Managing Business-Grade Services and Systems on Cisco IP Next-Generation Networks

Executive Overview

Through subscriber interactions at customer touch points, the Cisco® IP Next-Generation Network (IP NGN) management framework enhances, accelerates, and helps enable service providers to gain competitive advantage, delivering the desired level of customer experience. When enterprise customers subscribe to business-grade services from service providers, they experience what it is like to deal with that provider and form an opinion, good, bad, or indifferent. This experience is the ultimate conveyor of value to the customer and a primary influence on future behavior. The quality and consistency of that experience is fundamental to driving future loyalty or accelerating defection.

Demand for bandwidth in the metropolitan-area network (MAN or metro) is expanding exponentially, the result of myriad factors, including data-intensive applications, new business models that rely on the Internet, the growth of broadband services, distributed applications, Web services, IP convergence, streaming content, multimedia, new computing models, networked storage, and business continuity initiatives. Service providers can take advantage of Metro Ethernet to deliver Ethernet connectivity services using Layer 1 or Layer 2 transport and access to value-added Layer 3 services. Ethernet connectivity services provide a scalable, cost-effective solution to meet requirements for high-bandwidth, enterprise WANs and MANs. Users can implement them over existing optical, Gigabit Ethernet, IP, and Multiprotocol Label Switching (MPLS) infrastructures to create a VPN service.

Networks are like human DNA: they are unique, with a multivendor, multitechnology, multiservice environment. Service providers' networks must evolve and adapt, reducing time to market to deliver and manage convergence (technology, platform, software, form factor, process, user interface, and mindset) and divergence (terminal, bandwidth and content).

The Cisco IP NGN management framework includes a virtual network layer, open and extensible APIs, a common information model for real-time dynamic policy management based on events from multiple sources, and control to accelerate services deployment. Service provider strategies include acceleration of convergence to reduce ongoing operating expenses (OpEx) and capital expenditures (CapEx), while increasing addressable market divergence of revenue and brand value. There are several types of concurrent convergence and divergence:

- Convergence:
  - Technology: Telecommunications is clearly converging toward increasingly IP-based solutions.
  - Platform: Trend of integrating features that used to exist in separate pieces of equipment into a single piece of equipment has become a service provider expectation and preference.
  - Software: Standardized and common software platforms are becoming an increasingly important part of telecom networks.

- Form Factor: By standardizing the physical properties of equipment and components, it is possible to achieve greater "economies of scale".
- Process: Across today's competitive landscape; best practices are often shared among companies -- allowing them to draw inspiration from each other.
- User interface: Users expect and demand simplicity and familiarity as they switch between devices and applications.
- Mindset: Business and residential consumers are willing to pay more for new services, but the value of the experience must be clearly defined and reliably delivered.

- Divergence:
  - User Devices: Today's users have many device options to access applications and services
  - Bandwidth: Available bandwidth; providers need to take the nonuniform bandwidth allocation into account.
  - Content: Narrowcasting (to communities of interest) is a viable alternative to broadcasting.

Cisco network management offers a standards-based, end-to-end flexible and powerful product suite for device, network, service, and policy management in a multivendor, multitechnology, multiservice network environment.

Cisco network management provides a virtual network model to help service providers and carriers effectively manage multiple services and technologies in a multivendor network environment. Residing between the network layer and service layer, and creating a comprehensive, working virtual network abstraction, Cisco network management provides service providers and carriers the flexibility to:

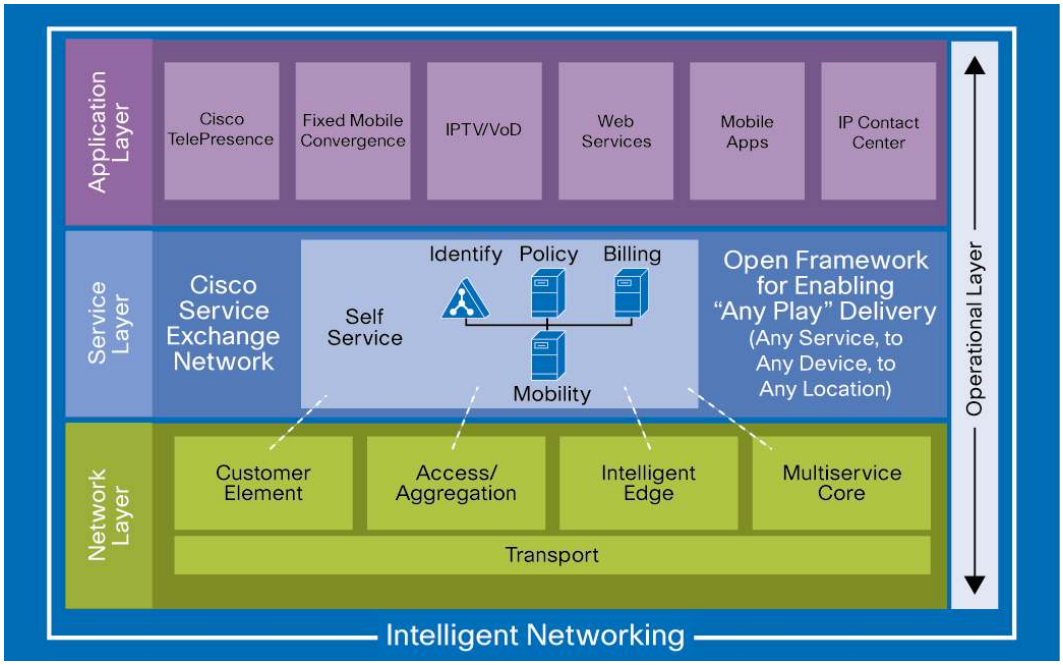
- Introduce network and service changes
- Accelerate service enablement and service assurance
- Scale and adjust to individual business and network growth needs

Cisco IP NGN Vision and Architecture

The Cisco IP NGN vision and architecture is designed to enable service providers to ubiquitously deliver rich, personalized, services (see Figure 1 below). Today's digital age subscriber expects an entirely new set of capabilities that unify their overall IP user experience at home, at work and on the move. Entertainment, content on demand and gaming as well as IP-based business and communications services must seamlessly migrate across mobile, cable or wireline networks. To deliver compelling and consistent user experiences, much more than simple access-agnostic transport and service delivery is required. Service providers have and will continue to transform their multiservice networks into intelligent infrastructures that offer sustainable competitive advantages in the form of revenue generation and operational efficiency. The Cisco IP NGN includes four layers: application, service, network and operational. The Cisco IP NGN enables service providers to:

- Accelerate service enablement and service assurance
- Scale and adjust to individual business and network growth needs

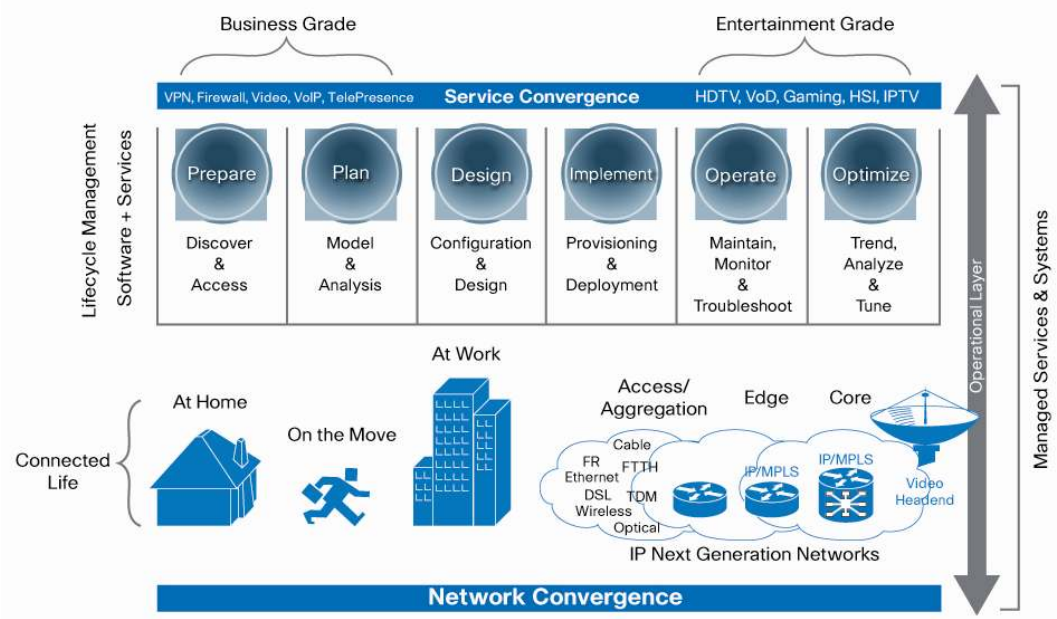
Figure 1. Cisco IP NGN Architecture



- Application Layer: Application convergence of end devices is quite apparent with computers being used as phones and phones being used to surf the web, computers being used as TVs; and TVs being used to surf the web, etc.
- Service Layer: To deliver such a rich variety of services to a broad range of devices over multiple access means, the network must have access to and be able to process granular customer information. Cisco created and continues to enhance the Cisco Service Exchange Framework (SEF) with its technology partners. Cisco SEF allows service providers to control customer access and use of services, but puts no limit on the types of applications that can be deployed.
- Network Layer: The secure network layer is the foundation of the Cisco IP NGN. IP/MPLS is being integrated throughout each section of the network. Edge and core network areas are converging, with each adopting capabilities of the other and providing greater efficiencies to the provider. Customer elements, whether they are end-user devices or routers at the network gateway, are converging as well. Service providers can benefit from this convergence by offering new, more, and better services.
- Operational Layer: The operational layer intelligently integrates the application, service, and network layers through various hardware and software solutions. Cisco technologies and solutions include tools and services that deliver a lifecycle approach to network management that helps carriers meet the complex requirements of today's connected home and managed business services demands. Cisco helps enable customers to proactively plan for future requirements and quickly respond to current application-performance issues. The comprehensive Cisco network management portfolio allows network operators to monitor, analyze, and optimize their networks as customer opportunities and needs evolve.

By building secure networks with more intelligence, fully integrated throughout, service providers can create highly resilient, adaptive, and scalable platforms that can grow and sustain profitable businesses (Figure 2).

Figure 2. Network Management Framework



Service Lifecycle Management

Key to being able to successfully deliver and manage the experience for business grade services are lifecycle management, from preparation and planning through design and implementation to ongoing operations and optimization, and platforms that compose the Operational Layer of the Cisco IP NGN architecture. Lifecycle management is expressed by the term PPDIOO, whose initials stand for prepare, plan, design, implement, operate, and optimize. Each phase should combine processes and platforms that allow network management teams to focus on attaining these business objectives:

- Alignment: Through assessments, analysis, and planning, yields a service portfolio aligned with subscriber demand
- Confidence: By maintaining a continuous service through robust business continuity infrastructures and consistent service-level compliance
- Efficiency: Develops management processes and platforms that leverage automation, integration, and simplification to protect profitability and maintain service quality
- Flexibility: To accelerate implementation of new services and increase agility to hone and adapt services as subscriber expectations change over time

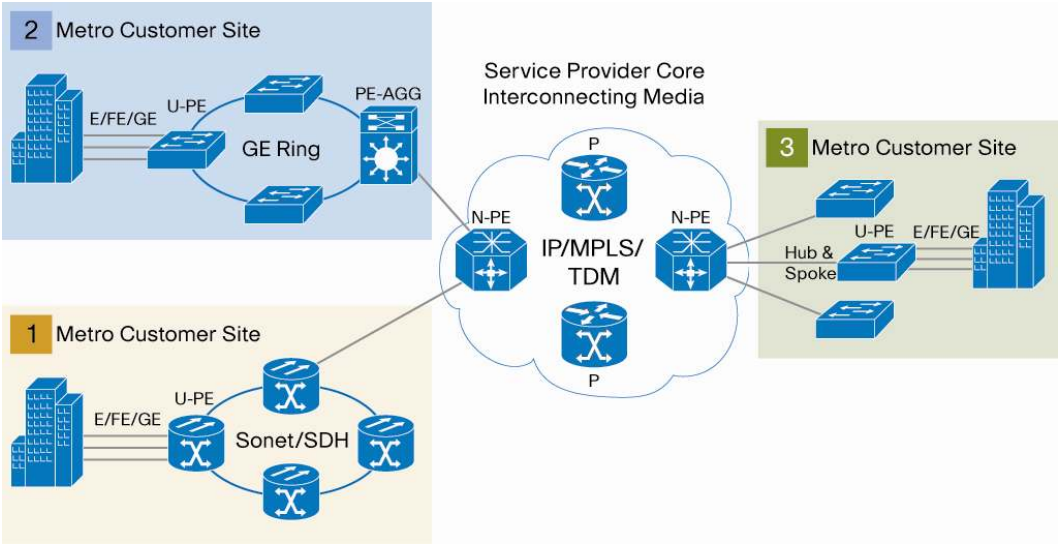
Deployment Scenarios

Enterprise customers reduce costs by outsourcing network management and network equipment to service providers at a predictable monthly recurring cost. At the high bandwidth business sites there is increasing use of fiber running Ethernet technology. The motivation for this change is increased service demand and flexibility. Service providers can capitalize on new and incremental revenue streams over their IP networks and reduce churn.

The specific challenges of implementing and managing business-grade services (bandwidth-on-demand, firewall, IPsec/MPLS VPN site-to-site and remote access, video, voice over IP [VoIP], PBX extension, intranet, quality of service [QoS], and so on) will vary among service providers based on their existing network architecture, current traffic matrix, traffic matrix forecast, network management system, overall network strategy, and other factors. It is essential to obtain and

maintain a close synchronization between the business plans (typically driven by the service provider's marketing department) and the network strategy (generally directed by the network operations department). The synchronization effort may sound simplistic but, in practice, is often a significant and underestimated challenge. Many business plans have failed to deliver the desired outcome because service providers have neglected to pay attention to this challenge. Figure 3 illustrates three deployment scenarios.

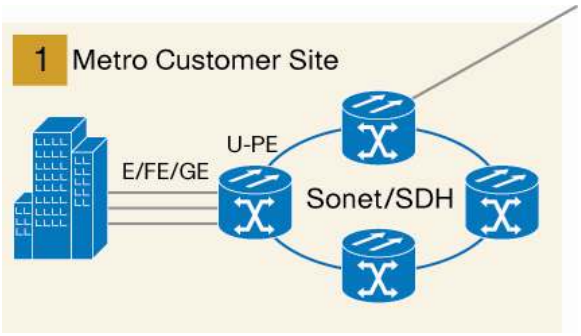
Figure 3. Metro Ethernet Customers 1, 2 and 3



Cisco Broadband Policy Manager (BPM) is highly integrable and provides the carrier-class policy management and capacity admission control solution used by service providers to manage the three scenarios described below for meeting the identified challenges. Cisco BPM evaluates rules and provisions dynamic policies; tiered applications (with different levels of service), application-driven QoS, and quota-based applications that identify subscriber usage of specific services and apply policies defined in business rules. The Cisco BPM voice and video capacity admission control helps ensure that the customer experience is consistent and protects against service-impacting events end-to-end. Explicit, optimal solutions are difficult to specify, as these will vary from carrier to carrier.

The first scenario is that of an incumbent operator with an extensive Synchronous Optical Network/Synchronous Digital Hierarchy (SONET/SDH) network that is considering a strategic investment in third-generation optical transport to modernize the existing infrastructure (Figure 4).

Figure 4. Customer Scenario 1: SONET/SDH Incumbent

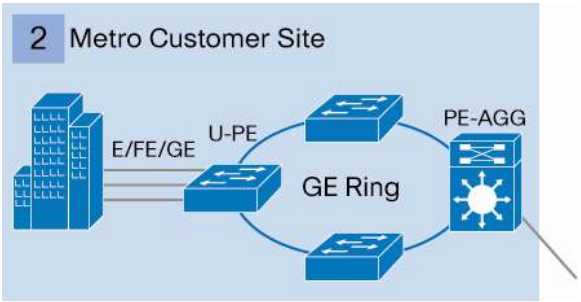


(Third-generation optical transport equipment includes SONET/SDH platforms with data-oriented features and other enhancements, optical switches, and metro wave-division multiplexing [WDM] systems.) This path could allow for the greatest flexibility in creating a framework that offers customers a choice of service and connectivity options while minimizing the inefficiency of holding underutilized assets. With Release 4.6, the Cisco 15454 ML series card introduced support for Virtual Concatenation (VCAT) and Link Capacity Adjustment Scheme (LCAS). These two features increase the efficiency of the transport network by allowing for granular and dynamic circuit creation. Cisco Transport Manager is more than an element management system (EMS); through the domain-level view, service providers quickly set up circuits using the central A-to-Z provisioning feature. Cisco Transport Manager (CTM) provides fault, configuration, performance, monitoring, and user-access security management capabilities on a robust client/server-based platform that scales to manage the equivalent of 3000 optical network system (ONS) and up to 100 simultaneous user sessions. Using the Cisco Transport Manager network provisioning, surveillance, and performance monitoring features, service providers can more rapidly roll out and maintain revenue-generating services that are built on Cisco optical networking, carrier routing, and voice gateway systems.

An investment in third-generation optical transport offers distinct advantages for carrying VoIP, video traffic, and other IP-centered services. The next-generation SONET/SDH specification offers data-centered features like Fast Ethernet functionality and a control plane for future optical signal schemes. It allows Generic Framing Procedure (GFP) for the standardized transport of synchronous storage area network and network-attached storage and protocols. And it also allows for Link Capacity Adjustment Scheme (LCAS) for the efficient treatment of dynamic traffic patterns as they change over time.

The second scenario (Figure 5) is that of a carrier without an existing SONET/SDH infrastructure. A carrier may opt to use an MPLS-based IP network for IP VPNs, VoIP, and other services.

Figure 5. Customer Scenario 2: IP/MPLS-based Challenger



The network's MPLS-based platform enable service provider to converge IP services and IP applications over a single network. To improve network flexibility and reduce operational costs, large businesses are using or evaluating IP VPN services. IP VPN services are meant to replace or augment private line and Frame Relay connections between enterprise locations. Today most major service providers offer IP VPN services with specific service-level agreements (SLAs) for network delay and jitter for enterprise locations that are connected directly into the service provider's network.

Enterprises can expect to reduce their WAN charges by up to 30–40 percent when they switch from Frame Relay. Adding a new location does not require service changes to the existing enterprise's locations. The IP VPN allows quick and easy interconnection of a large number of

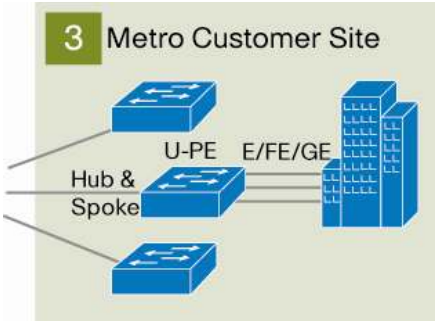
enterprise sites, providing cost savings compared with Frame Relay and ATM-based Layer 2 VPNs, which require a large number of virtual connections. On top of significant cost savings, IP VPNs also typically reduce network management requirements and improve network flexibility by facilitating a less-costly meshing approach compared with traditional Layer 2 VPN services such as Frame Relay and ATM.

Cisco IP Solution Center (ISC) family of network management applications helps service providers offering MPLS VPN services by providing the provisioning, planning, and troubleshooting features essential to manage the entire lifecycle of MPLS and Metro Ethernet networks (including the three scenarios listed in this section). The Cisco ISC Layer 2 VPN and Metro Ethernet Management application help service providers to manage the entire lifecycle of Layer 2 VPNs, Any Transport over MPLS (AToM), Layer 2 Tunneling Protocol Version 3 (L2TPv3), and Metro Ethernet services. Management features such as policy-based VPN, management VPN, and QoS provisioning help minimize the cost deployment of Layer 2 VPN and Metro Ethernet services and guarantee the accuracy of service deployment. Also the Cisco MPLS Diagnostics Expert (MDE) is an automated, workflow-based network management application that quickly troubleshoots and diagnoses problems in MPLS VPN deployments.

MPLS defines a label-switched path (LSP) between network nodes using label-switched routers (LSRs). It also requires that the label-switching and packet-forwarding function at each router is independent of how LSRs are set up or taken down from the network, a useful control function. In short, the advantage of MPLS is that it helps define a path in an IP network, which is advantageous for time-sensitive traffic like VoIP. Carriers deploying VoIP services need IP networks that control delay and congestion.

The third scenario (Figure 6) is a combination of the previous two scenarios. Advanced markets like Japan, with its significant deployments of fiber to the x (FTTx), “x “implies to building, home, node, or curb, allow for the creative use of optical technologies for IP services.

Figure 6. Customer Scenario 3: FTTx Deployments



Specifically, FTTx deployments have driven investments in advanced optical backbone networks, creating yet another option for a robust and scalable VoIP and video transport network.

Cisco Network Management Products

Cisco offers a comprehensive portfolio of management products that help enable service providers to deploy and control business-grade services over IP NGNs. Table 1 contains the current Cisco network management solutions that are available to help service providers deploy and control business-grade services over Cisco IP NGN today.

Table 1. Service Provider Network Management Portfolio

Portfolio	Core Functions (PPDIOO*)	Summary	Quality of Experience	
			Business Grade	Entertainment Grade
Cisco Active Network Abstraction (ANA)	PPDIOO	Network service discovery, activation, and assurance	x	x
Cisco Broadband Access Center (BAC)	PPDIOO	Residential device management provisioning		x
Cisco Broadband Policy Management (BPM)	PPDIOO	Policy design, voice and video admission control	x	x
Cisco Network Registrar (CNR)	PPDIOO	IP address management, DNS and DHCP	x	x
Cisco Transport Manager (CTM)	PPDIOO	Element management optical router, MGX	x	x
Cisco IP Solution Center (ISC)	PPDIOO	L2/L3 VPN troubleshooting and provisioning	x	x
Scientific Atlanta ROSA	PPDIOO	Digital analog video headend management		x
Cisco Managed Services Solution (MSS)	PPDIOO	Provisioning, configuration, and monitoring of managed security services for Cisco Integrated Services Router	x	

* The letters in PPDIOO stand for prepare, plan, design, implement, operate, and optimize: see Figure 2.

Cisco network management products and solutions enable SPs to plan, design, implement, operate and optimize business-grade services and systems on Cisco IP Next-Generation networks.

For More Information

For additional product information, contact your local Cisco account representative or visit the following product pages:

- Cisco IP Next Generation-Networks (IP NGN)
  http://www.cisco.com/en/US/netsol/ns537/networking_solutions_solution_category.html
- Cisco Service Exchange Framework (SEF)
  http://www.cisco.com/en/US/netsol/ns549/networking_solutions_solution.html
- The Connected Life
  http://www.cisco.com/go/connectedlife

- Cisco Services for Service Providers http://www.cisco.com/en/US/products/ps6889/serv_category_home.html
- Cisco Active Network Abstraction (ANA) http://www.cisco.com/go/ana
- Cisco IP Solution Center (ISC) http://www.cisco.com/go/isc
- Cisco Broadband Policy Manager (BPM) http://www.cisco.com/go/bpm
- Cisco Transport Manager (CTM) http://www.cisco.com/go/ctm
- Cisco Managed Services Solution (MSS) http://www.cisco.com/go/mss

Americas Headquarters
Cisco Systems, Inc.
170 West Tasman Drive
San Jose, CA 95134-1706
USA
www.cisco.com
Tel: 408 526-4000
800 553-NETS (6387)
Fax: 408 527-0883

Asia Pacific Headquarters
Cisco Systems, Inc.
168 Robinson Road
#28-01 Capital Tower
Singapore 068912
www.cisco.com
Tel: +65 6317 7777
Fax: +65 6317 7799

Europe Headquarters
Cisco Systems International BV
Haarlerbergpark
Haarlerbergweg 13-19
1101 CH Amsterdam
The Netherlands
www-europe.cisco.com
Tel: +31 0 800 020 0791
Fax: +31 0 20 357 1100

Cisco has more than 200 offices worldwide. Addresses, phone numbers, and fax numbers are listed on the Cisco Website at **www.cisco.com/go/offices.**

Printed in USA C11-408109-01 06/07

