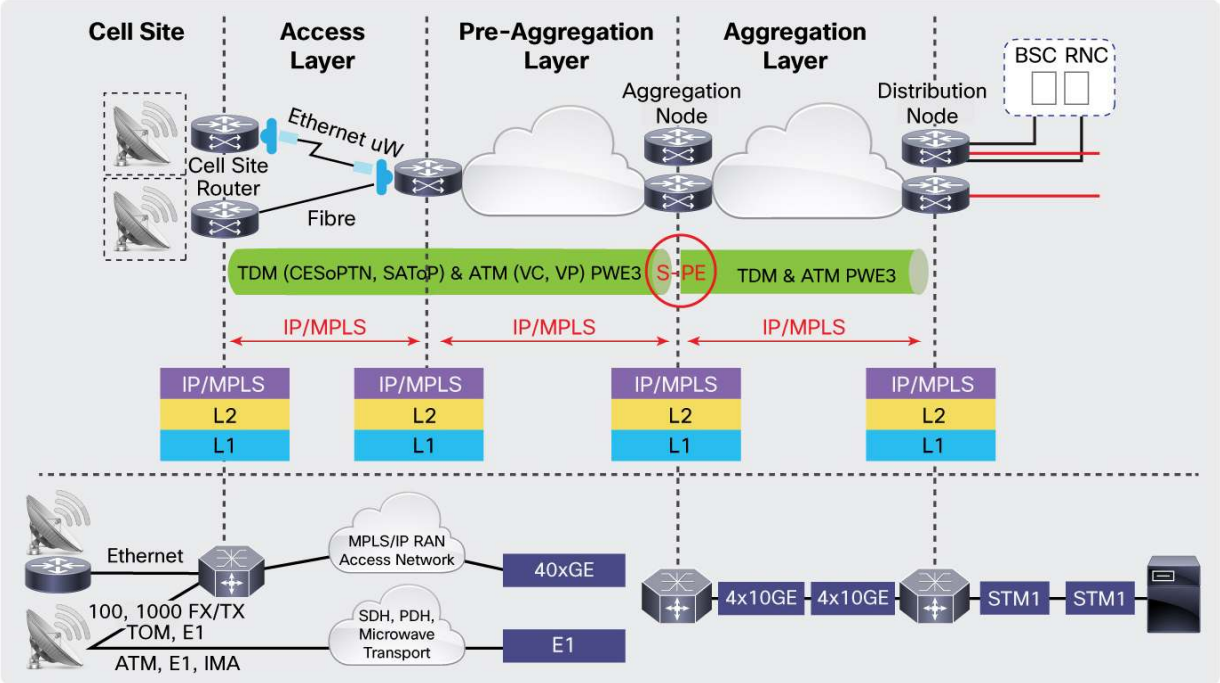
Figure 3. Prepackaged Ethernet OAM Report in Cisco Prime Performance Manager

Support for Unified Radio Access Network Backhaul

Cisco® Unified Radio Access Network (RAN) Backhaul and Mobile Transport over Packet (MToP) are two technologies that work together to help mobile carriers operate their mobile networks efficiently. MToP formats RAN traffic for transport across the packet network and in doing so extends Cisco IP network intelligence from the network core to the edge. It also establishes a common backbone for migration from traditional, disparate networks to a converged IP/MPLS mobile architecture.

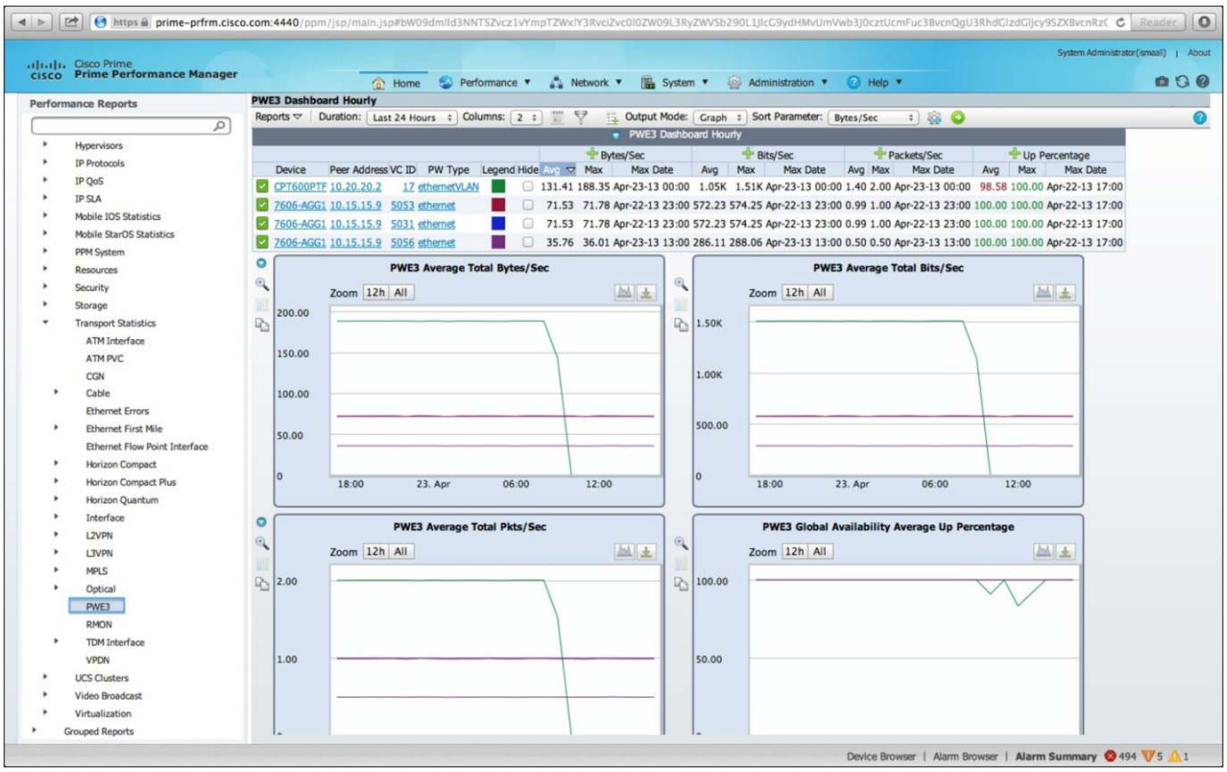
With MToP in place, the operator can take advantage of the Any Transport over MPLS (AToM) capability of its IP/MPLS foundation and build a general-purpose transport network, as shown in Figure 4. In this framework, pseudowires created inside the IP/MPLS network each carry a different kind of traffic. MToP uses these pseudowires to extend the packet-based core closer to the edge of the network. It flattens the multiple layers of the RAN onto a single MPLS network by encapsulating and transporting time-division multiplexing (TDM), Frame Relay, and ATM traffic over MPLS.

Figure 4. Cisco Unified RAN Backhaul Network



Cisco Prime Performance Manager provides a set of prepackaged reports for transport statistics for Pseudowire Emulation Edge to Edge (PWE3), MPLS, and IP SLAs. Figure 5 shows one example. These reports can give users a quick view of how these services are operating and how to plan for expansion or troubleshoot any congestion or faults. In addition to these reports, Cisco Prime Performance Manager can provide tools for monitoring network element resources, including availability reports for pseudowires and interfaces, and reports on central processing capability, buffers, and memory.

Figure 5. A Prepackaged Report on a Cisco Unified RAN Backhaul Network



A network operator running a Cisco Unified RAN backhaul network can utilize the threshold crossing alerts (TCA) capability of Cisco Prime Performance Manager - setting up particular thresholds for any key performance indicators (KPIs). Cisco Prime Performance Manager generates a report that reflects these thresholds and that is displayed in the browser window. A spike in this graph would indicate a dropped call for a mobile user, or that user's inability to get a signal. The operator could view the graph and identify where the spike was occurring, what time it happened, and other relevant details that would arm the operator with the information necessary to investigate and fix the device in question.

Support for Video Networks

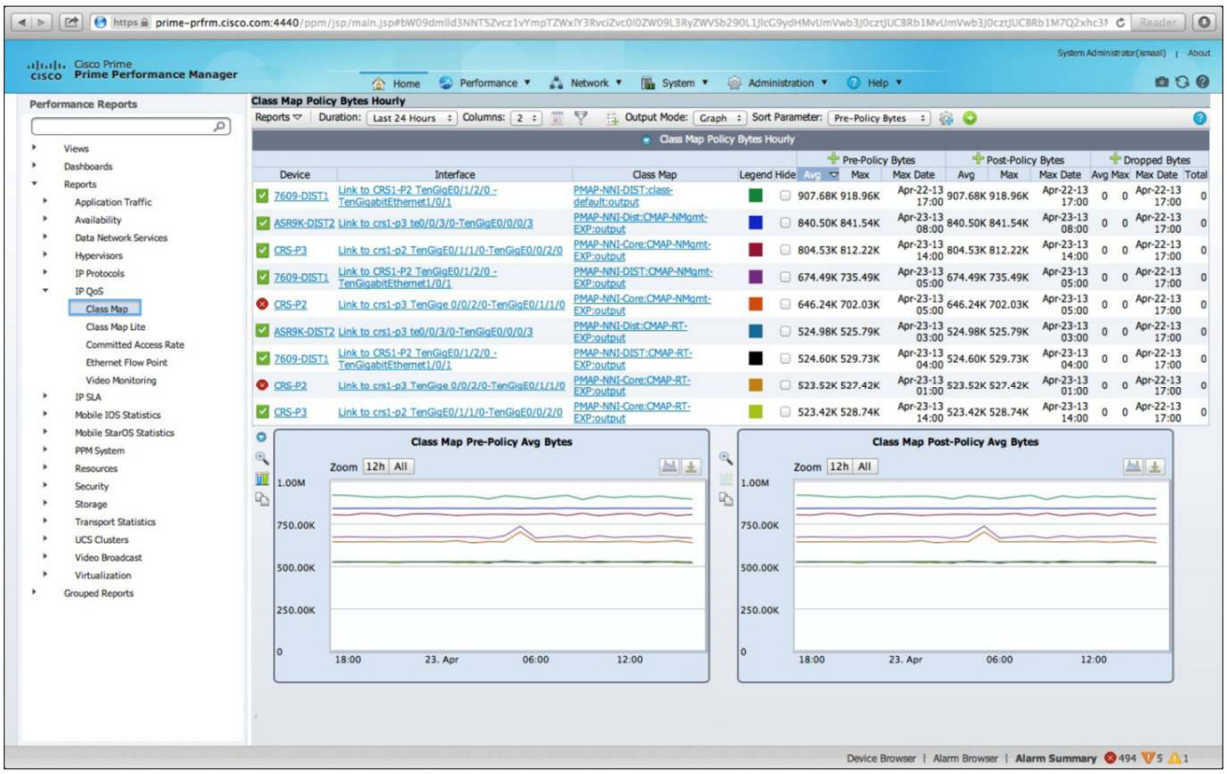
SLA levels of QoS are vital in any type of network, but in perhaps no other are they as apparent to the customer as in a video one, where that customer can actually see the effect of a dropped packet on the television screen. One IP video packet contains some 1400 bytes of data that comprise multiple MPEG-encapsulated video packets. The loss of even one IP video packet can result in a video impairment of half a second or more. Many dropped packets can result in video freezes or even the loss of the customer's signal.

Service assurance - or the lack thereof - is spelled out clearly in whether customers maintain or cancel subscriptions. Isolating video anomalies to a specific area of the network and allocating the proper operational resources is crucial to providing high-quality video over an IP network - as well as controlling costs. Video traffic differs sufficiently from other types of IP transmission that a stream that meets the requirements of the IP SLA might still not deliver the QoS needed by a video signal. Therefore video performance monitoring requires other specialized tools.

There is a solution: inline monitoring such as that provided by Cisco Inline Video Monitoring (Cisco VidMon), which provides network-based monitoring through the router transport line card. This approach monitors the video stream inline and in real time without sacrificing transport performance or scalability, as is shown in Figure 6. The benefits of Cisco VidMon include:

- Tight integration between video-quality monitoring and transport operations: If the Cisco VidMon feature detects a video-quality problem, it communicates that to the router, which can automatically and instantly switch over to a backup path.
- The ability to detect both hard and soft failures, including link-quality problems.
- High scalability and performance: The router with the Cisco VidMon line card can monitor thousands of video streams in line and in real time and with no performance degradation.
- Capital Expenditure (CapEx) and OpEx savings: No additional hardware is required for Cisco VidMon to perform inline video monitoring; the transport hardware handles this monitoring.
- Operationally, no manual intervention from network operations center personnel is required.

Figure 6. A Typical Report on a Video Network



Cisco Prime Performance Manager supports the collection and reporting of metrics including VidMon Media Delivery Index (MDI), Media Discontinuity Counter (MDC), Real-time Transport Protocol (RTP) loss and jitter, and Media Rate Variation (MRV). With Cisco VidMon, the router platform can monitor thousands of video flows simultaneously. By using Cisco Prime Performance Manager with Cisco VidMon, network operators can isolate the root cause of poor quality video flow to a specific part of the network and identify how to fix the problem.

A Way to Stay Ahead

Through proactive, rather than reactive, identification and management of problems and capacity planning, service providers can provide high quality services while reducing costs through efficient use of network resources. Reducing costs, of course, helps maintain profitability, supports new investments in the network and new services, and enables providers to pass savings onto customers.

Using Cisco Prime Performance Manager, service providers gain simplified monitoring for proactive service assurance, capacity planning, and network optimization for converged networks. Deployed as a standalone application or with Cisco Prime Network, Cisco Prime Performance Manager providers a powerful solution to help ensure high-quality service for end customers, while helping to reduce integration costs and the overall cost of network administration.

Cisco Prime Performance Manager is brought to you by an industry pioneer in IP networks. Cisco developed the basics of IP/MPLS, Mobile Transport over Packet, and Any Transport over MPLS and has been an industry leader in data networking in general. Its deep understanding of networks as well as specific technologies and how they can serve the multiple and varied types of applications and services that CSPs must offer make this solution both timely and effective.

About Cisco Prime

The Cisco Prime portfolio of IT and service provider management offerings empowers organizations to more effectively manage their networks and the services they deliver. Built on a service-centered foundation, Cisco Prime supports integrated lifecycle management through an intuitive workflow-oriented user experience, providing A-to-Z management for IP Next-Generation Networks, mobility, video, cloud and managed services.

For More Information

For more information about Cisco Prime Performance Manager, contact your local account representative or visit the Cisco Prime Performance Manager Overview at http://www.cisco.com/go/performance.

Download a no-cost, 60-day evaluation version of Cisco Prime Performance Manager from the Cisco Marketplace at http://www.cisco.com/go/nmsevals.

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