Enabling Performance-Based Multimedia Content Delivery to Branch Networks

by Zeus Kerravala | December 2007

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Executive Summary

According to the Yankee Group *2007 Economics of IP Communications Survey*, more than 80% of enterprises now have voice over IP (VoIP) deployed somewhere in their organization. This includes departmental, lab and branch trials as well as production deployments. The survey also revealed that organizations also plan to aggressively roll out IP-based multimedia applications to maximize the investment in VoIP. Case in point, Exhibit 1 shows that 82% of respondents plan to deploy desktop video conferencing along with their VoIP deployment. Along with video, there has been a rise in other types of multimedia content, specifically:

- Streaming video for e-learning and training
- Digital signage in retail environments to advertise new products and news to patrons through video displays, point-of-sale kiosks and video walls
- Real-time collaboration tools such as telepresence that enables users to experience lifelike interaction without the need to travel
- Unified communications and IP telephony, which enables companies to standardize on a consistent set of collaboration tools

To combat the network complexity created to deliver these applications to branch offices, there are a number of technologies, including QoS, route optimization, TCP optimization and content delivery, that can be used to improve how these multimedia applications interact with the wide-area network. In this Yankee Group Report, we define what these technologies are and how integrating them into a single architecture enables the branch to have the same services locally as the headquartered location, while keeping operational and capital expenses at a minimum.

Exhibit 1

VoIP Drives Multimedia Adoption

Source: Yankee Group 2007 Economics of IP Communications Survey

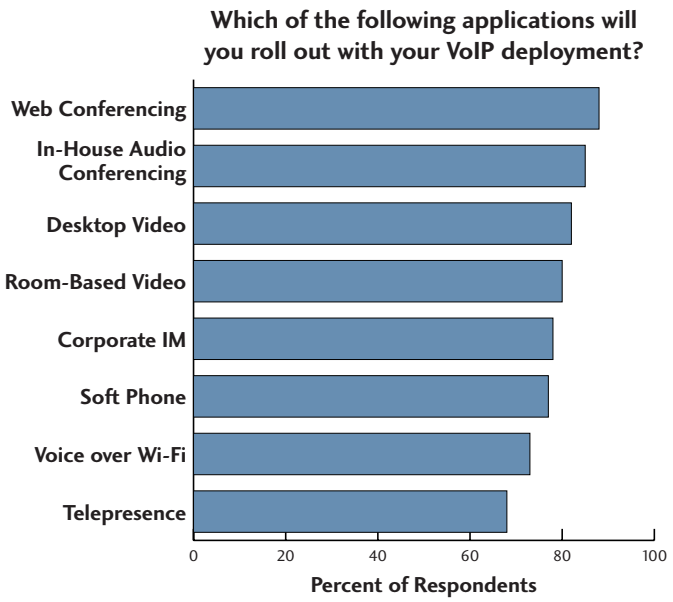

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Table of Contents

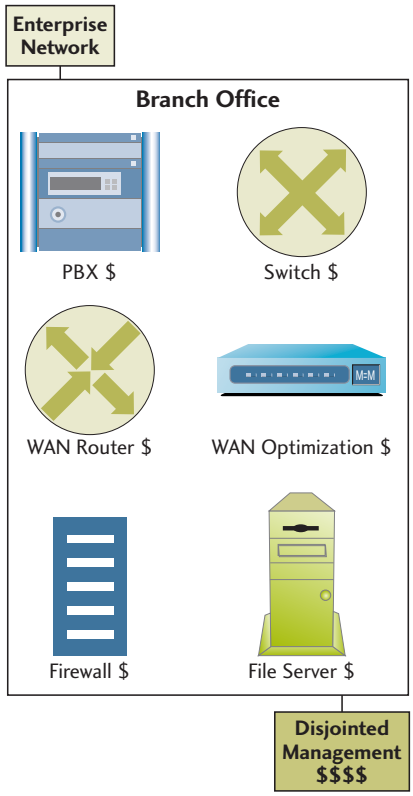
I. The Traditional Branch Environment . . . 3
II. The Empowered Branch: Multimedia Everywhere Gives Rise to the Intelligent Network . . . 4
Empowered Branch Technology Enablers . . . 5
Cisco Performance Routing . . . 6
Application and Content Networking System . . . 7
Security Integrated into the Network . . . 8
III. The Value of the Integrated Approach . . . 8
IV. Conclusions and Recommendations . . . 10
Recommendations . . . 11

I. The Traditional Branch Environment

Historically, corporations built their branch environments node-by-node with technology and configurations unique to each location. The corporate headquarters acted as a hub and distributed a limited set of applications and services across the network to each branch location. Network upgrades were often done on an ad-hoc basis and were normally limited to bandwidth upgrades or new hardware with little thought given to how that might affect the current operating environment. This was an acceptable, although not ideal, practice during the 1990s as companies were in continuous build mode and had ample capital to spend on their corporate networks. However, recent economic pressures have forced companies to look to improve efficiencies and most current enterprise networks have the following issues:

- **Aging, disparate networks:** The majority of companies have separate networks for voice, video and data traffic. In addition to these traditional communications networks, many vertical applications such as trading systems have their own networks.
- **High total cost of ownership:** Exhibit 2 shows a typical branch deployment where every feature in a branch is delivered from a separate and appliance and managed independently. This is a very expensive way to manage the technology in the branch office.
- **Non-optimal network performance:** Because enterprise services are often delivered over discrete networks, the performance of the network is often suboptimal. It's often the case where one network may be completely saturated where another network remains idle. This creates an environment where application response time is very inconsistent, causing frustration among the user population.
- **Low resiliency:** Because branch offices are often self-contained, their disaster recovery capabilities tend to be very low. This has the potential to make even the smallest outage very expensive.
- **Inconsistent branches:** Because decisions on branch infrastructure were often made on a location-to-location basis, the applications, services and features that workers use can vary widely by location. This creates significant inconsistency between locations as to how users work. Often, users need to alter the process with which they work based on what's available to them.

Exhibit 2
Complexity of an Overlay Appliance Model
Source: Yankee Group, 2007



The branch infrastructure will continue to become more complex as corporations deploy more media-rich functionality at the branch level with multiple overlay appliances. The following applications have the power to increase productivity, but will greatly increase the complexity of the branch:

- **Unified communications and IP telephony:** The Yankee Group *2007 Economics of IP Communications Survey* shows that more than 80% of enterprises have IP telephony running in at least a test environment. In many cases, the PBX or key system in the branch office does not interoperate with the PBX in the headquarters, causing telecom departments to make changes on a node-by-node basis. A consistent IP telephony platform enables the branch system to interoperate with the corporate system or, in some cases, the branch system can act as a survivable backup to the system at the headquarter location. This provides all the users with a consistent feature set. The same survey revealed that 79% of respondents said they will use IPT as the foundation for their future UC deployment. Exhibit 1 shows many of the UC components that are likely to be deployed post IPT.
- **Broadcast and on-demand business video:** A number of companies today use streaming or on-demand video training for e-leaning. In addition to saving money on travel costs, video can improve training and productivity. Video-on-demand (VoD) also provides a means to archive events so they don't have to be recreated every quarter. Lastly, today's on-demand systems call for central management to phase out older, videotape-based systems which are difficult to control and manage.
- **Telepresence:** Traditional video conferencing systems are difficult to set up and administer, and the quality tends to be inconsistent. Our research shows that traditional roll-around cart systems can take up to 30 minutes of IT time to set up an individual video session, removing any spontaneous use. Telepresence offers a unique experience where the user feels like the person they are communicating with is literally across the table.
- **Digital signage:** Many retail organizations have started to use digital signage as a way of advertising products and news to customers using large video displays and video walls. The use of digital signage will rise in other verticals such as hospitality, higher education, medical and other verticals where speedy distribution of information can have an immediate impact on the organization.
- **IP virtual private networks (IP VPNs):** As companies build more peer-to-peer applications, it is increasingly important to create network architecture that is flexible and can provide secure any-to-any connectivity.

These additional applications will drive user productivity, but will increase the complexity of already difficult-to-manage networks. It's currently not uncommon for each branch location to have a different device for routing, security, switching, voice, WAN optimization and other network services. A single device that could provide part or all of this functionality could dramatically reduce both capital expense costs and operational costs.

II. The Empowered Branch: Multimedia Everywhere Gives Rise to the Intelligent Network

A company's competitive advantage is no longer about a single core capability but about being able to harness the knowledge base of an organization's entire workforce and make critical decisions as fast as possible. Yankee Group research shows that more than 75% of workers reside in branch locations today, making it critical that communication services such as VoIP, video and telepresence as well as applications such as file services and e-mail perform in the remote location as well as they do in the headquarters.

Historically, delivering these features to a branch environment has not been easy to fulfill. The vision of an empowered branch is one in which all of the necessary applications and services that are available in the main office location are also available in the branch, with the benefit of centralized control. To maintain a company's competitiveness, it becomes increasingly important that the application and network performance at the branch be brought up to that of the headquarters; services must be consistent across the branch, the WAN and the data center. Additionally, branches that are already resource constrained need to prepare for the collaborative advancements from Web 2.0 making the network foundation even more important.

To effectively deliver multimedia content to the branch network, companies need to understand what makes this key technology important and bring a higher level of application fluency to the network. We consider a few key technologies in the next section, which looks at application optimization, network and route optimization as well as content delivery. In such networks, a good baseline quality of service (QoS) policy is also highly recommended.

Cisco's Empowered Branch vision helps organizations realize the full potential of their business by empowering the network with features and capabilities that improve productivity and enhance customer service. In this vision, the network acts as a platform with all of the integrated and interoperable components companies need to empower the branch location.

Empowered Branch Technology Enablers

Wide Area Application Services

Wide Area Application Services (WAAS) is a Cisco technology designed to accelerate the performance of TCP-based applications in a branch office environment. By using WAAS, organizations can consolidate storage devices and branch office servers into the data centers to allow them to be centrally managed. Additionally, new applications can be deployed directly in the data center allow the IT administrators to manage the applications and data centrally while offering the branch office workers LAN-like performance of applications.

To accelerate the applications, WAAS uses a number of optimization techniques, including compression and redundancy elimination. By mapping the various applications with the correct optimization technique, the following can be achieved:

- **Latency and bandwidth reduction through application acceleration:** Various protocol optimization techniques such as suppression are used in conjunction with caching technology to minimize the latency and unnecessary data traversing the WAN.
- **Bandwidth and throughput improvement using WAN optimization:** Bandwidth can be improved in a number of ways. WAAS couples compression with data redundancy elimination (DRE) to alleviate unnecessary bandwidth consumption. Additionally, TCP flow optimization (TFO) optimizes how TCP flows across a network to significantly improve efficiencies in WAN environments.

Interviews with customers that have deployed WAAS technology have revealed that users are experiencing up to a 90% improvement in the performance of TCP-based applications such as Windows files services and Microsoft Exchange.

Cisco's implementation of WAAS supports both an integrated solution as well as optionally the capability in a standalone appliance form factor. It has the additional benefit of being integrated into the branch office router. Independent of how the solution is delivered, WAAS provides network managers with a number of benefits including:

- Dynamic auto discovery of endpoints, enabling network managers to deploy the solution rapidly without creating overlay networks
- End-to-end visibility and interoperability with existing network functions such as QoS, security, Cisco NetFlow and high-availability features

Business Benefits of WAAS

There are numerous business benefits that can be achieved by deploying WAAS, including:

- **Lower branch TCO:** WAAS provides cost savings in branch offices by consolidating many of its functions such as file storage and backup and recovery in the data center.
- **Improved employee productivity:** Our research shows that, on average, users are 14% less productive when applications perform poorly. By providing LAN-like performance of applications over a WAN, the user experience will be greatly improved, which drives productivity up.
- **Accelerated application deployment:** The typical deployment cycle for applications can be slow because of network tuning and optimizing as the application gets rolled out to maximize the user experience. With WAAS, much of the typical network tweaking is no longer required. Customers using WAAS have reported that deployment times have been cut by as much as 30%.
- **Reduction of WAN data volume:** This can offset upgrading circuit costs.

Cisco Performance Routing

Cisco Performance Routing (PfR) is a technology designed to complement traditional routing technologies by adding intelligence to select best route paths to improve application performance. PfR optimizes application performance over private WAN links and internet access trunks. PfR bases its decision on a number of parameters that affect application performance including delay, reachability, cost, jitter and mean opinion score (MOS). Although most of PfR capabilities are on the outbound (egress) side, it can, for example, affect BGP metrics that influence the path the remote router takes to get to the local Layer 3 resource.

Cisco PfR can lower overall TCO by reducing network costs through effective link load balancing and by increasing the performance of the applications without a WAN upgrade. Traditional routing protocols, such as Enhanced Interior Gateway Routing Protocol (EIGRP), Routing Information Protocol (RIP) and Open Shortest Path First (OSPF), focus on metric-weighted best path selection. PfR focuses on providing application performance by mapping the application requirements to current network path performance. In essence, it's an application-based routing protocol.

As multimedia communications become more integral to a company's business process, so does the performance of applications such as VoIP and telepresence. While WAAS does an excellent job of improving the performance of non-real-time applications, by reducing latency and data transmitted over the WAN, PfR improves the performance of applications by choosing the best performing path for the application based on a set of requirements that the network manager predetermined. This is critically important to real-time applications such as VoIP and telepresence where fluctuating network performance (i.e., latency, jitter, and loss) can significantly impact these applications. PfR continuously evaluates network performance to select the best performing path for each application.

Business Benefits of PfR

- **Lower network costs through the reduction of bandwidth costs:** PfR allows traffic to be routed based on bandwidth costs so to minimize the traffic sent over expensive links.
- **Improved user productivity by increasing application response time:** Automated route optimization using PfR can automatically route around poorly performing paths.
- **Lower operational expenses:** PfR automates performance optimization, which is normally done manually. This frees up engineering resources to focus on other, more strategic initiatives.
- **Better availability by increasing overall network uptime:** PfR can detect and route around network black-hole and brownout anomalies. Yankee Group research shows that configuration errors accounts for more than 30% of network outages, many of which occur when engineers are trying to optimize performance by tweaking the router. PfR removes much of the necessity to do this manually.
- **Better utilization of WAN links with advanced load-balancing:** Network managers often run multiple WAN connections for redundancy, but often one more connection is overutilized and others are used lightly. PfR can intelligently distribute traffic, where appropriate to maximize utilization across all WAN connections.

Application and Content Networking System

Cisco's Application and Content Networking System (ACNS) enables enterprises to build their own content delivery networks (CDNs) to deploy a scalable, manageable and reliable digital media network that can be used to deliver DVD-quality, high-definition video applications over a WAN. ACNS is built on a diverse set of streaming media features that will allow long-playing videos to be streamed live, multicast or called up on demand over a WAN with the best possible quality.

The main uses for ACNS include:

- **Optimization of web traffic:** Yankee Group estimates that today, HTTP and HTTPS traffic makes up well more than 50% of WAN traffic, and it continues to grow. As companies continue to migrate traditional software to web-delivered applications, an enterprise CDN will be critical.
- **Streaming video:** Historically, video has been used for corporate presentations and e-learning. The use of video will grow exponentially during the next few years as companies use it to deliver video to kiosks and digital signs.
- **VoD:** Delivering digital DVD-quality VoD to corporate environments.
- **Stream collapsing:** ACNS allows multiple users in a single location to access the same content. For example, if 20 people are accessing a live streaming feed, ACNS can collapse that into a single feed over the WAN and replicate it on the LAN side.

Business Benefits of ACNS

- **Better utilization of corporate resources:** Many organizations have deployed streaming infrastructure for e-learning or other purposes, but the technology often goes unused because of poor performance.
- **Easy deployment for one-time events** such as conferences and seminars, which require high-quality video transmission.
- **Cost savings from reduction in travel costs:** Rather than having employees flying to the headquarters for corporate meetings, enterprises can now stream a CEO address or other corporate presentation over the WAN for users to view at their desk.
- **Improved customer experience:** By using advanced technologies such as digital signage, combined with ACNS, organizations such as retailers can push personalized content to customers creating an entirely new experience.

Security Integrated into the Network

In addition to ensuring that applications perform optimally, network managers need to ensure that the workplace is also secure in both wired and wireless environments in both the branch and the headquarter location. The secure network must be built on multiple layers to protect against security breaches while not blocking users from doing what they need to do. Many security appliances from best-of-breed vendors may solve a specific security problem, but unless they are from the same vendor, they can often cause interoperability issues or pose additional security flaws if not tested as a system.

Business Benefits of Integrated Security

- **Collaboration between network and security services:** Integrating security into the network has the benefit of being transparent to many IP services, such as QoS, ensuring minimal network reconfiguration.
- **Consistent security policies across wired and wireless networks:** Many security overlay technologies are for a wired or wireless environment only. This means that policies must be replicated across the various systems to ensure policy consistency.
- **Lower capital costs:** Many of the security technologies available from Cisco are available in the traditional appliance form factor, but also as a feature that has been integrated into the router and switch. This provides a great deal of flexibility to network managers as they plan security deployments.

III. The Value of the Integrated Approach

The technologies listed in Section II have tremendous value as standalone technologies. However, when the technologies are integrated together, they provide the foundation for the delivery of multimedia content to all branch locations in the corporate network. Cisco's WAAS, PfR and ACNS have specific functionality to optimize application traffic between two locations. ACNS focuses on static content, WAAS focuses on optimization at the application layer, and PfR monitors data flows and optimizes route paths to create the best possible WAN performance. These three technologies can be combined to create the necessary network intelligence, and optimize application behavior using the resources in the network, to create the optimum user experience.

Exhibit 3 (on next page) shows an example of a network where WAAS, PfR and ACNS are used together to optimize the performance of all multimedia traffic traversing the corporate network. They all can coexist in an integrated manner on the Cisco 3800 series Integrated Services Router.

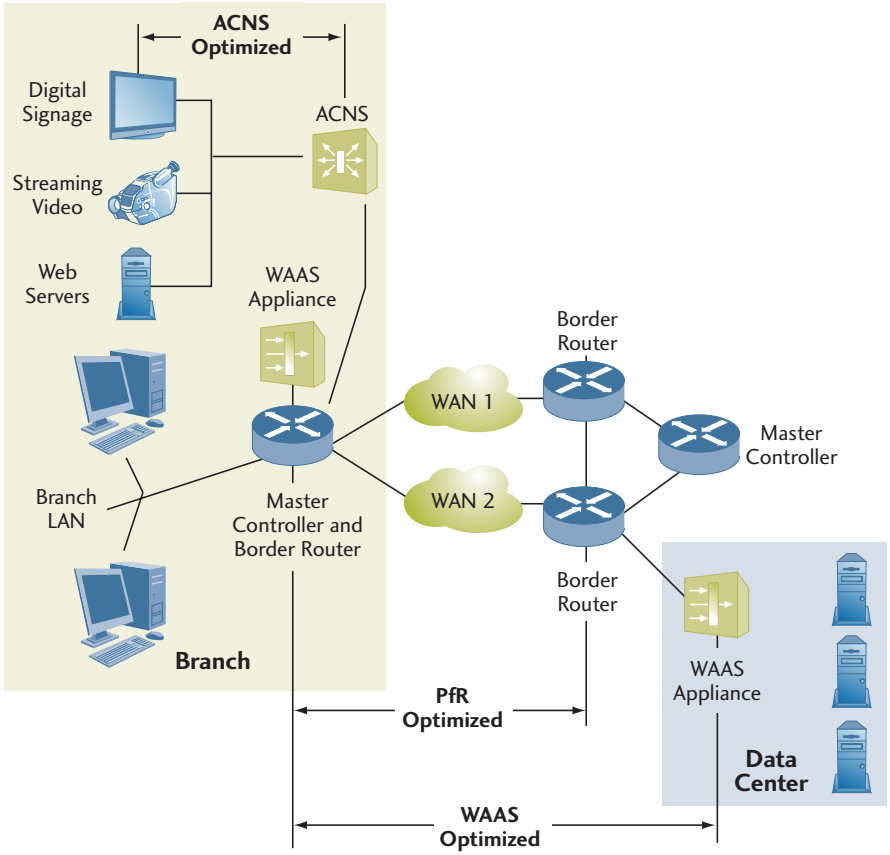
The WAAS appliances at the two ends of the WAN optimize the performance of applications such as Exchange, Windows file services and other TCP-based applications. However, a situation may occur where the path taken over WAN 1 becomes congested or unavailable. WAN optimization with WAAS can only be as effective as long as the WAN links are available, but don't have control over network path performance and availability. PfR complements the capabilities of WAAS and can be used to change the network path in real time to avoid a disruption in service and minimize any problems that may occur as a result.

Deploying PfR on both ends of the network provides additional benefits of advanced load balancing that increases effective network capacity and reduces costs. Cisco's ACNS product will optimize the performance of streaming video and web content at the local site by caching on-demand content or video pre-positioning frequently accessed content and then locally fulfilling requests. ACNS cuts down on the overall WAN traffic by eliminating subsequent requests for the same digital media. It should be noted that both the WAAS and ACNS appliances are available as modules for the branch routers that exist in almost every branch location today.

Cisco's approach of having the services integrated into the industry-leading Integrated Services Router (ISR) yields the following benefits:

- **Tightly coupled end-to-end solution:** All the necessary hardware, software and services are part of an integrated end-to-end solution. Having a single support contract and one vendor to contact can be a huge operational advantage.
- **Cross-feature awareness:** Many of the network services integrated into ISR are intelligent in that they include smart protocols that enable the services to be cross functionally aware of one another. This awareness optimizes the network, which increases network predictability and control.

Exhibit 3
Integration of WAAS, PfR and ACNS
Source: Yankee Group, 2007



- **Continuously expanding feature set:** Cisco's ISR is built on a flexible platform to which additional features and management capabilities can be added without having to go through a costly hardware upgrade. This provides network managers with the flexibility to deploy a service as an integrated module or as a standalone appliance based on the needs of the organization.
- **Lower overall reduction of both operational and capital expenses:** A single integrated appliance is much simpler to deploy, provision and manage. Additionally, new features can often be "turned on" in software, removing the need to purchase additional hardware.

Having these capabilities integrated into a higher-end modular router such as the Cisco 3845 Integrated Services Router not only provides for the benefits of integration, but also minimizes network disruption caused by addition or maintenance of individual overlay appliances or software interoperability issues. It also offers a higher degree of investment protection.

In summary, using Cisco's application network technologies has the following benefits in a multimedia branch environment:

- Cisco WAAS lowers bandwidth consumption by using caching technology.
- Cisco WAAS minimizes the impact of network latency, improving overall throughput.
- Cisco WAAS accelerates TCP-based applications such as e-mail. It can also pre-position CIFS-based content to reduce overall network utilization and prepare for large file distributions over the WAN.
- Cisco ACNS reduces overall network utilization by pre-positioning or caching video content.
- Cisco ACNS improves the performance of streaming media, web and digital signage.
- Cisco PfR improves the performance of telepresence, VoIP and video conferencing by optimizing selection of network paths.
- Cisco PfR improves WAN usage through better load management of WAN links.
- Cisco PfR improves application availability by routing around network anomalies.

IV. Conclusions and Recommendations

Multimedia traffic is on the rise and so is the complexity of delivering these rich media services to branch locations. The traditional ad-hoc network design and deployment is not sufficient to meet the future demands that will be placed on the network—a better branch office network strategy is required. A cohesive, branch office strategy can empower the workers in a branch to be as efficient and productive as those in the corporate headquarters and can deliver the following benefits:

- **Investment protection:** Companies can extend the life of their branch network equipment by deploying fewer devices with multiple features that can be added to a modular architecture. Organizations no longer need to do costly forklift upgrades to add new features and services. Instead, the life of the current platform can be extended by adding modules or turning on features.
- **Consistent user experience:** By using technologies such as WAAS, ACNS and PfR together, users in a branch location will experience the same look and feel with the same applications as their counterparts in the corporate headquarters.
- **Streamlined business operations:** Historically, many smaller branch locations did not get the same applications and services as larger locations. This would create an environment where the business processes in some branches would be different than those in a larger location or headquarters. An empowered branch strategy will enable organizations to create consistent processes that can be measured fairly across the company.

Recommendations

It will become critical for the IT staff responsible for branch networks to investigate how to leverage multimedia services such as telepresence, VoIP and streaming media. To successfully meeting future demands, a sound branch network strategy is needed. Network managers should:

- **Understand which applications are best optimized by which optimization technique.** Many deployments of application networks fail, not because of the technology but because every application responds differently to the various techniques. For example, VoIP traffic can't be accelerated, QoS has minimal impact on streaming media, and so on. It is also not necessary to optimize all traffic. Even if a portion of the traffic is WAAS optimized, more bandwidth is available for the unoptimized traffic.
- **Understand how point products impact the rest of the network.** Point products may solve a particular application problem, but they might impact another part of the network and cause operational overheads coming from different vendors. When deploying a point product, be sure to understand fully whether factors such as ACLs, QoS settings or security parameters need to be modified.
- **Seek advanced professional services.** An effective branch office network strategy is more than just technology. Seek a vendor that can provide advanced services such as business analysis, project management, training and deployment support. No corporate network operations staff can excel in all areas of running a network and understanding its relationship to the business. Use advanced services to fill the knowledge gaps.

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