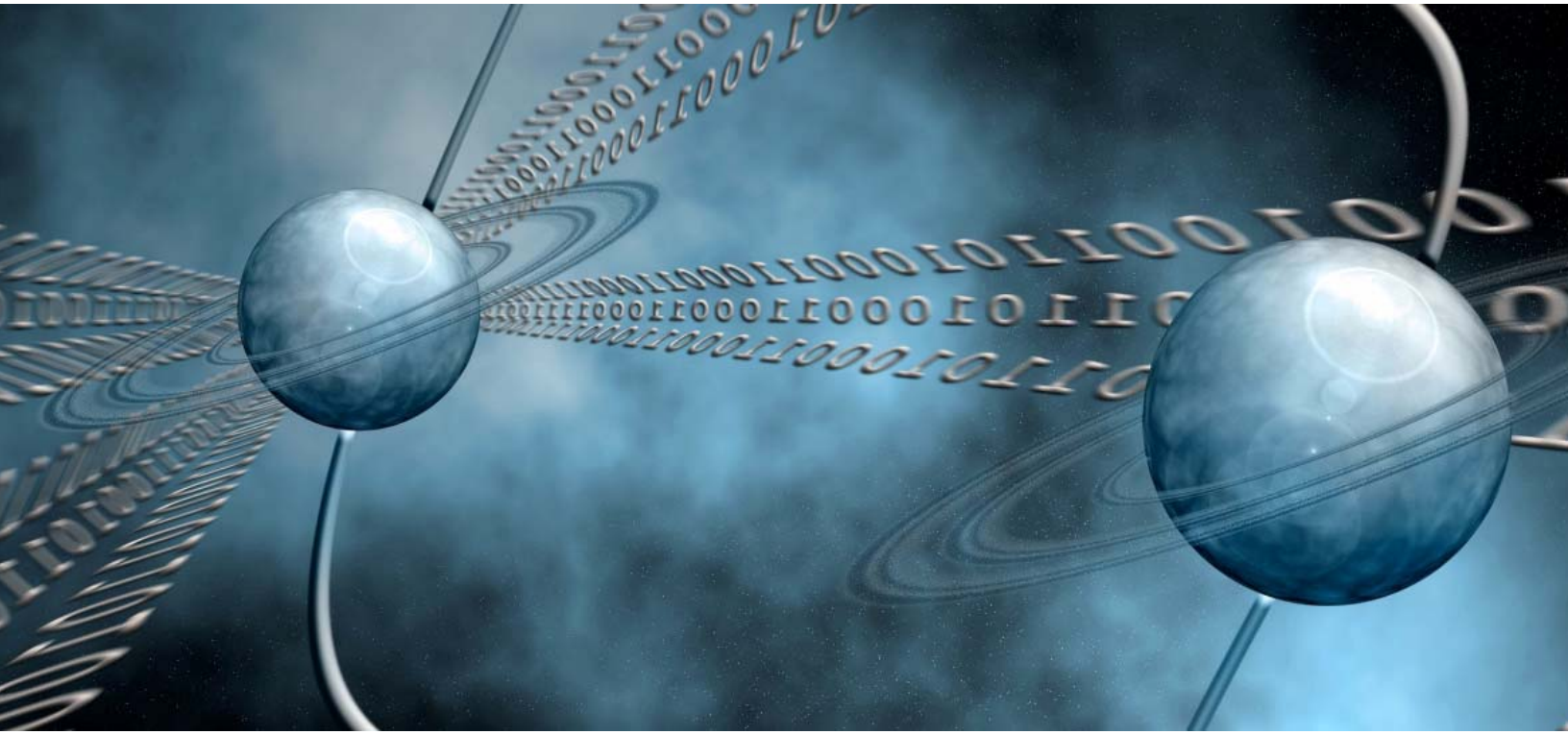
The Financial Benefit of Cisco's Elastic Core



Executive Summary

The core network, today, leverages large-scale core IP packet routers that form the heart of the Internet. Though the core does its job well, high traffic growth, increasing service diversity, rapid adoption of cloud services, escalation of service threats and low core utilization are creating challenges for the core. There also is little optimization of network capacity and no integration with cloud services, making the core less flexible and less responsive to changes in demand and hurting efficiency and resource utilization. Specifically, there is no integration of services at layers above IP or with optical transport at layers below IP.

Cisco enjoys a commanding 66% share lead in the core routing market, according to ACG Research's market analysis. Cisco is now leveraging its position by creating a vision for an elastic core that includes massive multi-chassis scale, continuous (hitless) operation, cloud intelligent networking and carrier-grade network services. This vision is part of the Cisco Open Networking Environment® framework to bring the value of the network to applications and enable the opportunity for operators to monetize and accelerate service creation with agile business models.

ACG Research analyzes the financial benefits of three Cisco software-based initiatives for the core: Anti-DDoS managed service using the CRS CGSE services module, demand engineering for optimization of routes and cloud services workload location, and nLight providing integration and optimization of the optical and packet layers network wide. The core Anti-DDoS managed service implementation in the CRS is shown to yield 156% return on investment (ROI) over five years. Demand engineering produces a 24% total cost of ownership (TCO) savings compared to the present mode of operations (PMO) by optimizing network routes and the location of cloud service workloads. nLight reduces core TCO up to 50% by supporting automated signaling for capacity planning between the optical and packet layers.

Key Takeaways

Cisco is transforming the core to one that focuses on software capabilities of the network. Benefits derived from three such initiatives are:

- 18 months payback and 156% ROI from a CRS CGSE service module that delivers a managed Anti-DDoS service.
- 24% TCO savings from demand engineering for optimization of placement of routes and cloud service workload location.
- Up to 50% TCO savings from nLight, which helps to optimize optical and packet capacity utilization.

Introduction

Current core networks have been extremely successful at scaling the Internet, allowing service providers to move to converged IP services and providing manageable and reliable packet transport. The evolution of the Internet has created a new set of challenges for the core:

- Growth of multiple device types, applications, services and traffic: This drives a requirement for IPv6 to handle large numbers of IP addresses, massive core scale, and the need for smarter optimization of network resources instead of simply throwing bandwidth at the problem.

- Rapid adoption of cloud services: This drives a requirement that the network be cloud aware. A feedback loop must be built between the network and business demands so the network can adapt to changing business demands and requirements.

- Escalation of security threats: The core must be made smarter so that it is aware of security threats such as Distributed Denial of Service (DDOS) attacks. This capability is especially important at peering points where the core interfaces with the cores of other service providers' networks.

- Poor utilization of the optical core and limited integration of the optical and packet cores: Integration of information flows and control between the optical and packet cores is needed to raise overall network utilization well above current levels[1].

The next-generation core must address these issues of the current core by incorporating service capabilities and integrating the cloud and the core packet and optical networks with each other to allow for system-level optimization.

IP services in the core are different from services at the Edge. Core IP services are focused on solving problems unique to the core (such as handling peering with other core networks) and optimizing the core network.

Three financial studies are developed to build the business case for Cisco's approach to transforming the current core to the next-generation core:

1. ROI of a managed Anti-DDoS service in the core: The Carrier Grade Service Engine, a services card used in the Cisco CRS core router, is used to provide a managed Anti-DDoS service to enterprises.

2. TCO benefits of demand engineering and route placement optimization: The TCO of demand engineering optimization in the core is compared to the present mode of operations.

3. TCO benefits of Cisco nLight technology for core capacity planning: nLight increases the timeliness and accuracy of data shared between the packet and layers. This improves the

[1] Current packet and optical networking protection schemes rely on redundant network links and simple fail-over schemes. Consequently, the packet and optical networks are typically designed to maximum utilization levels of 50%. Furthermore, because there is little integration between the optical and packet cores overall utilization falls well below 50%. One Tier 1 provider estimates that its core network operates at 12% utilization.

capacity planning process for both the optical and packet layers. The TCO of this improvement is quantified as compared to capacity planning processes that do not use nLight technologies.

Cisco Open Networking Environment

Cisco's evolutionary approach to elastic, programmable, agile networks and the emergence of "Software Defined Networking" (SDN) architecture is its Open Networking Environment (ONE). The Network Positioning System (NPS) with demand engineering and nLight technology integrating the packet and optical networks are building blocks of the Cisco Open Networking Environment®. The Cisco Open Network Environment® enables deep multilayer programmability between the application and network environments. It is an adaptable framework consisting of three fundamental technology components: multilayer programmable interfaces (APIs), agents and controllers; and virtual overlays.

This logical framework of innovative technologies enables operators to extend network intelligence to aggregate and transform underlying network data in ways that can enrich application development and accelerate the creation of more advanced service delivery. Figure 1 shows how Cisco Open Networking Environment® creates a bidirectional feedback loop, building an elastic network that provides analytics to network controllers that make policy decisions to enable agile service delivery, network monetization, and infrastructure resource optimization.

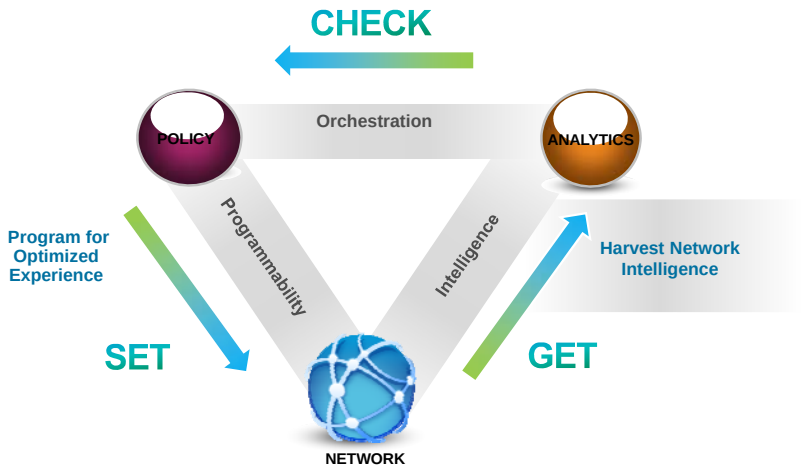


Figure 1 – Cisco Open Networking Environment Elastic Network

TCO Benefits of Services in the Core

Core IP services focus on optimizing the core network. Two important IP service problems are IPv6 introduction tied to IPv4 depletion and DDOS threat mitigation[2]. These problems are best handled at peering points, which operate at massive scale and are the boundaries between the service provider and its peers. The Cisco CRS Carrier-Grade Services Engine (CGSE) is an integrated multi-CPU service module that offers carrier-class performance and scale. It can process up to 20 million stateful network address translations (NAT) or support 10 Gbps of Anti-DDoS services per CGSE module. The CGSE occupies a single slot of the CRS; it is a high-performance and availability solution.

[2] NPS is an important core IP service.

ROI of an Anti-DDoS Core Services Solution

Distributed denial of service attacks cause network and service downtime, customer dissatisfaction, loss, and tarnish enterprises' reputations. McAfee estimates that botnets and DDoS attacks cost an average enterprise $6.4 million for a 24 hour outage[3]. Mitigation of DDoS attacks within the service provider's network fully protects an enterprise from DDOS attacks by separating attack traffic from legitimate traffic in the service provider's network and only passing the legitimate traffic onto the enterprise. By delivering Anti-DDoS service via the CRS CGE a distributed architecture is created that provides seamless integration with the routing infrastructure.

A case study is presented to illustrate the return on investment that can be produced by deploying the CGSE to support an Anti-DDoS managed service offered to enterprise users of business Internet and IP-VPN services. Study assumptions include:

- 5,000 IP VPN circuits are in service in the initial study year
- 2% of the circuits are 10 GE, 15% 1 GE, and 84% 100 Mbps Ethernet
- 7% of IP VPN subscribers adopt the Anti-DDoS service
- 3% IP VPN up-sell (additional sales of IP VPN) is produced because the Anti-DDoS service enhances the attractiveness of the underlying IP VPN service (it makes it safer)
- 100 Gbps of Anti-DDoS service traffic is handled in the first year and grows at 29% CAGR
- CRS CGSE is deployed at four locations

Figure 2 shows the additional revenue produced by the managed Anti-DDoS service, capital expense (CapEx) and operations expense (OpEx) associated with the CRS CGSE deployment and the resulting discounted cumulative net cash flow over five years.

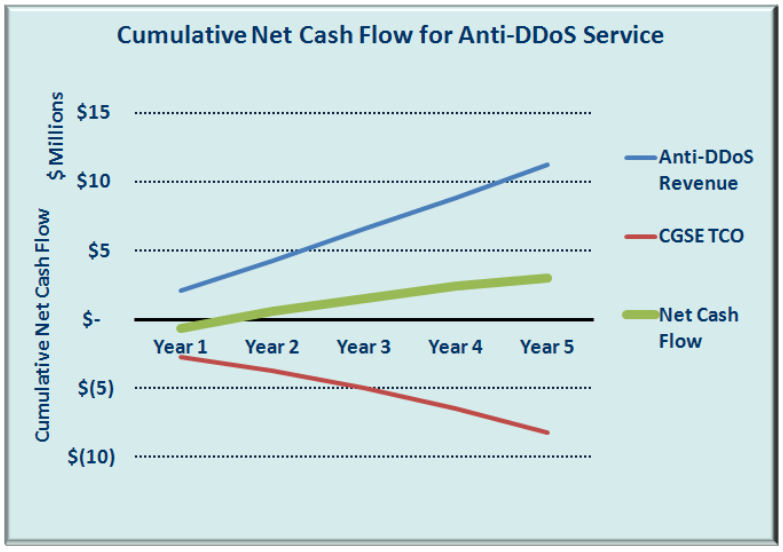


Figure 2 – Cumulative Cash Flows for Anti-DDoS Service Deployment

The CRS CGSE project reaches break-even in 18 months and produces a 156% ROI over five years. The high ROI is produced because of the low incremental cost of the CRS CSGE. The cost is low because it is simply added to an open slot in an existing CRS router. OpEx also is low because it uses the same Cisco

[3] McAfee, "Into the Crossfire", January 2010

IOS XR network operating system as the CRS. This reduces service deployment, testing, training and software upgrade expenses. Additional environmental (power, cooling, and floor space costs) savings are produced by the modular design because it eliminates redundant system components such as chassis, power supplies, backplane, and i/o ports that would be required by an appliance-based solution.

The IP VPN service revenue growth will be stimulated by the Anti-DDoS managed service offering. The addition of the Anti-DDoS managed service option enhances the security of the underlying IP VPN service and, consequently, the IP VPN service itself will get a revenue boost from subscribers who previously held back from subscribing to the service. The benefits of Anti-DDoS also can help to reduce churn and attract new customers to the VPN service. This additional revenue shortens payback time to less than one year and drives ROI even higher.

TCO Benefits of Demand Engineering Optimization

Cisco Network Positioning System is a component of the Cisco Open Networking Environment®. Demand engineering is an example of a network optimization application that runs on NPS. Demand engineering uses a bi-directional feedback loop between the network and application service level agreement (SLA) requirements to find the optimal placement of workloads (storage and virtual machines) in data centers and network traffic routes to achieve an optimal system-wide solution. Demand engineering differs from traffic engineering in that traffic engineering finds optimal routes on the network to maximize utilization to serve demand. Demand engineering actually places demand in optimal locations on cloud-based virtual machines (VM) to optimize the overall network.

Study Methodology

Packet transport expenses were calculated for a 20 node core IP network consisting of Cisco CRS core routers. Annual packet transport expenses include capital depreciation for a three-year asset life and annual operations expense. The following key assumptions were made:

- 90% of total traffic is suitable for demand engineering (Demand can be relocated using cloud VMs)
- Demand engineering has the effect of virtually reducing traffic load because of its choice of optimal location of workloads and optimal network traffic routes

Simulations were run to determine the utilization increases produced by demand engineering. The result was a 24% TCO savings over five years compared to PMO. Nonmonetary benefits also accrue to demand engineering optimization, including higher service velocity and increased SLA compliance because applications requirements are automatically linked to the traffic routing and workload assignment processes.

TCO Benefits of nLight

Cisco nLight technology provides information sharing between the optical and packet layers, which are used to automate service provisioning and provide converged management of the optical and routing layers. Integrating the IP packet and DWDM optical layers provides for the ability to optimize network designs and provide optical wavelengths to support service SLAs in minutes or hours instead of months.

nLight integrates the IP and optical layers by sharing information and using network APIs, components of the Cisco Open Networking Environment®. Some of the information that might be shared from the DWDM layer to the packet layer may include:

1. Circuit I.D.: Unique circuit identifier
2. Shared Risk Link Groups (SRLGs): Common DWDM layer risks that may be shared by a circuit, for example, optical regenerator shelf, multidegree ROADM sites, and fiber segment that passed through a manhole
3. Latency: Actual latency between ingress and egress point on the DWDM system
4. Path: Actual path a circuit may traverse

When turning up a new circuit/service, the packet layer request may include:

1. Matching path
2. Disjoint path
3. Specific latency or latency bound
4. Avoid or include specific SRLG(s)
5. Lowest optical cost circuit

There is no need for the packet layer to be aware of optical input, output powers, optical signal to noise ratio, chromatic dispersion, etc., across the network. Conversely, there is no need to share the Interior Gateway Protocol[4] of the packet layer, the interface configuration, etc. What is shared is an abstracted set of information to aid in removing inefficiencies out of a multilayer network.

TCO Benefits of Capacity Planning with nLight

The information sharing capability of nLight enables creation of a unified and automated capacity planning process for the packet and optical layers. This increases the timeliness and accuracy of data shared between the packet and optical layers as part of the capacity planning process and consequently reduces TCO. Figure 3 pictorially compares the flow of data in the capacity planning process with and without nLight.

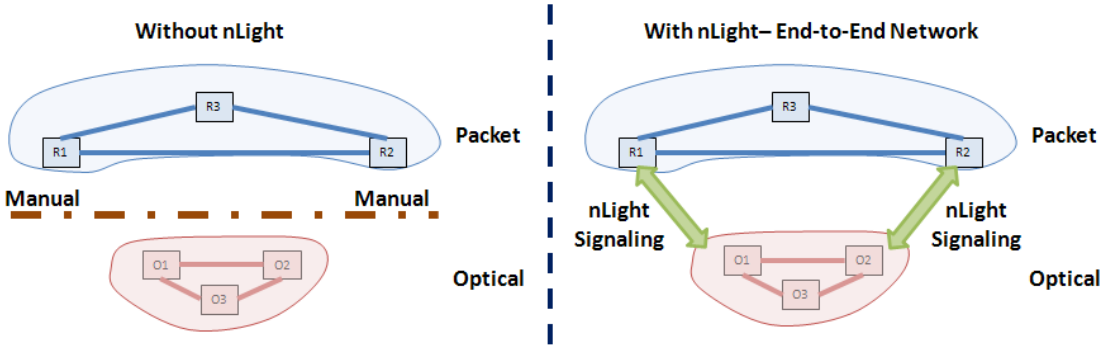


Figure 3 – Information Sharing with/without nLight

[4] A routing protocol used to exchange routing information within an autonomous system.

Without nLight technology, information sharing is slow and subject to errors because of manual hand-offs between the layers. In addition, neither layer has an end-to-end network view. With nLight enabled, information sharing is automated through nLight signaling and an end-to-end network view is provided.

Today, without nLight large service providers divide the packet and optical layer management roles into separate routing and transport organizations. Figure 4 schematically shows how this organizational separation causes delays and overestimation of bandwidth requirements.

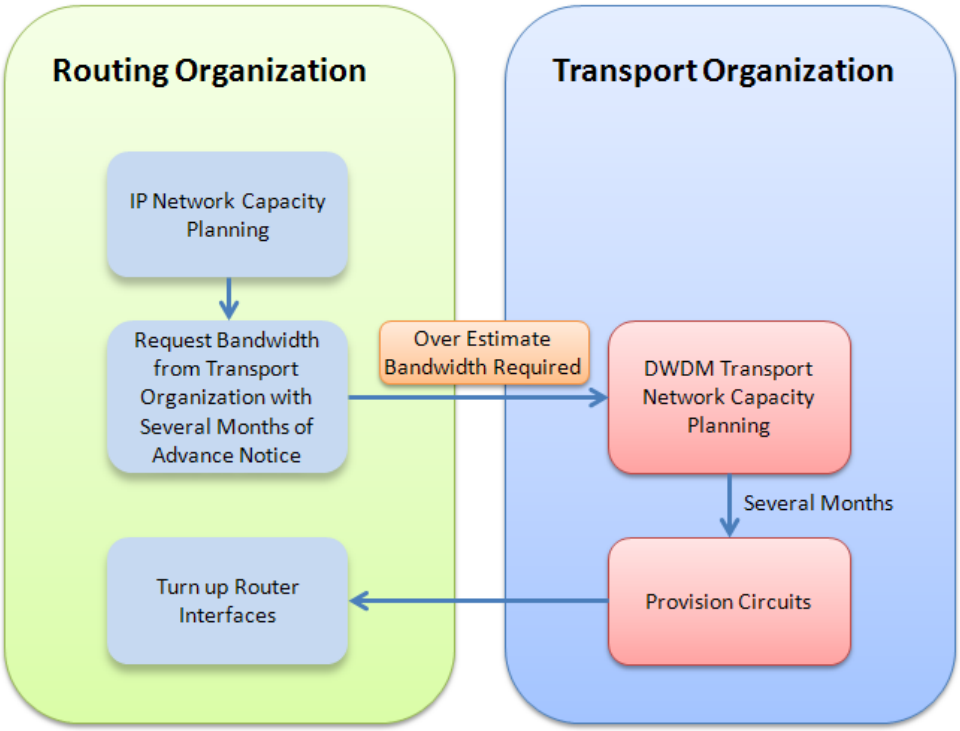


Figure 4 – Capacity Planning Process without nLight

Each organization hands off data by manually entering it into spreadsheets or databases. Each spreadsheet or database is a function of the expertise of each organization and typically requires coordinating activities among organizations or in some extreme cases there is no coordination or information sharing. Each organization performs its own capacity planning activities according to an internal schedule subject to the priorities and objectives of the organization. Consequently, the routing organization makes its bandwidth requests to the transport organization several months in advance of its need for circuits required to turn up router interfaces.

The bandwidth requests of the router organization must necessarily be overestimated because the traffic load is volatile and growing rapidly. The overestimation is made as a hedge against the risk of being caught with inadequate circuit capacity over the next planning cycle.

Figure 5 shows the capacity planning process that is enabled by nLight.

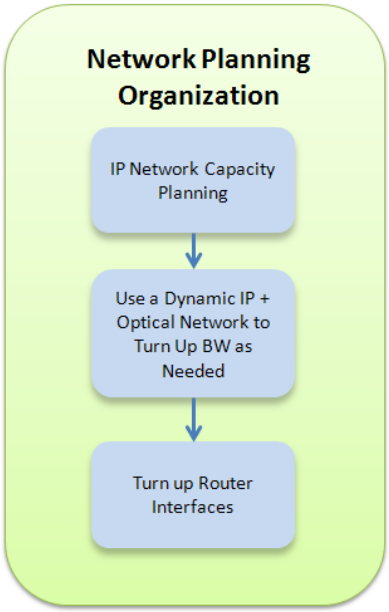


Figure 5 – Capacity Planning Process with nLight

A dynamic packet and optical network allows for end-to-end provisioning of capacity as needed. This provides just-in-time capacity management and optimizes the utilization of network resources.

TCO Modeling Results

The TCO benefit of using nLight to eliminate bandwidth overestimation is modeled for a typical core network. Figure 6 shows the results of the modeling exercise.

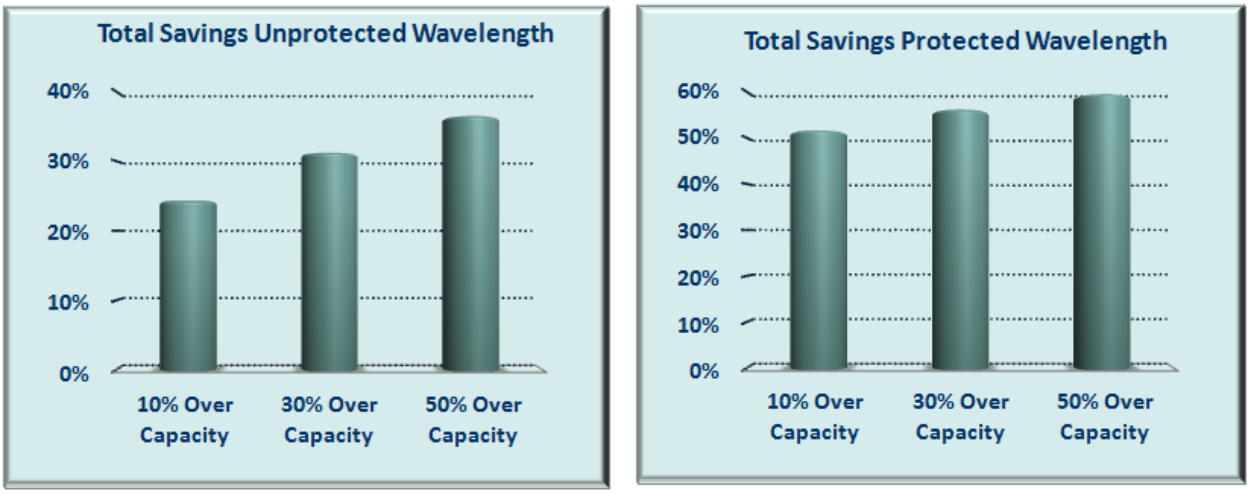


Figure 6 – Percentage of TCO Savings with nLight versus Capacity Overestimates

nLight significantly reduces TCO by eliminating even small overestimates of required bandwidth capacity. For example, in a design using unprotected wavelengths nLight produces a 24% reduction in TCO by eliminating a 10% overestimation of required capacity. The deployment of nLight on a network with protected wavelengths produces more than a 50% TCO reduction by eliminating a 10% overestimation of required bandwidth capacity. These savings are achieved because nLight enables a

just-in-time capacity provisioning process that reduces the risk of being caught with inadequate circuit capacity.

Conclusion

The next-generation core must incorporate service capabilities and integrate the cloud, packet core, and optical transport networks with each other to achieve increased system level optimization. Achieving system-level optimization addresses the challenges presented by increasing network scale and diversity, the rapid adoption of cloud services, escalating security threats, and complex operational models. Cisco is extending its leadership in core networking through three software-based initiatives:

1. Core Services: Anti-DDoS and Carrier-Grade NAT hosted on the CRS CGSE module
2. Core Optimization: Demand engineering for system-wide optimization
3. Integration of the packet and optical layers: nLight information sharing between the optical and packet layer to improve overall network utilization

Benefits produced by these software-based initiatives include:

- 18 month payback and 156% ROI over six years from a Cisco CRS CGSE implementation of managed Anti-DDoS services
- 24% TCO savings over five years for the core network from the use of demand engineering to optimize network routes and the location of cloud service workloads
- 24% reduction in TCO of the optical and packet core networks in a design using unprotected wavelengths, eliminating a 10% overestimation of required capacity by using nLight
- Up to a 50% reduction in TCO of the optical and packet core networks in a design using protected wavelengths, eliminating a 10% overestimation of required capacity by using nLight

The three software-based initiatives produce additional benefits such as increased automation of engineering, planning, and service delivery processes; reduction in time to market; and tighter linkages between customers' requirements and adaptable resource allocations of the physical and virtualized infrastructure.

These software-based initiatives are key elements of Cisco's elastic core definition that includes massive multi-chassis scale, continuous (hitless) operation, cloud intelligent networking and carrier-grade network services.