

## Achieving WAN Operational Efficiency with the Cisco ASR 1000 Series

A change is occurring in the enterprise business model. The global scope of the enterprise is increasing, with many large enterprises now supporting worldwide, 24-hour operations. New types of content-rich applications are being deployed, as well as real-time collaborative services that incorporate voice and video. And with an increasingly mobile workforce, as well as the need to provide secure access to business partners and contractors, the traditional domain boundaries of the network are also beginning to shift.

Nowhere in the network are these changes felt more acutely than on the WAN edge. As a result, the typical requirements placed on a WAN edge aggregation router have expanded and the WAN edge has become an increasingly complex infrastructure to manage and maintain. Formerly, the WAN edge router was seen as a place in the network where speed and scalability were the main criteria for success. Progressively, the role of the enterprise WAN edge router has evolved into a consolidated focal point for rich services such as voice, multimedia, and real-time collaboration and commerce.

### Requirements for Next-Generation WAN

Advances in technology are changing business policy, which is in turn accelerating changes in WAN infrastructure. Convergence of services such as data, voice, and video into a single network is another influencing factor. In addition, integrated services and application awareness such as quality of service (QoS), firewalls, IP Security (IPsec), and IPv6 suggest the need for business policy changes. To meet growing business needs and cost-control requirements, many organizations are optimizing resources and reducing complexity of their WAN headend infrastructure to address new WAN infrastructure challenges:

- **WAN edge infrastructure performance:** Enterprises as well as service providers need to deliver higher-performance, higher-bandwidth services over their converged WANs, along with capacity headroom to operate efficiently
  - Emergence of new business applications and a new communication paradigm has caused an unprecedented increase in bandwidth requirements and scalability requirements for the WAN
  - Older infrastructure cannot support high-bandwidth WAN aggregation and Internet edge applications
  - For Ethernet WAN services, enterprise customers are looking for a small-form factor, high-performance router to provide services at multigigabit Ethernet speeds
- **Highly available WAN infrastructure:** Businesses need to provide anytime, everywhere access to applications and services over the WAN. This scenario requires a more highly available, resilient, and adaptive infrastructure than they have today. Customers need their WAN edge infrastructure to support:

- Rapid failover without service disruption
- Streamlined change management and service turn-up without WAN disruption -- and with fewer errors
- Increased system redundancy at the platform level
- **WAN security for data protection and compliance:** Customers need to satisfy industry regulations regarding data privacy, and adhere to regulations such as the Sarbanes-Oxley Act (SOX), the Payment Card Industry Data Security Standard (PCI DSS), the Health Insurance Portability and Accountability Act (HIPAA), etc. Businesses need their WAN edge infrastructure to:
  - Deliver network resiliency with a self-defending architecture
  - Secure all critical business and client information without creating a performance bottleneck
  - Integrate and embed security services within the network to reduce the need for standalone devices
  - Inspect traffic flows at high speeds for attack prevention, policy enforcement, and application security
- **Service delivery with application intelligence:** Service providers and enterprises need to meet demanding internal service-level agreements (SLAs), with improved service delivery and application performance over the WAN. To accomplish this demand, customers need their WAN edge infrastructure to:
  - Fulfill internal SLAs while containing WAN and telecom expenses
  - Speed service and feature deployment to quickly adapt to changing network requirements
  - Provide advanced services that interoperate with critical network functions to ensure application performance and security

Although centralizing and upgrading resources brings great benefits, it can also pose security, latency, and performance challenges. Optimal business productivity is achieved only when the same level of services is available across a network. In this situation, the WAN headend router becomes a critical part of providing secure, available, and remotely manageable and extensible service.

The benefits of technological advancements and policy compliance are fairly tangible, but the costs and complexity of owning and operating a next-generation network are difficult to predict. Does the existing equipment have enough headroom to support future growth needs? What are the complexities in introducing a new application in the network? Is there a significant cost and learning curve to implement a new solution?

### **Network TCO: Under the Microscope**

All networks have both capital expenditures (CapEx) and OpEx investments, but the degree to which these investments affect a company's profit line is governed by the features, functions, and adaptability of the network solution itself. Adding additional bandwidth is often seen as a solution for all network problems. Certainly some applications will perform better with increased bandwidth. However, this solution is neither an economical nor a long-term one. Operational costs, in terms of recurring monthly bandwidth charges, will increase. Over time, new applications will emerge to consume any excess bandwidth. Thus, the enterprise is caught in a vicious cycle of

overprovisioning and oversubscribing the network -- and the result is increased cost in maintaining and deploying devices at the WAN headend.

Following are some of the causes of increasing TCO:

- **Configuration and support complexities:** Intricate installations are burdensome to maintain; multiple hardware devices, software loads, and management systems cost much more than simple solutions. Identifying the root cause of a problem is difficult, resulting in longer mean times to repair and greater use of IT resources. Multiple devices in series are more susceptible to network outages. Downtime of a single device can affect the performance and availability of other devices. Cabling "spaghetti" increases the risk of human and mechanical error
- **Conflicting performance criteria of equipment:** In a multiple-device cluster, one device may affect the performance and productivity of others. For example, network configuration requirements for voice and video applications may be hampered by security configurations
- **Higher recurring expenses:** Power, carrier-tariff, cooling, and rack-space expenses continue to rise. In many different scenarios, real estate and rack space, power, and cooling setup are often at a premium. Finding ways to reduce these recurring costs can improve the network TCO
- **Hardware diversity:** As the number and variety of devices rises in a typical WAN headend, the need for platform-related training increases. This need results in increased resource allocation toward personnel training and management
- **High availability:** Business-critical resiliency in terms of redundant devices -- redundant VPN headends, redundant routers for multihoming to provider networks, redundant firewalls, remote access, and others -- is of critical importance at the WAN headend to have consistent, reliable, "always-on" services across the WAN. This requirement results in increased CapEx as well as OpEx for network operations
- **Multiple maintenance contracts:** The more devices in your network, the more maintenance contracts you must purchase and renew. Management of different vendor relationships and maintenance contracts can be time-consuming and confusing.
- **Security and regulatory demands:** The need for encryption and physical security of hardware and data is growing. Equipment diversity increases the risk of a security hole and raises the chances of a single device being left vulnerable to attack. To meet regulatory compliance, many organizations are trying to remove resources and reduce complexity of the network. Operating diverse appliances in the network tends to slow down this process
- **Higher costs for incremental services:** Many appliances and purpose-built devices have limited or no flexibility to accommodate changes in WAN headend networking needs. Providing a single incremental service often means a full upgrade to previously installed equipment, resulting in expensive site visits and large incremental capital costs
- **Minimal synergies between applications:** In an integrated device, traffic follows a single path that ensures synchronized, reliable delivery while protecting service integrity. In an unsynchronized multidevice scenario, devices compete to apply QoS, security, and network policy, resulting in a less-efficient network and more possibilities for administrative error.

- **High upgrade costs:** Because a large portion of the costs of WAN headend upgrades is related to service visits, it is crucial that you minimize the frequency and severity of any site visits. With diverse appliances, it gets costly to add additional capabilities without adding new hardware, perpetuating bloat and complexity in the network, and reducing the agility and response time of the IT support team

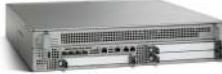
Gartner Group research indicates that over the full deployment lifecycle of a network, the initial cost of buying equipment is relatively small -- about 20 percent -- of the TCO compared with the ongoing operational costs -- 80 percent. Beyond these fixed costs, additional opportunity costs result from "service lockouts" that are caused by underinvesting in enabling technologies. The operational costs and lost opportunity costs outweigh savings realized by buying a less-expensive but lower function- and service-capable platform.

### **Cisco ASR 1000 Series Aggregation Services Routers**

Cisco® is transforming the network edge with the Cisco ASR 1000 Series Aggregation Services Routers, a new line of midrange routers that establish a new price-to-performance class offering, benefiting both enterprises and service providers. Cisco ASR 1000 Series Routers provide a great opportunity for simplifying the WAN edge and significantly decreasing network operating expenses (OpEx). A single Cisco ASR 1000 Series Router with integrated services provides powerful performance and scalability for the midrange segment of the network. By efficiently integrating a critical set of WAN edge functions such as WAN aggregation, Internet edge services, firewall services, VPN termination, etc. into a single platform, the Cisco ASR 1000 Series can help enterprises meet their business objectives by facilitating deployment of advanced services in a secure, scalable, and reliable manner while minimizing the total cost of ownership (TCO).

Cisco WAN aggregation solutions distinguish themselves from other solutions by offering multiservice routers with the highest performance, availability, and density for concurrent data, security, voice, and application-acceleration services with maximum headroom for growth. Cisco ASR 1000 Series Aggregation Services Routers feature embedded security, performance, and memory enhancements, and high-performance interfaces featuring the latest WAN technologies can help enterprises meet the needs of the most demanding WAN network. Table 1 provides chassis comparison and specification for the three initial models of the Cisco ASR 1000 Series Routers.

**Table 1.** Cisco ASR 1000 Series: Chassis Comparison and Specifications

Model	Cisco ASR 1002	Cisco ASR 1004	Cisco ASR 1006
			
<b>Physical specifications</b>	Height: 3.5 in. (88.9 mm) Width: 17.2 in. (437.4 mm) Depth: 22 in. (558.8 mm)	Height: 7 in. (177.8 mm) Width: 17.2 in. (437.4 mm) Depth: 22 in. (558.8 mm)	Height: 10.5 in. (266.7 mm) Width: 17.2 in. (437.4 mm) Depth: 22 in. (558.8 mm)
<b>Shared port adapters</b>	3 SPA slots	8 SPA slots	12 SPA slots
<b>Cisco ASR 1000 Series Embedded Services Processor (ESP)</b>	1 ESP slot	1 ESP slot	2 ESP slots
<b>Route processor</b>	Integrated in chassis	1 route-processor slot	2 route-processor slots
<b>Number of SIPs supported</b>	Integrated in chassis	2	3
<b>Redundancy</b>	Yes, software	Yes, software	Yes, hardware
<b>Built-in Gigabit Ethernet ports</b>	Yes, 4 Gigabit Ethernet Small Form-Factor Pluggable (SFP) ports	0	0

The Cisco ASR 1000 Series Aggregation Services Router shares numerous benefits of being a part of the Cisco portfolio of routers. As a Cisco router, the Cisco ASR 1000 Series takes full advantage of the power of Cisco IOS® Software. The routers take full advantage of different features of Cisco IOS Software available today -- from Nonstop Forwarding/State Switchover (NSF/SSO) and In Service Software Upgrade (ISSU) to embedded management features such as IP SLA, Cisco IOS Embedded Event Manager (EEM), Cisco IOS Embedded Syslog Manager (ESM), and others -- and they will take advantage of new features in the future. In addition, you can manage the Cisco ASR 1000 Series Router with a set of network management applications -- both Cisco and third-party tools -- that you currently use for managing other Cisco products. This solution allows IT managers to take full advantage of their existing knowledge, training, and infrastructure to cost-effectively implement a next-generation WAN solution.

Cisco ASR 1000 Series Routers provide performance-rich, fully integrated enterprise intelligent services with carrier-class resiliency. They offer the following benefits:

- High performance at the WAN edge to support new and faster WAN services:
  - Increase WAN bandwidth performance and capacity by more than tenfold (to 10 Gbps) compared with performance and capacity of Cisco 7200 Series Routers
  - Facilitate new WAN initiatives such as:
    - Rich application use by local, remote, and mobile users: Converged data, voice, and video applications
    - Segmentation of enterprise networks for workgroups: Logical separation of services
    - Data center consolidation: High-performance application delivery to remote and mobile users

- Enable high-performance services with the Cisco QuantumFlow Processor (QFP), which combines massive parallel processing, customized QoS, advanced memory management, and integrated services programmability to facilitate fast services deployment and increased feature velocity, resulting in reduced qualification and deployment time and OpEx savings
- Offer easy upgrade path: Cisco ASR 1000 Series Router price-to-performance positioned between Cisco 7200 Series at the low end of the portfolio and the Cisco 7600 Series and Cisco Catalyst® 6500 Series at the high end
- Unparalleled WAN availability for consistent and reliable service delivery across the WAN
  - Increased network availability and reduced time to deploy and qualify new services
  - Highly available carrier-class design with redundant hardware and software, providing consistent, reliable, and always-on services:
    - Resilient hardware platform architecture with control-plane and data-plane separation for powerful system availability
    - Complete hardware redundancy for forwarding and route processors with millisecond failover and zero packet loss
    - Industry's first dual OS (Cisco IOS XE Software) redundancy, which facilitates streamlined change management with less disruption and fewer errors
    - Modular Cisco IOS XE Software that provides restartability, fault containment, and ISSU
- High-performance embedded WAN edge security for attack prevention and compliance
  - Ability to turn on embedded high-performance security services without affecting WAN routing performance
  - Integrated “all-in-one” router approach that simplifies operation and reduces costs and time to qualify, deploy, and maintain the WAN infrastructure
    - Provides secure services aggregation for private WAN and remote sites
    - Offers embedded secure Internet access, multiservice gateway, session border controller, firewall, and VPN termination
  - Built-in high-performance security services that provide high integration of security services with routing available, reducing the need for standalone devices
    - Firewall with up to 10-Gbps throughput, onboard IPsec acceleration, VPN, and Network Address Translation (NAT) services
    - Deep Packet Inspection and Network Based Application Recognition (NBAR) for protection against notable worms, viruses, and day-zero attacks
- Improved WAN service levels and operational excellence
  - Reduced and optimized total WAN operating costs through effective bandwidth usage, and overlay network and device consolidation, power efficiencies, and service integration
  - Improved bandwidth usage with embedded and accelerated Cisco Performance Routing and Traffic Management and Instrumentation (scalable full NetFlow Version 9)
  - Cisco ASR 1000 Series Router compatibility with future versions of hardware and software architecture to readily adapt to new business requirements

- Sophisticated Cisco ASR 1000 Series Router system software and hardware design to address oversubscription and provide scalable and flexible QoS for predictable application performance

### **Simplifying Network Complexities**

The Cisco ASR 1000 Series offers several tangible benefits when compared to overlay appliances:

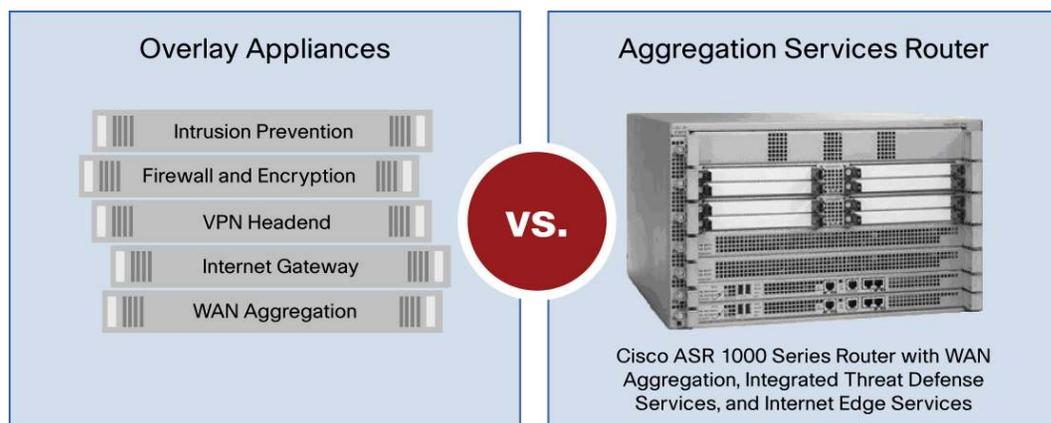
- **Service coherency:** Cisco ASR 1000 Series Routers are designed and built with multiple concurrent services in mind, and they provide a higher degree of service integration and consistency than multiple independent devices
- **System support:** Cisco offers complete accountability for deploying and operating an aggregation services router because it approaches the network as a whole. There is a single point of support (Cisco SMARTnet<sup>®</sup> support); fewer complications in terms of maintenance contracts, software licenses, and upgrades (Cisco Software Application Support plus Upgrades [SASU]), and opportunity to use shared port adapters (SPAs) used on other Cisco platforms
- **Operational efficiency:** Integrated devices have fewer components and fewer user interfaces to manage. Troubleshooting faults and errors is easier with integrated technology as compared to overlay appliances

### **Achieving Energy Efficiency through Service Integration**

The innovative new Cisco ASR 1000 Series Router can be an important component in a customer's energy-efficiency strategy. By consolidating the capabilities of multiple single-function devices, the Cisco ASR 1000 Series Router provides an energy-efficient deployment alternative. This approach offers customers direct benefits, such as reduced rack space, power, and cooling requirements.

With regard to these energy-efficiency criteria, it is important to compare how Cisco routers have become more power-efficient over time. Using the year 2000 as a benchmark, Cisco WAN edge routers have achieved up to a twentyfold increase in power efficiency. These numbers are based on a simple calculation of packets forwarded per watts consumed. If we also consider the increase in capabilities in that timeframe, which permit the replacement of single-function appliances, the power-efficiency quotient would be higher still. The Cisco ASR 1000 Series Routers are the newest additions to this tradition of ever-increasing efficiency.

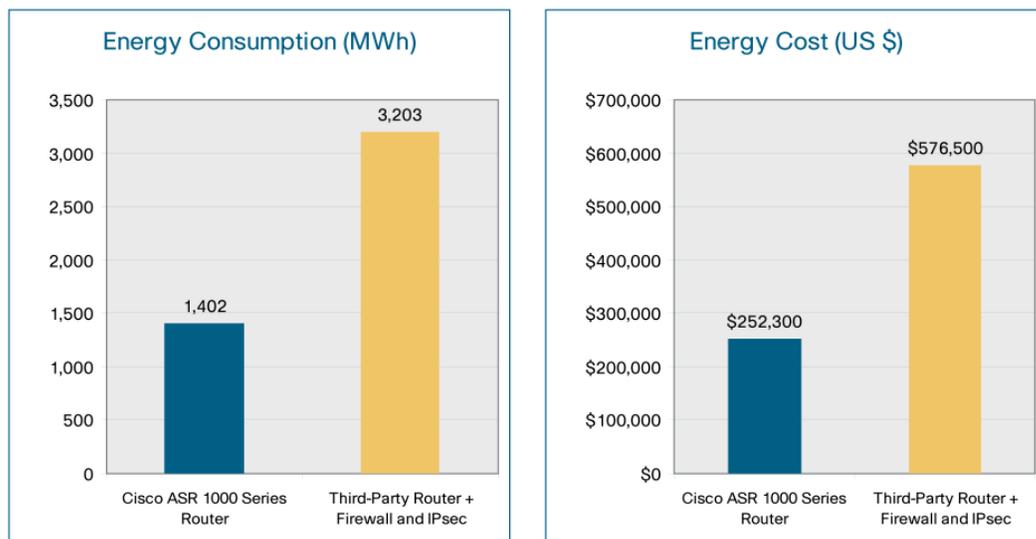
One of the most important ways in which the Cisco ASR 1000 Series Router can help in reducing your energy consumption is its capability to consolidate the services of multiple single-function appliances. Figure 1 examines some of the important integrated services the Cisco ASR 1000 Series Router can provide.

**Figure 1.** Comparison of Overlay Appliances Approach and Cisco ASR 1000 Series Router

Although the Cisco ASR 1000 Series Router can perform many functions, even a moderate consolidation of capabilities can have a surprising effect on energy usage. Comparison of the 6-rack unit (6RU) Cisco ASR 1006 Router with a commonly deployed, comparable third-party router supplemented by commonly deployed, comparable third-party firewall and IPsec services indicates that significant power savings can be achieved. It is estimated that the third-party appliance combination would use 18,011 kWh of electricity more than a Cisco ASR 1006 Router would use annually while performing the same functions at the same speed. Using calculations based on U.S. Environmental Protection Agency metrics for CO<sub>2</sub> emissions, this extra usage equates to 11,500 kilograms of CO<sub>2</sub> emissions or 1304 gallons of gasoline.

Depending on the level of consolidation, the Cisco ASR 1000 Series Routers can significantly reduce the requirements for rack space, power consumption, and cooling. As further service integration occurs and more appliances are eliminated, savings grow proportionately. The versatility of the Cisco ASR 1000 Series Router allows its deployment in multiple places in the end-to-end network -- for use as a headend aggregation or Internet gateway or as the main router and firewall in regional aggregation sites. And -- in larger branch offices -- the 2RU Cisco ASR 1002 Aggregation Services Router can act as the vehicle for VPN or leased-line access to corporate headquarters.

With the deployment of each Cisco ASR 1000 Series Router, the power-efficiency benefits increase. Figure 2 shows the anticipated power savings over a 5-year lifecycle for a company deploying 20 Cisco ASR 1000 Series Routers in a variety of scenarios throughout its network. This comparison is, again, versus a comparable third-party router supplemented by comparable standalone third-party firewall and IPsec appliances.

**Figure 2.** Energy and Cost Savings for 20 WAN Systems over 5 Years

As more businesses move toward 24-hour operations, network availability can have a significant environmental effect. The traditional solution for providing network availability has been to deploy at least two -- and sometimes more -- of each device that provides critical services in the network. Not only does this approach require more rack space, power, and cooling, but it generates significantly more electronic waste when the various routers and appliances are retired from service. The Cisco ASR 1000 Series Routers can provide excellent energy efficiency while at the same time delivering a comprehensive set of networking services to organizations of all sizes.

### The TCO Model

The integrated approach of the Cisco ASR 1000 Series Router helps decrease OpEx. To calculate the bigger cost component of TCO, Cisco studied a comprehensive OpEx model. The model considers a midsize enterprise with about \$250M in revenue and 2500 employees, and about half of company sales come over the network. Every year the enterprise experiences 4 unplanned network outages, each lasting about 2 hours. Other input characteristics include 1000 minor deployments with 8 hours of personnel time per deployment, and 4 major updates that require 75 hours of personnel time and 120 hours of support personnel time per update. Using installation and deployment costs provided by a reputable systems integrator, an initial deployment of the solution was estimated for 5 WAN edge routers.

The model uses cost-benefit analysis for four different scenarios of employing Cisco ASR 1000 Series Routers. These cases illustrate the advantages of owning a Cisco router with integrated services over a set of competitive overlay appliances. Specific comparisons in OpEx over a 5-year period include the following:

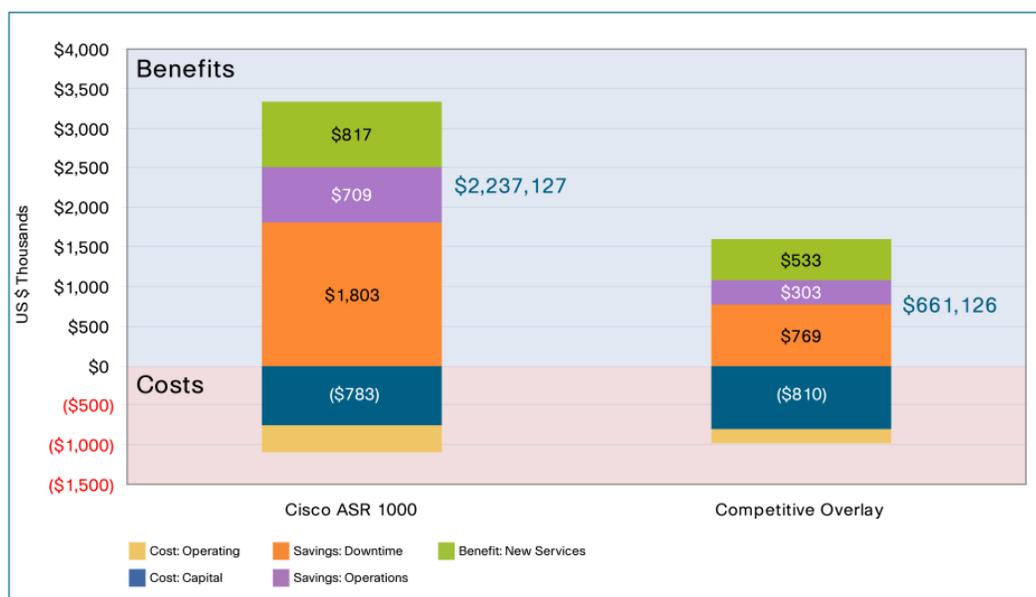
- **Direct costs:** Network management and hardware management tools, annual maintenance contracts, facility costs (space, power, and cooling requirements), and implementation (deployment and provisioning) costs
- **Indirect costs:** Availability costs, such as planned downtime, unplanned downtime, loss of employee productivity, and revenue loss due to network downtime

### 1. Basic WAN aggregation router with hardware redundancy:

- 10-Gbps bandwidth and hardware redundancy

In this scenario, the initial investment in and operating costs of the Cisco ASR 1000 network are close to those of the competitive solution. However, benefits are clearly greater for the Cisco ASR 1000 implementation -- \$3.3M for the Cisco ASR 1000 vs. 1.6M for the competitive overlay. The most significant benefit comes from hardware redundancy and hitless software upgrade and failure capabilities in the Cisco ASR 1000 that result in significant downtime savings. The net present value (NPV) in case of upgrading the network with Cisco ASR 1000 Series Routers on the WAN edge is about \$2.2M over a 5-year period (refer to Figure 3).

**Figure 3.** Deployment of Cisco ASR 1000 and a Competitive Overlay for Basic WAN Aggregation



### 2. WAN aggregation router with enabled security:

- IPsec services
- Firewall services
- Deep Packet Inspection
- 10-Gbps bandwidth and hardware redundancy

For deployment of the Cisco ASR 1000 or competitive overlay as a WAN aggregation router with security services such as IPsec, firewall, and Deep Packet Inspection, both costs and benefits look favorable for the Cisco ASR 1000 Series Router solution. Customers can save money on deploying the solution as well as enjoying additional benefits through downtime savings and new services. The NPV in this scenario is estimated to be about \$3.1M over a 5-year period (refer to Figure 4).

**Figure 4.** Deployment of Cisco ASR 1000 Series Router and a Competitive Overlay for Basic WAN Aggregation with Security Services

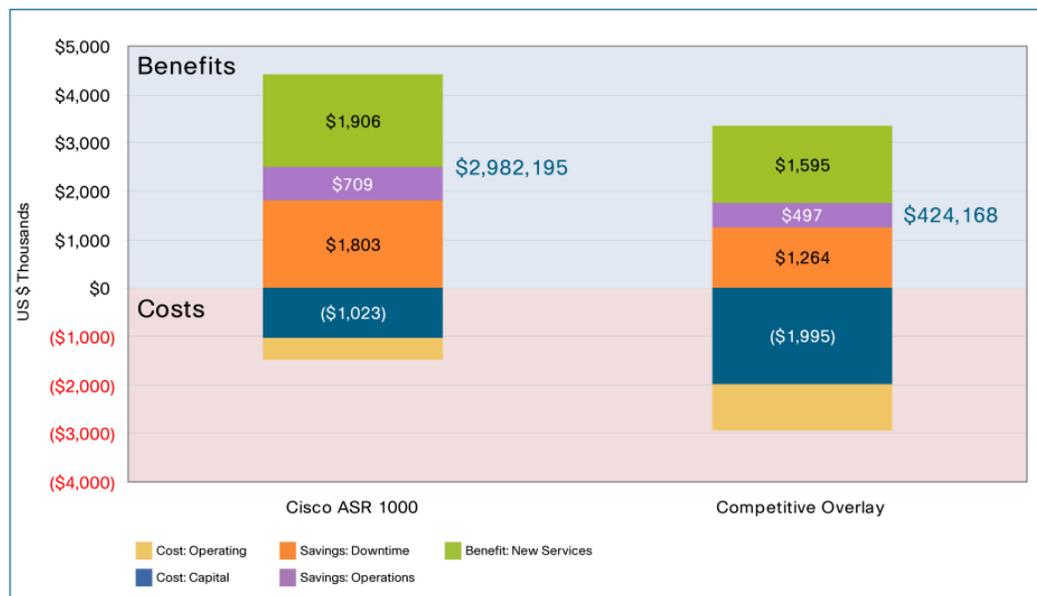


3. WAN aggregation with enabled voice and video services:

- Cisco Session Border Controller service
- 10-Gbps bandwidth and hardware redundancy

For deployment of the Cisco ASR 1000 or competitive overlay as a WAN aggregation router with voice and video functions, CapEx on the cost side and downtime savings on the benefits side become the primary attractions. Customers can save about \$1.5M with deployment of the solution based on the Cisco ASR 1000 Series Router and another 1.1M in benefits. The overall return on investment in this case is estimated to be about \$3.0M over 5 years (refer to Figure 5).

**Figure 5.** Deployment of Cisco ASR 1000 and a Competitive Overlay for Basic WAN Aggregation with Voice and Video Services

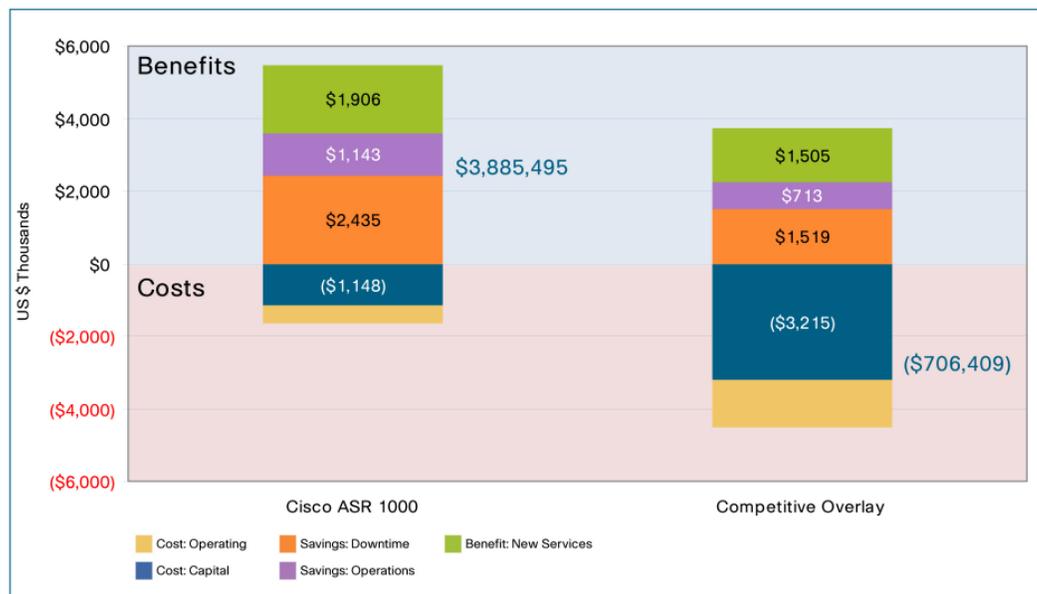


#### 4. WAN aggregation router with enabled security:

- IPsec services
- Firewall services
- Deep Packet Inspection
- Cisco Session Border Controller service
- 10-Gbps bandwidth and hardware redundancy

The last scenario is the deployment of the Cisco ASR 1000 or a competitive overlay as a WAN aggregation router with the complete set of services -- from security to voice and video functions. This case illustrates the primary advantage of the Cisco ASR 1000 Series Router -- aggregating numerous different services on a platform. The Cisco ASR 1000 substitutes a set of different appliances to offer lower CapEx and OpEx -- \$1.6M for the Cisco ASR 1000 vs. 4.4M for a competitive overlay. At the same time, benefits from deploying the Cisco ASR 1000 will surpass those of a competitive overlay by more than \$1.7M. The overall return on investment in this case of deploying the Cisco ASR 1000 in this scenario is estimated to be about 3.9M over 5 years (refer to Figure 6).

**Figure 6.** Deployment of Cisco ASR 1000 and a Competitive Overlay for Basic WAN Aggregation with Security, Voice, and Video Services



Owning a Cisco ASR 1000 Series Router with integrated services over a 5-year lifecycle brings great return on investment. In other words, an enterprise or service provider with a network with 5 WAN edge routers can save up to \$3.9M with an investment in a Cisco ASR 1000 Series Router network, eliminating diverse, overlay point products, and complexity related to ongoing operations, support, and troubleshooting.

## Conclusion

The Cisco ASR 1000 Series, a compact and powerful aggregation router for the enterprise and service provider WAN edge, greatly reduces the need for power, space, sparring, and maintenance. The Cisco ASR 1000 Series addresses the complexities of today's "perfect networking storm" and whatever challenges tomorrow's emerging applications may bring. By integrating core WAN edge functions into a single platform and providing high-performance WAN services in a scalable, secure, and reliable manner, the Cisco ASR 1000 Series Routers provide a great opportunity for enterprises to simplify WAN operations and significantly decrease OpEx of their network infrastructure.

## For More Information

For more information about the Cisco ASR 1000 Series, visit <http://www.cisco.com/go/asr1000> or contact your local Cisco account representative.



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Cisco Systems, Inc.  
San Jose, CA

**Asia Pacific Headquarters**  
Cisco Systems (USA) Pte. Ltd.  
Singapore

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