# The Case for Next-Generation Multiservice Networks


## Summary

There has never been a more important time for service providers to maximize their return on capital investments and minimize their operating expenses. Service Providers need to get the most possible revenue out of their current customers by selling them additional services, or by adding value to existing services. By taking advantage of their investment in today's Layer 2 networks and introducing value-added IP-based services such as IP VPNs, service providers can future-proof their revenue streams, as well as protect their customer base.

In the past, some service providers opted to build out a separate IP network to tap the large, emerging IP services market. Others accommodated customers' growing IP services bandwidth demands by running IP over their current Layer 2 ATM or Frame Relay networks but continuing to offer separate Internet access. Neither approach used their current investment to best advantage or protected their current revenue streams.

The next-generation multiservice network alternative, which is deployable today, offers significant economic and services benefits to service providers. By IP-enabling a multiservice Frame Relay or ATM network, adding IP capabilities to a Layer 2 network edge or core, service providers can significantly reduce the costs associated with running separate circuit-switched, Frame Relay, ATM, and IP networks while opening up emerging value-added IP service opportunities.

Incumbent providers can provide a path to IP directly over the same Frame Relay and ATM connections they offer today—not only preserving their current revenue but also using their ATM and Frame Relay incumbency to best advantage to generate a new incremental revenue stream. New service-provider entrants can take advantage of proven, highly reliable Frame Relay and ATM networks to generate immediate revenue from today's transport services and IP-enable these multiservice networks to quickly and cost-effectively get into the emerging IP services market. Utilizing Multiprotocol Label Switching (MPLS), Cisco provides a next-generation multiservice infrastructure that combines the unique features of ATM for transport aggregation with the power and flexibility of IP services:

- Frame Relay
- ATM
- Private lines
- Digital subscriber line (DSL)
- Voice adaption transport
- Integrated voice/data access

Service providers can IP-enable an existing Cisco ATM or Frame Relay network—or simply add Cisco multiservice solutions to the "network edge" of a Layer 2 network infrastructure to reduce overall network costs; simplify operations, provisioning, and back-office complexity; maintain current transport revenue streams; and gain new long-term IP services revenue.

This paper outlines the business case for a next-generation multiservice infrastructure and the network evolutionary steps service providers can take to ensure profitability and market competitiveness.

Service providers seeking to quickly and efficiently enter voice and data service markets, as well as those providers already offering transport services, must implement a network infrastructure that supports not only the services that generate immediate revenue (private line, voice, Frame Relay, Internet access) but also those that will become true "service differentiators" in the future (application hosting, unified messaging, and business-to-business and business-to-consumer electronic commerce).

These value-added services not only reduce customer churn by creating real differentiation in an increasingly competitive landscape but, more importantly, also offer a means to increase per-customer spending through an expanded menu of services.

Until now, service providers wishing to offer customers such a wide range of services and technologies would be forced to implement separate circuit-switched, ATM, and IP networks—a costly and time-consuming venture that few, if any, service providers have been willing to undertake.

Cisco offers service providers a next-generation multiservice network solution that supports the delivery of today's revenue-generating voice, Frame Relay, and ATM services and accelerates the delivery of emerging IP-based services. Taking full advantage of Cisco's leadership in MPLS and its flexible multiservice platforms, the Cisco solution allows service providers to implement a single, cost-effective infrastructure to deliver a wide range of voice and data services. For a minor incremental investment, service providers can IP-enable an existing Cisco ATM or Frame Relay network, or even a non-Cisco Layer 2 network, to reap the significant revenue reward and cost savings of a unified multiservice infrastructure. Cisco multiservice solutions combine IP and ATM in a simple and resilient manner, economically delivering VPNs with the privacy and security that customers demand today and efficiently offering quality of service (QoS) across a service provider's network or multiple networks. Using Cisco multiservice solutions, customers can establish a simplified, fully meshed, secure, and high-performance network. Cisco's unique ability to deliver an infrastructure that supports existing and emerging services, while offering the network efficiencies of MPLS and the QoS capabilities of ATM, gives service providers numerous competitive advantages. Cisco next-generation multiservice solutions also provide:

- Service and technology flexibility
- Rapid provisioning
- Efficient and effective network management, allowing service providers to offer robust service-level agreements (SLAs)
- A platform that meets the requirements of existing voice and data services and the emerging transmission and application services of tomorrow

Let's look at two different scenarios that illustrate how the Cisco next-generation multiservice architecture can aid service providers in their efforts to efficiently and effectively deliver services tailored for today and tomorrow.

## Cisco Virtual Switch Architecture

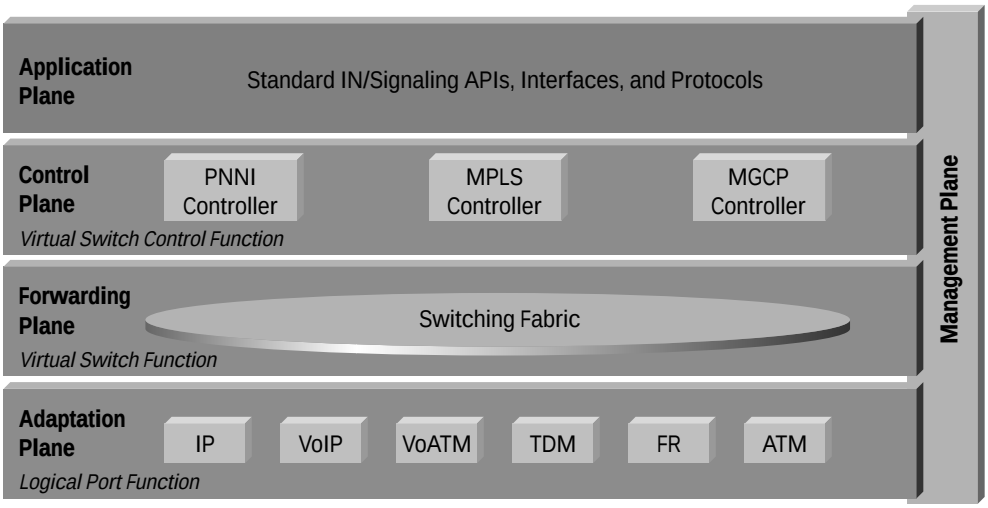
The ability to IP-enable an existing Frame Relay or ATM service is made possible through the Cisco Virtual Switch Architecture (CVSA). The CVSA is comprised of a series of four planes: Application, Control, Forwarding and Adaptation, a Virtual Switch Interface, and a dynamic partitioning function. The Control Planes are independent from the Forwarding

Plane and can contain multiple, independent control protocols such as PNNI and MPLS. The Cisco Virtual Switch Architecture allows multiple, simultaneous Control Planes to direct the Forwarding Plane. The dynamic partitioning function allows highly granular control of individual ports to facilitate the usage of multiple Control Planes on a single port.

The benefits to service providers from the Cisco Virtual Switch Architecture are:

- Supports ATM, Voice, and IP services simultaneously with separate control planes for maximum service efficiency
- Separate queues for delivering ATM and IP QoS natively
- Transition existing services from PNNI to MPLS as desired with no new hardware required
- Simultaneous use of ATM classes of service and IP QoS
- Maximum control over addition of MPLS for services and migrating to MPLS as a common control plane
- Cost-effective manner of adding MPLS to ATM switches for new services as well as controlling costs by consolidating network infrastructure

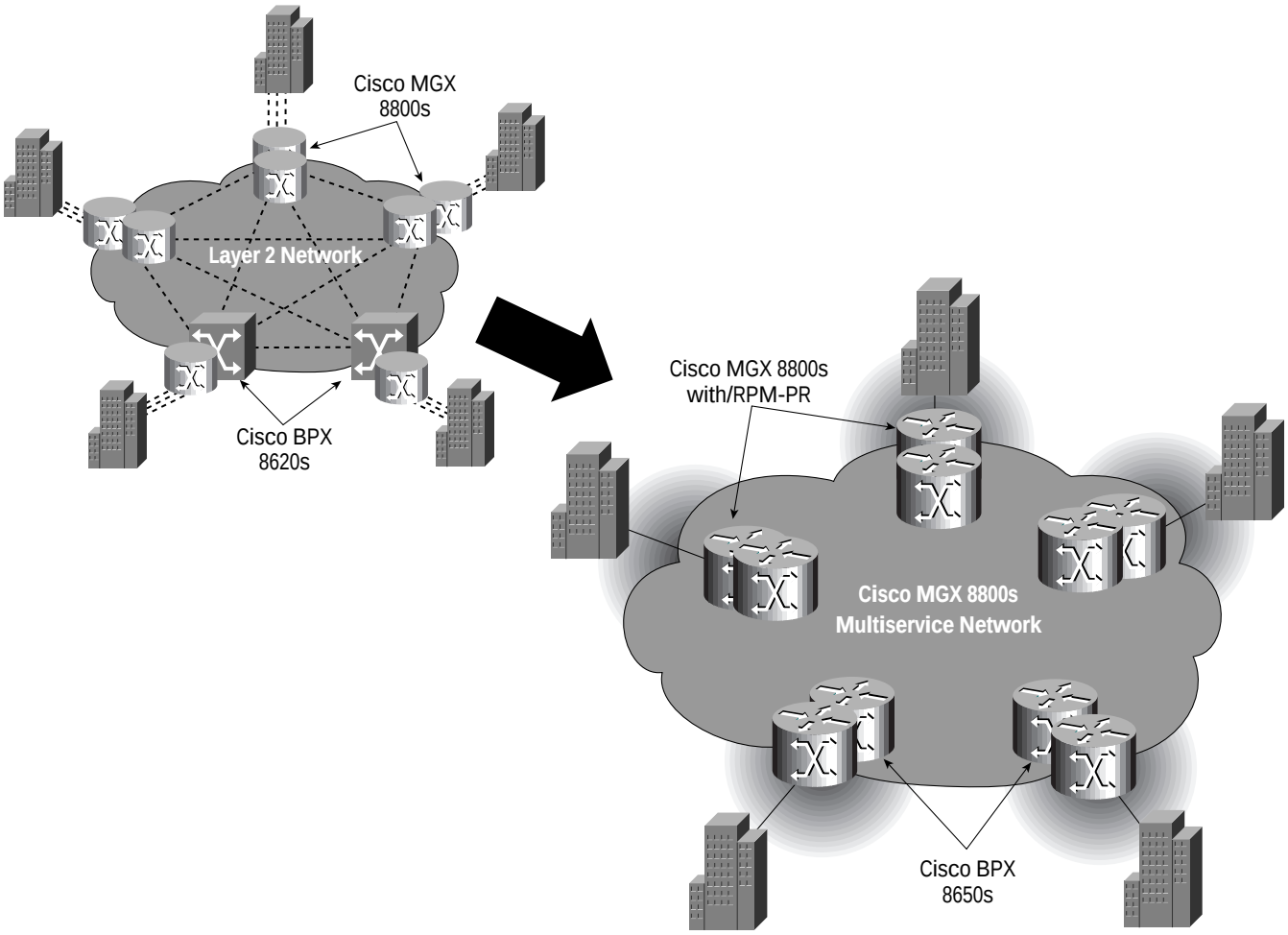
Figure 1 Cisco Virtual Switch Architecture




## Adding IP to a Cisco Layer 2 Frame Relay/ATM Network

Frame Relay and ATM service revenue continue to make up the bulk of service-provider revenue (Vertical Systems Research, 2001). However, industry analysts project emerging IP-services to play a significant role in service-provider revenue by 2005. Service providers currently enjoying the revenue and profit benefits of delivering Frame Relay and ATM to their customer base are seeking a method to participate in existing and emerging voice, private line, and IP-based services. Additionally, Frame Relay and ATM providers also recognize the potential for service differentiation and new revenue that emerging media and electronic commerce capabilities offer. In the past, service providers with Frame Relay or ATM infrastructures have been frustrated in their search for a unified, multiservice network solution. Those that have entered IP services delivery have been forced to construct separate router-based networks along with separate management, provisioning, and billing systems. In addition to being costly and inefficient, these separate infrastructures did not allow service providers to take advantage of their ATM and Frame Relay incumbency. Only Cisco has provided solutions to service providers that have allowed them to evolve their networks. By simply adding IP to a Cisco ATM or Frame Relay network (Figure 2), service providers have a unified, cost-effective infrastructure from which to accelerate delivery of new value-added services while preserving existing services and revenue.

Figure 2 IP-Enabling a Cisco Layer 2 Frame Relay/ATM Network




This easy network upgrade can have a significant impact on a service provider's bottom line, impacting the number of customers and services that can be supported, revenue growth from new IP services, time to revenue, and overall return on investment.

To demonstrate the financial benefits of IP-enabling a Cisco Layer 2 network, a five-node service provider network was modeled with Cisco MGX™ 8800 systems feeding into a Cisco BPX® 8620 Layer 2 network at each node. An average of 850 customers per node was assumed. To IP-enable its network, the service provider would simply need to add route processor modules (RPMs) to the Cisco MGX 8800 systems and upgrade the Cisco BPX 8620 systems to a Cisco BPX 8650.

To calculate expenses, the upfront and incremental equipment was accounted for, colocation expenses were factored in, and headcount to install and maintain equipment and staff the billing department were added. On the revenue side of the model, the setup fees and monthly charges were included for both the Layer 2 and Layer 3 services. In this scenario, the lower average monthly charge for the IP service will lead to incremental customer growth over a Layer 2-only network.

A "New-to-Existing Customer Ratio" variable determines the percentage of IP customers that are new to the service provider versus the percentage that are simply existing customers who have changed service from Frame Relay only to IP-enabled Frame Relay service. Raising this number to 75 percent would mean that 75 percent of IP customers are new customers. This variable directly impacts customer growth rate.

Table 1 lists the variables used for this scenario. (Appendix A contains a more detailed list of assumptions and descriptions of the variables.)

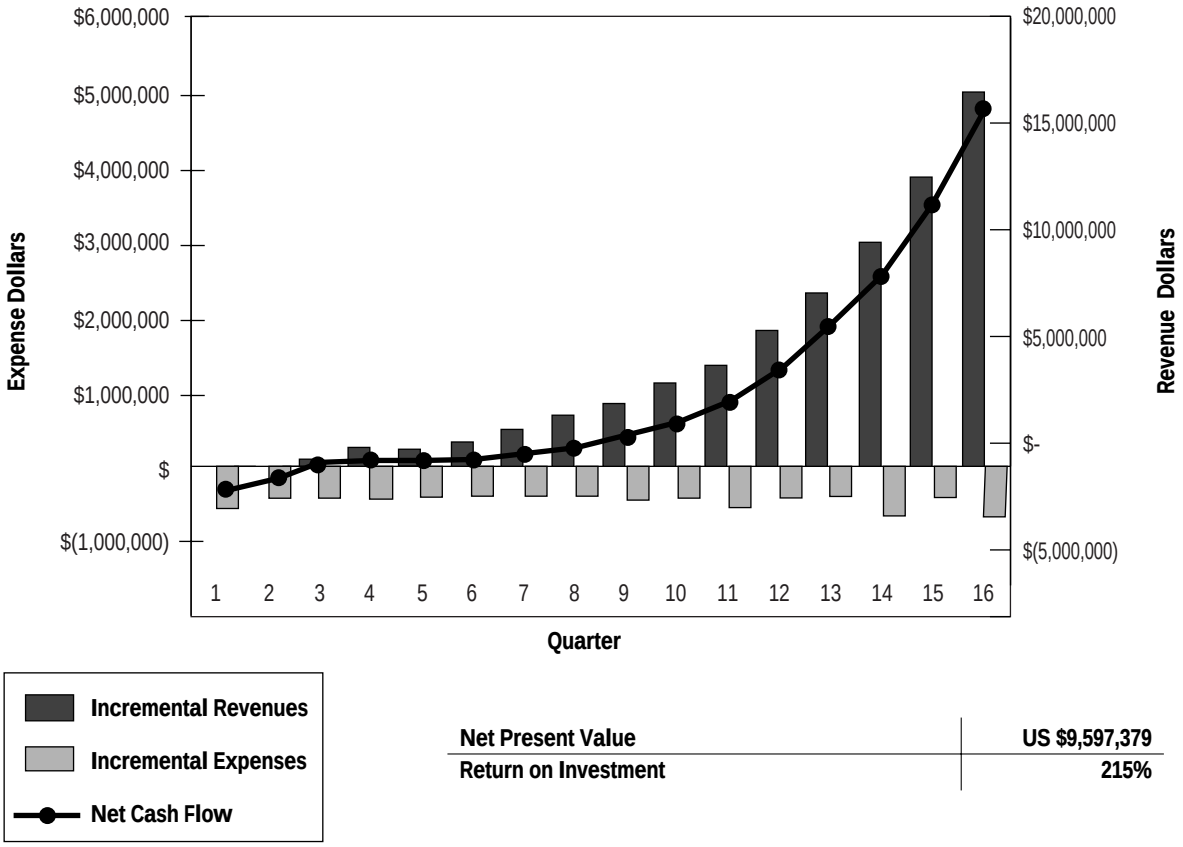
Table 1 Variables Used in IP-Enabled Network Scenario

| Variables | |
|---|---|
| Annual Customer Growth | 17% |
| Annual FR Growth Rate | 19% |
| Number of Nodes | 5 |
| Initial Customers per Node | 850 |
| Cost of Capital | 15% |
| FR Set-Up Fee | US$250 |
| IP Set-Up Fee | US$150 |
| Average Monthly FR Charge | US$1200 |
| Average Monthly IP Charge | US$1000 |
| Average Cost per Person per Quarter | US$40,000 |
| Initial Percentage IP Customers | 3% |
| New to Existing Customer Ratio | 50% |

To illustrate the significant economic benefits of the network upgrade in this scenario, an incremental cash-flow analysis in Figure 3 was created. It shows the costs (such as capital equipment purchases and staffing) as well as revenue potential (customer growth) over a four-year period of a Cisco IP-enabled versus a non-IP-enabled Frame Relay or ATM network. Two common tools were used to measure the value of the upgrade: net present value (NPV) and return on investment (ROI). NPV puts the value of future cash flows into present-day terms. A project with a positive NPV (that is, any NPV more than US$1) is worth consideration as a project. ROI is a measure of investment efficiency. (For reference, an ROI of 50 percent is considered very good. Compare this to the "risk-free" rate of just 6 to 7 percent return.)

For the five-node service provider network scenario of the model, the net incremental cash flow had an NPV of US$9,597,379 and ROI of 215 percent. Clearly, this is an exceptional investment.

Figure 3 Cash-Flow Analysis for IP-Enabling a Cisco Layer 2 Network



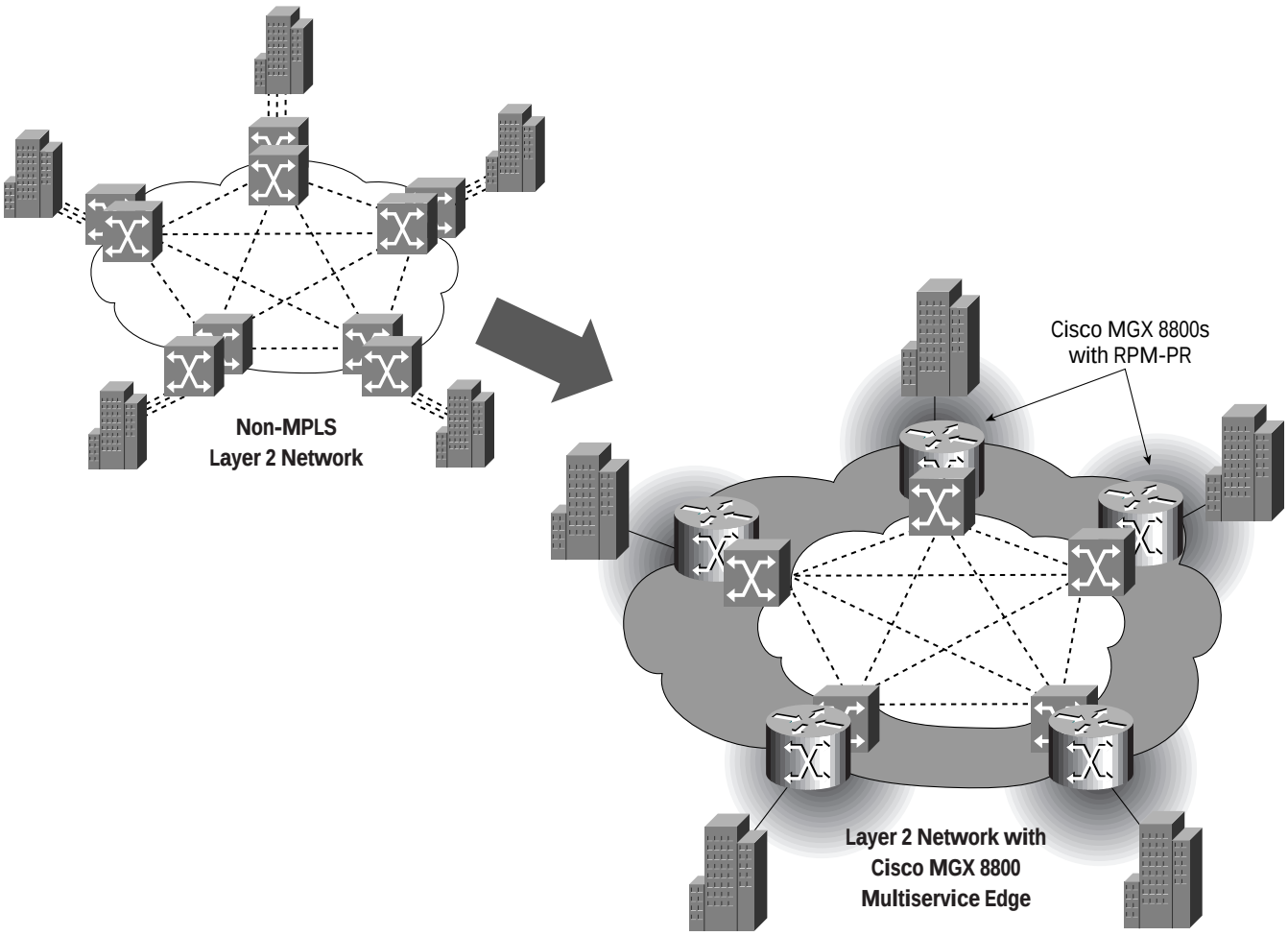

| | |
|---|---|
| **Net Present Value** | **US $9,597,379** |
| **Return on Investment** | **215%** |

## Adding IP to a Non-Cisco Layer 2 Frame Relay/ATM Network

As has been illustrated, adding IP capabilities to an existing Cisco Frame Relay or ATM network infrastructure is simple and fast, and it provides strong cost-efficiencies and revenue opportunities. However, not all providers can start from this strong foundation. Service providers seeking to add IP services to an existing Frame Relay or ATM network not based on Cisco technology and without network-based MPLS capabilities can still use Cisco multiservice solutions to cost-effectively IP-enable their infrastructure and enjoy the significant financial rewards.

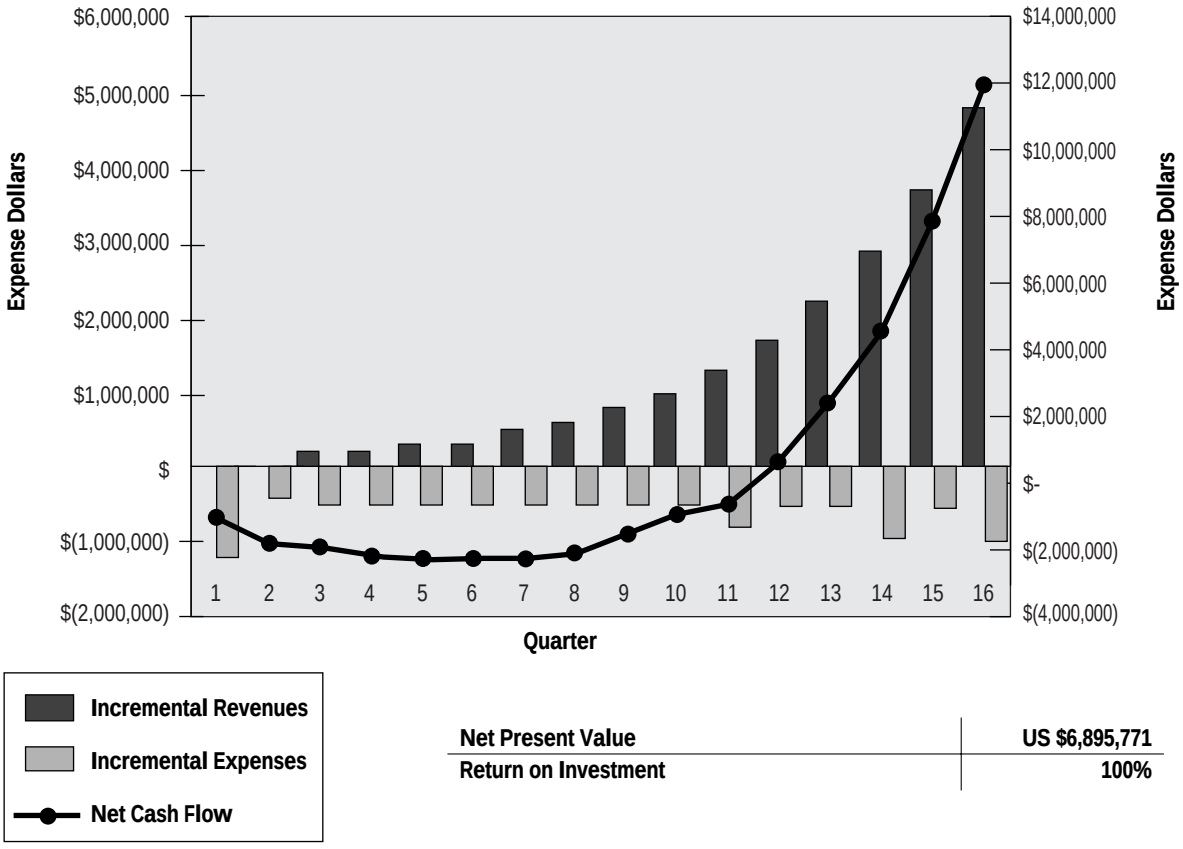
As illustrated in Figure 4, service providers can add a Cisco multiservice edge solution and retain their existing Layer 2 infrastructure for transmission of all services through the core. They can add Cisco to selective edge locations or all edge locations, giving them the ability to quickly offer new IP services for a small incremental cost.

Figure 4 Adding Cisco Multiservice Edge to a Non-Cisco Layer 2 Network




For this example, again consider a service provider with a five-node Layer 2 ATM network with an average of 850 customers per node. To upgrade its network, the provider would colocate a Cisco MGX 8800 chassis with Channelized T3 cards and system resource modules (SRMs) or OC-3 processor switching modules (PXMs) (depending on the existing hardware), RPMs for the Cisco MGX 8800, and any other additional necessary hardware (such as cables) for each node. Figure 5 illustrates the cash flows and project valuations from this scenario using the input variables.

Figure 5 Cash-Flow Analysis for IP-Enabling a Non-Cisco Layer 2 Network




| | |
|---|---|
| **Net Present Value** | **US $6,895,771** |
| **Return on Investment** | **100%** |

Although the NPV and ROI are not as significant as those of an IP-enabled Cisco network, adding Cisco next-generation multiservice switches at the edge provides a solid evolutionary step and strong incremental business benefits. This is ideal for service providers who do not want to change their core networks but still want to offer new IP services.

Table 2 outlines the business impact of the scenarios that have been discussed. Upgrading a Cisco network offers the highest ROI and NPV because of the simple and inexpensive upgrade path. Upgrading an existing non-MPLS network allows a service provider to quickly deliver high-revenue IP services and reduce provisioning costs and staffing. And, if the service provider manages to grow its IP customer base more quickly (through a more aggressive rollout of services, strong marketing, and so on), over time the provider might be able to match the returns of the MPLS-based ATM network. For example, increasing the growth rate of IP services customers in the second scenario by just five percent (not exceedingly difficult because they are starting with low absolute numbers), the service provider might actually get a better NPV than that of the first scenario (US$8,076,171 as opposed to US$9,595,379). Clearly, the economic benefit of IP-enabling a network is very closely tied to a provider's ability to market services.

Table 2 Business Advantages of a Cisco IP-Enabled Multiservice Edge and Network

| Business Impact | Maintain Current FR/ATM Network (not IP-enabled) | Add Cisco to Non-MPLS Network | Deploy Cisco IP-enabled Multiservice Network |
|---|---|---|---|
| Annual Customer Growth | 17% | 27% | 27% |
| Annual Revenue Growth | 16% | 24% | 24% |
| Incremental Co-Location Costs | US$0 | (US$480,000) | (US$340,000) |
| Return on Investment | N/A | 100% | 215% |
| Net Present Value | (US $7,278) | US$6,895,771 | US$9,597,379 |

As we have just shown, service providers can receive greater or lesser benefit depending on the degree to which they IP enable their network.

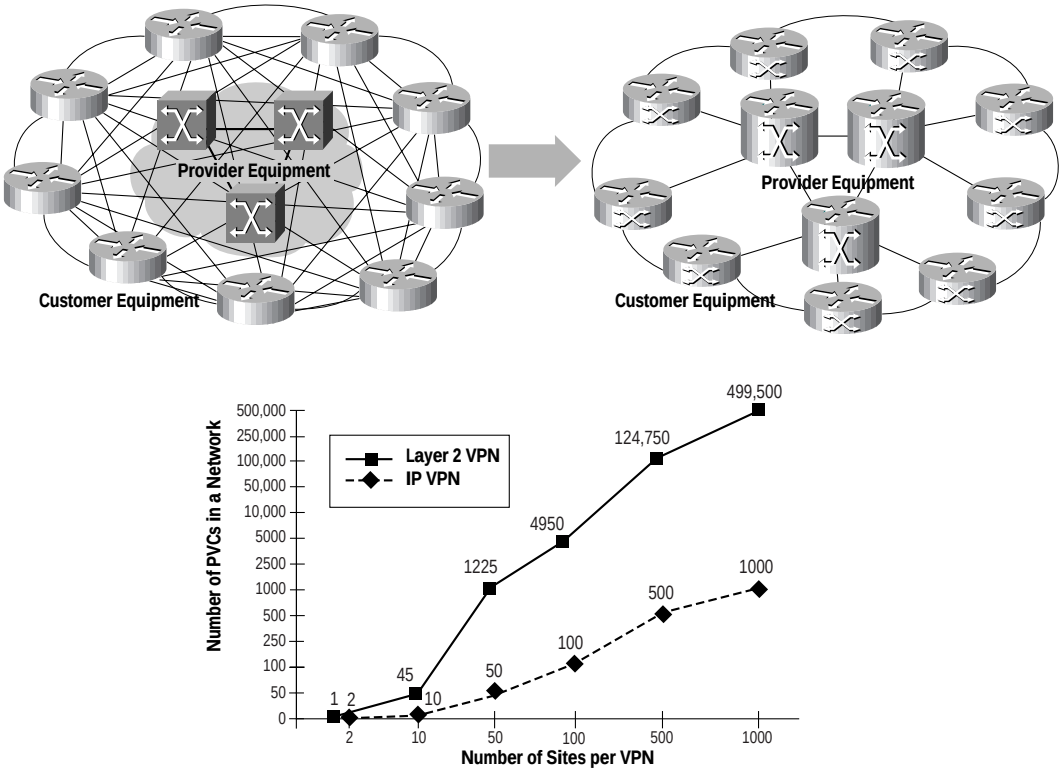
But with either implementation, service providers and customers will also benefit from simplified provisioning and maintenance at the very edge of the network—between the customer premise and the service provider edge.

With the fully-meshed PVC model, the "N Squared" problem extends out to the customer site; for each site in the VPN, there is a corresponding PVC at each of the customer sites. For example, a VPN with five sites would have four PVCs (one for each of the other sites) at each site for a total of 20 PVCs for the VPN.

With an IP enabled network, only a single PVC from the customer premise to the provider edge is required. Figure 6 shows just how great a reduction in complexity IP enabling a L2 network can make.

While not captured in financial analysis, this complexity represents additional cost for both the customer and service provider. Moving to an IP enable service will benefit both.

Figure 6 Layer 2 VPNs vs. IP VPNs and Number of PVC by Sites in a VPN




## Next-Generation Multiservice Equals New Revenue and Cost Savings

A next-generation multiservice architecture aids services providers in achieving revenue goals—and profitability—through:

- Reduced capital investment—Cisco delivers a single network infrastructure that eliminates the requirement for service providers to purchase separate circuit, ATM, Frame Relay, and IP-based networks.
- Simplified management, provisioning, and billing—The Cisco solution simplifies service-provider operations and back-office systems through a reduction in the number and complexity of network elements that must be managed, provisioned, and used to gather billing statistics. The result—vastly reduced cost to deliver services, significantly reduced service provisioning cycles, and happier customers.
- "Sticky" services—The Cisco solution allows service providers to quickly and efficiently implement a network platform that eliminates complex "layered" network approaches and delivers value-added services that, when engrained in customers' business practices, cannot be easily dislodged.
- Increased operational efficiencies—Cisco's solution simplifies the implementation and delivery of packet-based transmission services. Additionally, by utilizing a single platform, service providers are not forced to train personnel on multiple platforms and management systems, instead utilizing operations personnel to service customers.
- A "future-proof" network—The Cisco multiservice network not only preserves today's Layer 2 revenue and lowers Layer 2 operational costs, providing a path to IP directly over today's Frame Relay and ATM connections, but also enables new revenue-generating IP services.

Whether new services will entail streaming media, business-to-business or business-to-consumer electronic commerce transactions, or hosted applications, a next-generation Cisco multiservice network is capable of meeting their stringent protocol, quality, latency, and throughput demands. For service providers, the result is a network investment that pays for itself today and into the future.

## Cisco IP-enabled Solutions

No one understands the emergence of e-business as a competitive weapon better than Cisco Systems. Over the last several years, cost savings from its Internet-based applications have averaged increases of over 50 percent each year, exceeding $1 billion in savings. Two applications in particular, e-sales and e-learning, are currently having a dramatic impact within Cisco. Today, Cisco's sales team has better access to sales statistics, real-time bookings, and customer news, as well as a more efficient process for tracking overall sales efforts. Cisco achieved a 40- to 60-percent cost savings through increased use of e-learning over instructor-led training in its Q4 '01 alone. Cisco has used e-business techniques to grow faster than all key competitors and reach a market capitalization that continues to be in the top 10, even during significant market fluctuations.

Cisco multiservice solutions are, therefore, designed with these new business models in mind. This solution is for service providers seeking to take advantage of existing ATM infrastructures to deliver not only Frame Relay, ATM, and voice services but also highly profitable hosted applications and VPN services. For service providers wishing to conquer new markets and reach a new customer base, IP-enabled Cisco multiservice implementations are the answer. Whether it is DSL or wireless access, private line, Frame Relay, or ATM, the Cisco solution delivers the robust, highly available, flexible infrastructure solutions that service providers can use to accelerate delivery of New World voice, data, and e-commerce services. Cisco's IP-enabled multiservice infrastructure can help a service provider meet its business goals whether it is an emerging service provider seeking to explode into multiple markets or an existing service provider wanting to enter new service markets utilizing its current network.

Cisco has the vision and provides the platforms from which service providers can quickly deliver the exciting and highly profitable next-generation IP services that provide a competitive edge in a confused and changeable market environment. With Cisco solutions, service providers are assured that their network infrastructures will enable not only today's business transport and transition services but also those of emerging markets.

## Appendix A

### Assumptions

Following are the assumptions that were used in this business case and in the scenarios. Of course, no two networks are the same, so the scenarios presented here will likely vary from any particular service provider's situation. However, these scenarios do illustrate the kind of financial benefits that IP-enabling a Layer 2 network can yield.

*Annual Frame Relay Growth Rate (19 percent)*

Annual Frame Relay growth is the annual growth rate variable for Frame Relay services. Nineteen percent is an average derived from research by Vertical Systems Research.

*Annual IP Growth Rate (108 percent)*

Annual IP growth rate is the annual growth rate variable for IP services. One hundred eight percent is an average derived from industry reports and customer feedback. This number may seem high because it is 100-percent growth based on a small initial number. However, the actual customer growth numbers derived from this are quite conservative.

*Annual Customer Growth*

This is the new customer growth rate for the business. This number was derived from the growth-rate inputs and is the average rate at which the sum of the Frame Relay and IP customers grew.

*Number of Nodes*

This is the number of points of presence (POPs) in the network. Each node aggregates Frame Relay users and Frame Relay-to-ATM internetworking for transport across the core of the network.

*Initial Customers per Node (850)*

This is the average number of end users that are being aggregated at each node. Total customers are initial customers per node multiplied by the number of nodes. Customer growth is driven from this number. Frame Relay customer growth was calculated by multiplying initial customers per node by Frame Relay growth rate.

*Cost of Capital (15 percent)*

Cost of capital is the rate used to discount future cash flows to derive NPV and ROI. Cost of capital varies from company to company.

*Frame Relay Setup Fee (US$250)*

Frame Relay setup fee is the charge a customer pays to get Frame Relay service set up.

*IP Setup Fee (US$150)*

This is the charge a customer pays to get IP service set up.

*Average Monthly Frame Relay Charge (US$1200)*

This is the recurring monthly charge a customer pays for Frame Relay service. It comprises an average basic service price of US$750 per month and a per-virtual circuit (VC) charge of US$150. It is assumed that the average customer has three VCs.

*Monthly IP Charge (US$1000)*

This is the recurring monthly charge a customer pays for IP service. It comprises an average basic service price of US$750 per month (this is the Frame Relay price) and an IP VPN charge of US$250 per month. This price structure favors customers with larger numbers of VCs, and creates a barrier to prevent all customers from shifting to IP services right away. For this case, a conservative pricing approach was taken, although a service provider could just as easily input higher numbers for the average monthly IP charge.

*Cost per Person (US$40,000)*

Cost per person works out to be US$160,000 per year and accounts for salary plus benefits. This is an average number.

*Initial Percentage of IP Customers (3 percent)*

This is used to derive the initial number of customers who sign up for the IP service.

*New-to-Existing Customer Ratio (50 percent)*

Of all new IP customers, this is the ratio of existing Frame Relay customers who moved to the IP service versus those who are new to the service provider.

*Colocation Cost per Square Foot (US$1000)*

This is the charge a service provider pays per square foot to collocate equipment. For these scenarios, four square feet was used for the footprint of a Cisco MGX chassis.

*Annual Frame Relay Price Decline (5 percent)*

This is the average price decline for Frame Relay-only pricing. It is based on historical averages derived from research by Vertical Systems Research.

*Additional IP Engineers per Node-1*

This is the number of IP engineers (with US$160,000 yearly salaries) added per node to an IP-enabled network.

*Additional Billing Staff-2*

This is the number of additional billing workers who were added up front to accommodate billing for these new services.

*Net Present Value*

NPV is calculated from the first day that the project is started using a 15-percent discount rate.

*Return on Investment*

Return on investment is calculated as: NPV incremental revenue divided by NPV incremental expenses.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