White Paper

Demonstrating SD-WAN Business Value; Rethinking WAN for a Modern Age

April 2019

Contents

Introduction

For many organizations, the wide area network (WAN) infrastructure that connects an enterprise's remote and branch offices has not changed for decades. Over the years, organizations consolidated many regional data centers into a few highly available data center locations which meant that remote locations had to connect to centralized applications over WANs and all internet traffic went through these data centers as well. This introduced bandwidth constraints and latency issues. The development in WAN optimization provided incremental and measurable improvement in WAN performance and provided some bandwidth cost containment. However, that technology typically was only deployed at the most problematic sites that struggled to achieve acceptable levels of performance and user experience. It did not solve all the issues with WAN connectivity.
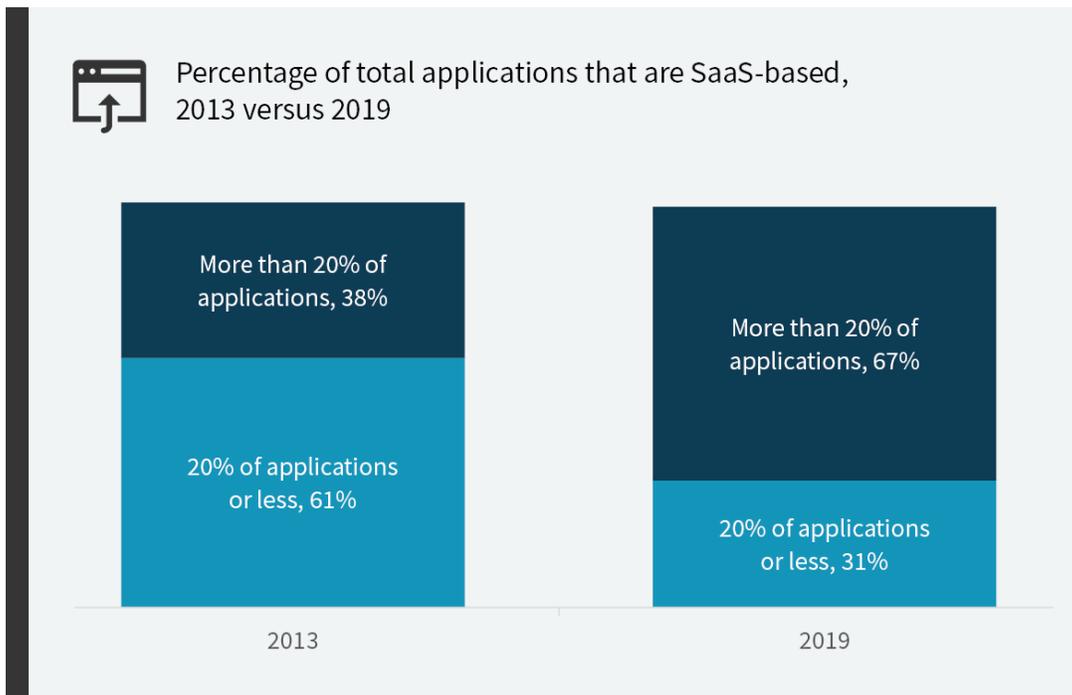
WAN infrastructure planning was limited to increases in capacity that were met by provisioning additional carrier MPLS (multiprotocol label switching) network capacity. This was a slow process, connections were costly, and visibility and control over traffic was lacking.

With the increased adoption of software-as-a-service (SaaS) and Infrastructure-as-a-service (IaaS), the nature of application usage and related data center usage is changing at a rapid pace, and traditional methods for meeting networking needs are neither cost-effective nor responsive enough to meet business needs. Today's network users seek a better solution for connecting to their business-critical applications.

Changes in Application Use

Application use in enterprises is changing from a model in which they are hosted within an enterprise data center toward a SaaS or IaaS model where they are hosted in the cloud. ESG research indicates that 67% of enterprises now have 20% or more of their applications delivered via SaaS-based applications versus only 38% just six years ago (see Figure 1).[1]

Figure 1. Increase in SaaS-based Applications

Percentage of total applications that are SaaS-based, 2013 versus 2019

More than 20% of applications, 38%

20% of applications or less, 61%

2013

More than 20% of applications, 67%

20% of applications or less, 31%

2019

Source: Enterprise Strategy Group

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[1] Source: ESG Research Report, *2019 Technology Spending Intentions Survey*, February 2019.

Furthermore, 58% of enterprises report leveraging IaaS. In fact, of those organizations using IaaS, almost half (49%) report that they are running production applications in those environments.[2] As a result of this change, organizations find that sending network traffic from remote locations through the data center and then to the cloud is costly and is becoming unnecessary, as users at remote locations are connecting to cloud-based applications directly over the internet.

This means that legacy network architectures (MPLS links that go through the data center first) are no longer suited for the traffic patterns required for accessing cloud-based applications today. Not only are bandwidth requirements to the Internet changing, but the nature of network access has also become more demanding. Network-based unified communication (UC) and voice over IP (VOIP) and video conferencing applications have increased in use. In all these cases, the demands on the network are increased, since voice traffic is more sensitive to the quality of the network conditions than conventional web traffic. A slight disruption in the timely delivery of packets results in lower voice quality. Accompanying video transmission will also impact the quality of experience.

These evolving forms of communication require better management of network latency, packet loss, and jitter, which can only be delivered by a dynamic quality of service (QoS) that can implement policy-based traffic steering over redundant links. There is also a need for segmentation of data traffic based on its type, such as PCI data from retail POS systems. Plus, as more organizations implement IoT initiatives at the edge, it will be necessary to transfer this sensor data back to centralized data repositories in the cloud or in a data center. It will be important to segment this traffic to mitigate risk and ensure timely transfer of the data.

Transition to Consumption Model

Company-owned data centers have traditionally served as hubs for remote branches. However, as enterprises transition to cloud-based architectures, it signifies a shift in consumption, from CapEx-centric to OpEx, as organizations leverage as-a-Service, pay-as-you-go consumption models. As a result, many organizations look for the network technologies to follow suit. (Note: Carrier network services are typically OpEx.)

Complexity Is Increasing, but Your Headcount Isn't

Organizations undergoing this transition understand that this new, flexible, and dynamic cloud environment is bringing benefits to the business, but not necessarily to the IT staff. After spending years consolidating applications to a few data center locations, IT is now dealing with applications that are distributed across multiple locations (data center, IaaS, SaaS, edge, etc.). However, given budget pressures, few have the luxury of adding more staff. Therefore, it will be imperative for organizations to deploy network solutions that enable existing staff to be more productive and leverage streamlined or efficient processes. Many customers who seek to refresh the WAN infrastructure focus on the potential data savings by using alternative networking technology to reduce MPLS costs. However, that is only part of the story. It is additionally important to reduce friction in IT operations. Sending IT staff to install and configure or troubleshoot edge devices adds costs and time to new location rollouts and to problem resolution for existing sites, so customers need to evaluate savings from many angles.

Lack of Control and Visibility into Application Traffic

In traditional MPLS carrier networks, there is little to no visibility available to the customer. Nor is there an ability to prioritize the traffic based on its type or intended use. For example, most would agree it would be good to prioritize credit card payment information over guest WiFi. Organizations need to apply business policies to application traffic running over the WAN in order to mitigate risk and ensure the performance of critical applications. Having visibility into the traffic and

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[2] Source: ESG Research Report, *2019 Technology Spending Intentions Survey*, February 2019.

the ability to leverage centralized policy to steer traffic will allow users to more efficiently use available bandwidth. For example, an organization could run critical applications over MPLS links and guest WiFi over broadband.
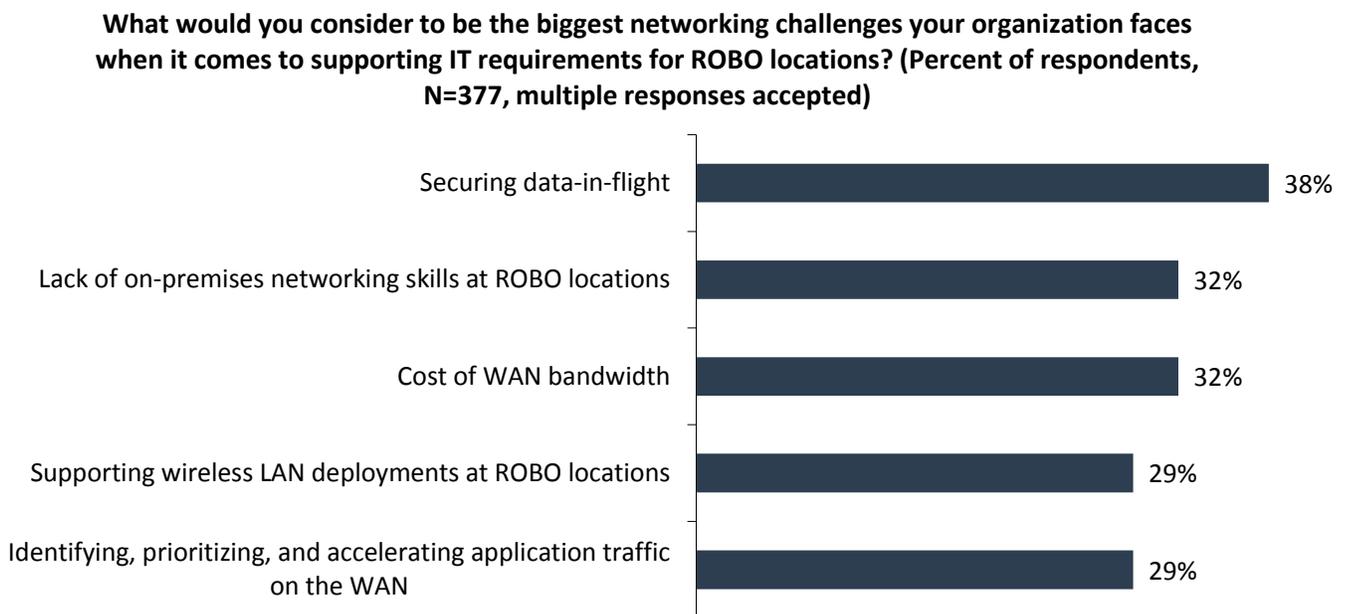
Revisit the WAN Architecture

For these reasons, organizations need to reevaluate their WAN architectures. Traditional architectures were designed for a centralized application delivery model. The hub-and-spoke model was data-center-focused and suitable for the days when most applications were client-server-based and hosted in the data center. There is a mismatch in the architecture, which also results in higher costs. The WAN is designed to be overprovisioned to handle the worst case, which is when all the remote sites access applications at once, concentrating all of their traffic over the links to the data center. But, given this hub and spoke architecture, overprovisioning is the only way to ensure that the network delivers the performance that the end-users expect. Even worse, for high availability, organizations have deployed redundant MPLS links (from different carriers) that act in an active/passive mode in case of failover. In this scenario, 50% of the bandwidth is unutilized but 100% of the cost is paid.

WAN Challenges Are Varied

In order to determine the IT priorities and challenges when it comes to supporting the technology requirements of remote office/branch office (ROBO) locations, and how organizations plan to address those challenges, ESG surveyed 377 North American senior IT professionals representing midmarket (100 to 999 employees) and enterprise-class (1,000 employees or more) organizations. When respondents were asked about the biggest networking challenges they face when it comes to supporting IT requirements for remote office/branch office (ROBO) locations, the most-cited responses were securing data-in-flight (38%) and cost of WAN bandwidth (32%). ESG believes that the fact that not one challenge dominated the responses indicates that organizations encounter a wide variety of challenges and incur associated costs. It is important to note, however, that costs vary depending on the number of locations, how dispersed they are, and the quality of the network service and equipment providers (see Figure 2).[3]

Figure 2. Top Five Networking Challenges Supporting IT Requirements for ROBO Locations

What would you consider to be the biggest networking challenges your organization faces when it comes to supporting IT requirements for ROBO locations? (Percent of respondents, N=377, multiple responses accepted)

Securing data-in-flight	38%
Lack of on-premises networking skills at ROBO locations	32%
Cost of WAN bandwidth	32%
Supporting wireless LAN deployments at ROBO locations	29%
Identifying, prioritizing, and accelerating application traffic on the WAN	29%

Source: Enterprise Strategy Group

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[3] Source: ESG Master Survey Results, *IT Plans and Priorities for Remote and Branch Offices,* May 2015.

A Better Solution Is Needed

Organizations need to design WANs to meet the ever-changing requirements of remote and branch offices. In a time of cloud, IoT and digital transformation, these networks have to fulfill a number of different roles not originally intended. New solutions need to address multiple pain points including:

- **Enhanced productivity and responsiveness to business**: Accelerate network rollouts to new locations via a zero-touch deployment model that reduces truck rolls, onsite remote installation, configuration complexity, operations, management, and troubleshooting. In the same way that SaaS has modernized application deployment and management, the supporting network infrastructure needs to change to support this new model.

- **Network infrastructure simplification**: Reduce unnecessary deployment and management of network infrastructure, such as head-end devices or appliances at branches, if they can be replaced by modern alternatives that combine multiple functions into simple appliances, augmented by cloud-hosted services.

- **Bandwidth cost reduction**: A hybrid WAN that combines multiple transports such as MPLS networks along with broadband Internet links, controlled via a centralized orchestration system for policy management, monitoring, and troubleshooting, will meet these needs. By creating a unified network composed of different connections at the back-end, customers remove the need for disruptive changes to the application infrastructure, and minimize the changes needed for the network configurations.

- **Business policy control for application traffic**: Not all applications are treated equally by the business. As such, the network needs to prioritize application traffic over the WAN to ensure mission-critical applications are given priority over guest WiFi traffic, for example. Network teams need to understand which applications and traffic (VoIP, Video, etc.) are a priority and establish policies to ensure the network service matches those. This would also include establishing priorities in a failover environment as well.

- **Link aggregation:** Leveraging policy control, it is possible to run multiple links in an active/active mode. This means that all the bandwidth can be leveraged to transport data, voice, and video, regardless of the network connectivity—MPLS, dual MPLS, MPLS and broadband, or dual broadband, for example. Organizations can use transport independence to take full advantage of the total capacity and leverage business policy to dictate prioritization in the event of an outage (i.e., guest Internet is out, but mission-critical apps stay up).

- **On-ramp to the cloud**: The increase in cloud-based applications and the shift to direct Internet access from remote and branch offices will introduce security and application performance issues based on the distance (and therefore latency) of the remote office to the cloud. When evaluating solutions for the WAN, verify that the technology has the ability to provide an on-ramp to the cloud to ensure end-to-end performance for cloud-based applications. Typically, this would take the form of a cloud gateway—located at or next to the cloud data center.

- **Ability to reach remote sites:** Some remote locations do not have access to MPLS network connections, so the logical choice would be to leverage broadband connections. Also, in some cases it may be much easier and faster to connect to broadband initially and then add MPLS when available. In some cases, neither are available. However, advances in wireless technology from service providers with 4G LTE connections and soon-to-arrive 5G may make it possible to provide connectivity via a wireless connection. Make sure you explore all avenues. Wireless may also be a viable failover option in areas with limited MPLS or broadband connectivity.

- **Ability to deploy sites rapidly:** The pace of business continues to accelerate, and the network needs to keep up. Organizations need to bring up new sites quickly and with minimal effort. The days of being able to wait months for

carrier circuits is long over. In many remote locations, organizations may have to work with broadband connections or even LTE. The key is to get the site up and connected as soon as possible over whatever network connectivity is available with minimal onsite presence required. This is driving what is referred to as zero-touch deployments (ZTD), where if nominal infrastructure is available (i.e., VMs), the setup, configuration, and policy enforcement can be implemented remotely. In a best-case scenario, a "golden image" of a site can be created and a single button can spin up a new site.

VMware SD-WAN by VeloCloud Can Modernize Your WAN

To enable organizations to achieve the previously mentioned capabilities, VMware offers its SD-WAN solution. Originally created in 2012 by the VeloCloud team and acquired by VMware in 2017, VMware SD-WAN by VeloCloud is a cloud-delivered SD-WAN solution. The solution is comprised of the VMware SD-WAN Edge (available as VNF or appliances), VMware SD-WAN Gateways (deployed strategically at cloud data centers and PoPs to enable cloud and SaaS connectivity), and VMware SD-WAN Orchestrator and Controllers (deployed in the cloud or onsite).

These elements combine to provide organizations with a next-generation WAN architecture capable of single click provisioning, centralized policy control, and complete enterprise-wide visibility. From its inception, VMware SD-WAN has focused on delivering automation and simplicity for its users and has helped transform thousands of WAN architectures to deliver business value for its customers.

Case Studies

Let us examine some case studies from customers to illustrate this.

NorthGate Markets, a California-based retail grocer, supports up to 43 sites in California. It prides itself on providing fresh and prepared food and as such it has a diverse set of products from a number of different sources. In order to ensure it has the right products at the right store when they are needed, it relies on an ordering application that requires connectivity to each store, data center, and distribution center. In addition, the chain of stores also provides financial services in the form of check cashing, loans, money transfers, and currency exchange that need network connection for verification.

Initially, NorthGate relied on an MPLS network consisting of two T1s to each store (1.5Mb each) that utilized a 3G wireless back up. The service was provided by AT&T. Unfortunately, the MPLS network went down frequently and the 3G backup was limited in what it could carry, not to mention that it was difficult to repeat this configuration in every location. After dealing with several outages and events where T1s started flopping back and forth and required manual intervention, it looked for alternative solutions. In early 2016, the IT team began to evaluate SD-WAN solutions. However, when AT&T heard, it proactively offered its SD-WAN solution (based on VMware SD-WAN), disrupting its own business but ensuring a continued relationship. NorthGate shifted over to an all broadband solution with a 4G wireless backup.

The transition was extremely easy, typically only requiring 30 minutes per location and only seconds of downtime. It was so easy in fact that it shunned the typical weekend 2AM transition and began cutting stores over in the middle of the day. Plus, it was able to eliminate the physical routers that were at each location. This also coincided with a move NorthGate was making to the cloud and the VMware SD-WAN Gateways ensured connectivity and performance with its cloud applications.

As a result of the shift, the organization was able to reduce its expenses by 40%, increase the bandwidth per store from 3Mb to 80Mb/18Mb, and significantly improve connectivity SLAs, with no disruptions to the applications. Even if the broadband connections are lost, the 4G network is able to continue operations. In addition, NorthGate is planning to take advantage of the increased bandwidth to deliver new financial and customer services and the increased analytics to better

serve its customers. Looking further to the future, NorthGate is hopeful that 5G technologies connected to its VMware SD-WAN will provide further benefit.

LincLogix is a network service provider based in Indiana. For the last 15 years, LincLogix has been reselling MPLS networks to customers based on traditional carrier offerings. However, this proved to be expensive, and had limited bandwidth, since it was essentially legacy technology. Its customers were challenged in that they needed more bandwidth but had price constraints. Organizations were left with few options and high availability options (3G backup or redundant MPLS links) only drove costs higher.

Several years ago, LincLogix became aware of the emerging SD-WAN technologies and evaluated several candidates. It chose VMware SD-WAN by VeloCloud for its ease of use and plug-and-play capabilities. In essence, this was the start of LincLogix2 2.0.

LincLogix explained how SD-WAN enabled one of its customers, a financial services company serving rural Indiana farmers, was able to transform its business using LincLogix SD-WAN services. With 45 branches in rural areas, getting MPLS connectivity was difficult, in some cases incurring $30-50K just for last mile connectivity and forcing the company to deal with multiple different service providers. LincLogix was able to step in and propose a single vendor solution leveraging SD-WAN over broadband connections. This not only dramatically reduced costs for an infrastructure upgrade (existing routers) but enabled new business opportunities. With the ability to connect with more bandwidth, the company was able to leverage new technology in the form of interactive teller machines, whereby remote users could converse with bank tellers in a centralized location over a video connection. To get the same bandwidth to enable this to work over MPLS would have cost them 10X what they were spending.

LincLogix was also able to help a manufacturing company to migrate to SD-WAN to recognize up to 40% in savings and enable new business initiatives like digital signage and digital mirrors.

Reducing the Total Cost of Ownership (TCO) for WAN Solutions

Let us examine how the cost savings are derived in these case studies. The savings arise through the reduction of network link and network equipment costs, and management costs, as well as the elimination of traditional WAN upgrades required by increasing demands for bandwidth. Enabling a diversity of choices in network service providers also drives down costs through competitive pricing. It is instructive to view this through the lens of a "before" and "after" network.

We examine the specific cost categories in further detail using illustrative examples. These are based on the transition from a dual MPLS-connection and single broadband connection network infrastructure to a VMware SD-WAN-based network that augments a single MPLS with two broadband Internet connections.

The cost comparison is based on deploying an infrastructure for a 50 branch network. This may apply to upgrading an existing network infrastructure or budgeting for greenfield environments. However, given the cost savings, it may be modified to apply to brownfield environments or to incrementally upgrading an existing branch network.

The Three-way Benefits

In this hypothetical enterprise with 50 branches, we determine how three cost areas, composed of bandwidth, OpEx, and network infrastructure costs were reduced, resulting in over one million dollars in savings or more than 2.2x (comparing a spend of $1,870,000 versus $830,000) over three years (see Figure 3).

Part of the savings results from reductions in the cost of bandwidth. More importantly, OpEx, or ICOM (installation, configuration, operations, and management), costs were eliminated by moving many of the services to a cloud service and

converting the branch network to a new operating model that offers simplification and visibility. Since branch network function maintenance is now centralized with VMware SD-WAN, it is no longer necessary to budget for truck-rolls.

In other words, rather than having the enterprise directly manage the physical branch network, this hypothetical enterprise now relies on a software-defined "branch-as-a-service," which converts manual, internally managed infrastructure to a centrally managed service.

Figure 3. Costs for a 50 Branch Deployment
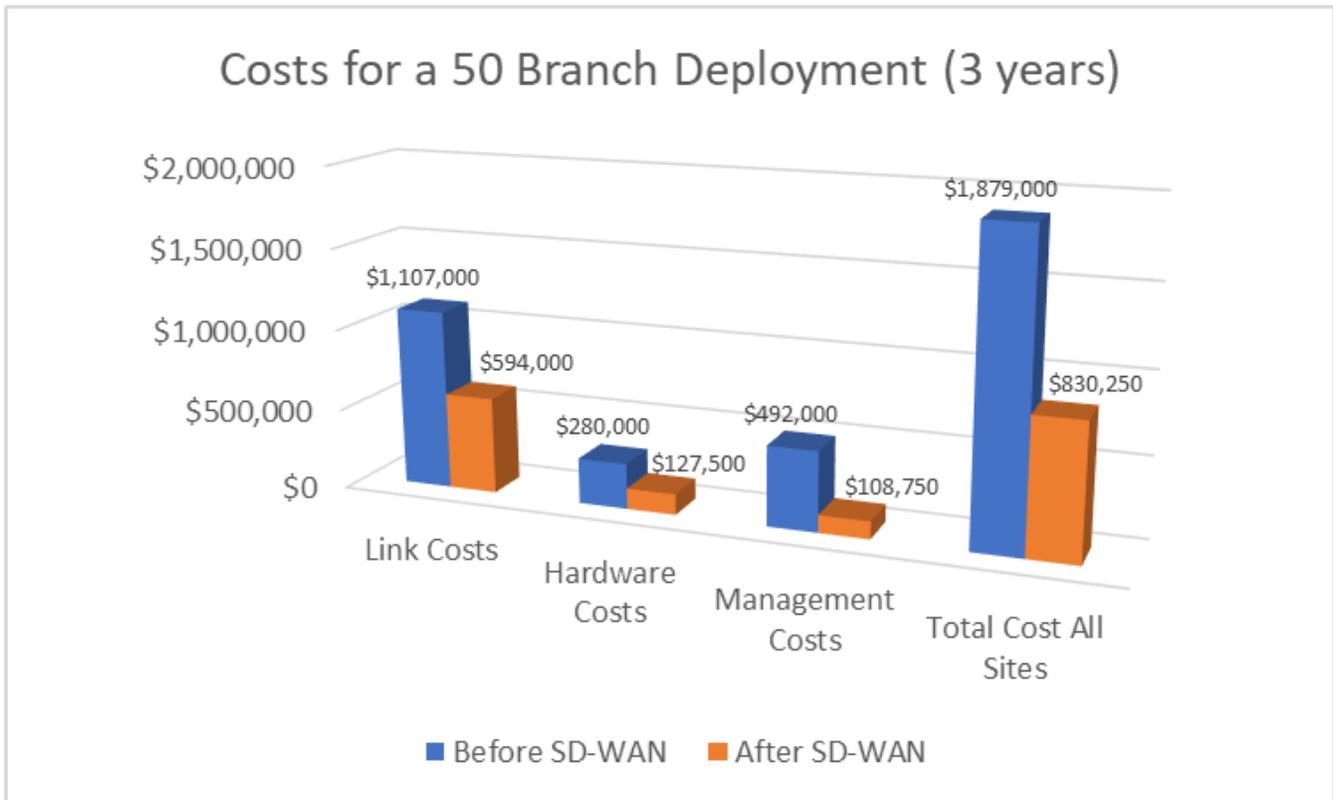
Source: VMware

Bandwidth

The majority of the cost savings result from this category. In the example shown, a dual MPLS, single broadband connection was replaced with a single MPLS, dual broadband Internet connection (one each from two providers to provide diversity in service levels), which can provide a high level of reliability along with higher bandwidth. The deployment practice traditionally depended on the site.

Table 1. Traditional Deployment Practice by Site and Reliability Goal

Site	Reliability Goal	Deployment Practice
Data center(s), Headquarter(s)	99.998%	Dual MPLS, Internet backup
Regional office	99.99%	Single MPLS, Internet backup
Branch office	99.5%	Single MPLS
Small office/teleworker	98%	Internet VPN

Source: VMware SD-WAN by VeloCloud

Table 2. Next-generation Deployment Practice by Application Type and Reliability Goal

Application Type	Reliability Goal	Connection Type	Status
Video Telepresence	99.998%	Dual MPLS	✓
		Single MPLS	✗
		Dual Internet	✗
		VMware SD-WAN	✓
Voice	99.9%	Dual MPLS	✓
		Single MPLS	✓
		Dual Internet	✗
		VMware SD-WAN	✓
Business-critical apps (ERP)	99.9 – 99.99% (Varies by time)	Dual MPLS	✓
		Single MPLS	✗
		Dual Internet	✗
		VMware SD-WAN	✓
Email, web, file shares	99.9%	Dual MPLS	✓
		Single MPLS	✓
		Dual Internet	✓
		VMware SD-WAN	✓

Source: VMware SD-WAN by VeloCloud

Summarizing Tables 1 and 2, modern day collaboration applications such as telepresence, voice over IP, and business-critical applications like ERP demand higher levels of application reliability irrespective of where the application is consumed. With the current deployment practices, only data centers and corporate headquarters with at least dual MPLS can support these applications. Many of the branches fail to meet the reliability goals required to deploy these applications for end-user benefits. VMware SD-WAN with 99.998% reliability assurance can enable branches of any size with any type of connection to deliver all of the modern-day applications.

Network Infrastructure

The VMware SD-WAN approach eliminates a variety of legacy branch on-premises equipment with the VMware SD-WAN Edge appliance or virtualized network function (VNF) software, which are sold on an annual subscription basis. In a traditional environment, the initial capital and maintenance costs with legacy equipment are still significant, and can exceed $280,000, over three years.

The network infrastructure is composed of routers, layer 7 firewalls, WAN optimizers, and VPN devices, as well as data center head-end devices. With a new approach, this can be replaced by a predictable recurring cost of up to $42,500 per year that represents equipment at each branch and in hosted cloud services and only $127,500 over three years.

Additionally, this new architecture enables direct Internet access for connecting to SaaS-based and IaaS-based applications as compared to an architecture comprised of data-center-hosted applications. However, not all legacy applications hosted within data centers will disappear overnight, so there is a need to maintain network connections to the data center. VMware SD-WAN can be viewed as a cost avoidance and expansion containment solution to defer upgrades during migration to SaaS-based and IaaS-based applications.

The VMware SD-WAN solution offers interoperability with existing network infrastructure, so it does not require a wholesale conversion to use cloud-based apps, or for the entire branch network to use SD-WAN-based connections. A subset of branches may deploy the system, which enables an incremental upgrade.

Operational Expenses

The operational changes not only reduce OpEx budgets, but also affect the business by reducing friction and shifting to a zero-touch deployment branch model. In the example, the OpEx ICOM budget is eliminated altogether since the processes for maintaining branch hardware are replaced by VMware SD-WAN-based appliances and cloud-based services. This benefit is difficult to quantify yet constitutes important benefits that reduce the costs of network downtime, intermittent or degraded connections, and interruptions caused by dispatching troubleshooting staff. These effects may be substantial and can result in reduced productivity, as well as decreased customer and employee satisfaction.

Since savings can vary depending on telecom providers and bandwidth, consider the following categorized infrastructure costs as samples. The assumptions shown in Table 3 form the basis for our cost model.

- **Network connections:** MPLS costs are estimated to average about $600 per 3 Mbps in the US and Internet costs, such as cable broadband, are estimated as $75 for speeds of 15 Mbps down/5 Mbps up.

- **Network infrastructure:** Central head-end costs are $40,000 for two aggregation services routers in a data center to serve all branches. Per-branch costs might range from a router all the way to an appliance that provides router, firewall, WAN optimization, WAN path control, VPN, and annual support. We assume these branch devices are paid up front, including software licensing costs, and are followed by an annual support contract.

Table 3. Next-generation Deployment Practice by Application Type and Reliability Goal

| Branch network infrastructure	Quantity per location	Current model	Future model	Potential savings
Branch router	1	$1,400	0	$1400 upgrade eliminated
Branch router support contract per year	1	$400	0	$400 per year eliminated
Virtualization license used in a branch router (one-time cost)	1	$2,600	0	One-time cost eliminated
Total branch network infrastructure costs		$4,400		
VMware SD-WAN infrastructure cost	1		$850	Annual subscription
Bandwidth costs via MPLS	1	$600 (average) for MPLS	$150 for dual Internet at $75 for each 15 Mbps down/5 up connection	

Source: Enterprise Strategy Group

In the following two figures, we can see the comparisons of the cost structure in a three-year budget cycle. Recurring bandwidth costs are reduced, and the high upfront network infrastructure costs are replaced by a predictable subscription cost for a "branch-as-a-service."

Figure 4. Dual MPLS Only – Costs for a 50 Branch Deployment
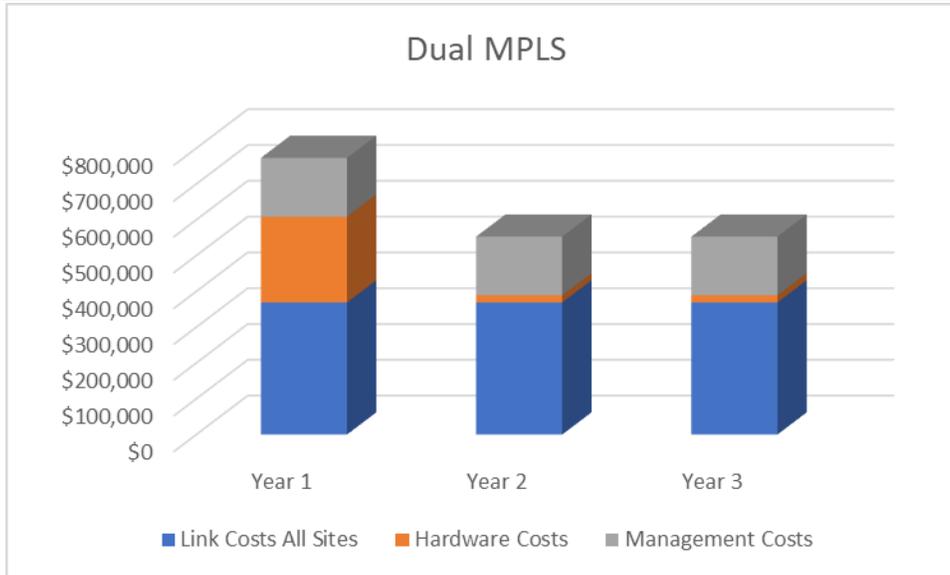
Source: VMware

Figure 5. Single MPLS, Dual Internet – Costs for a 50 Branch Deployment
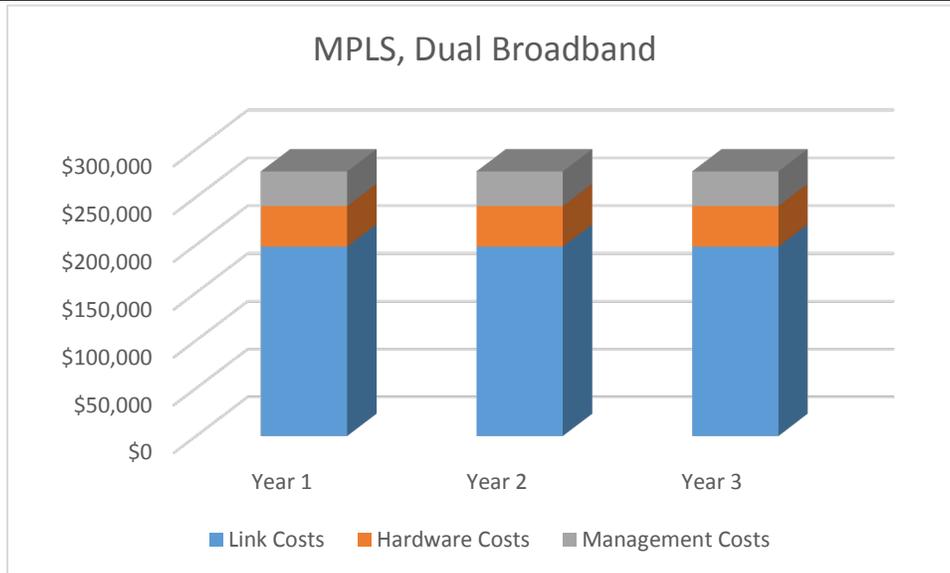
Source: VMware

How to Make a Transition?

Conventional Infrastructure—Choosing a Transition

In a conventional WAN, MPLS networks are provisioned, and additional bandwidth upgrades are purchased, as demand increases. MPLS networks in North America are typically provided at lower speeds on the branch side compared to broadband, and may range from 3 Mbps to 10 Mbps, which is the range we use in our analysis. WAN optimization may be

used to defer the trigger point when bandwidth upgrades are required but given the current trend increases in bandwidth usage, purchasing additional MPLS networks eventually becomes necessary. An enterprise that adopts a new SD-WAN architecture can reduce the recurring costs and slow the pace of bandwidth upgrades. But how and when an organization adopts these technologies depends on the existing infrastructure, and to some extent on how far along the organization is in existing contracts for MPLS networks. Canceling existing contracts may trigger early termination fees. Enterprises may be hesitant to adapt to new architectures as well, so it benefits them to go forward on incremental transition paths.

The benefit of the VMware SD-WAN architecture is that it works with what organizations have today and enables different forms of adoption based on individual needs. The deployment does not have to be a complete conversion of the network, as existing MPLS networks can continue to be used while alternatives are being examined.

The benefits resulting from SD-WAN fall into four general categories:

- **Device consolidation:** reducing multiple appliances in the branch and the data center.

- **Dynamic multipath optimization:** reducing bandwidth costs without performance degradation.

- **Centralized visibility into network performance, configuration, and status:** better awareness and control.

- **Troubleshooting improvements:** reducing truck rolls for deployment, configuration, and troubleshooting.

SD-WAN is most noted for the dynamic multipath cost savings since it reduces bandwidth service costs over the long term. These savings accumulate over time to provide the most visible and predictable form of cost reduction. However, the agility provided by zero-touch deployment and ability to leverage broadband or wireless connectivity enable organizations to rapidly turn up new sites. The benefits are provided for both central IT and the branch office, in the following budget categories:

- **Branch IT infrastructure CapEx savings:** Many branches house a variety of networking infrastructure hardware, including firewalls, VPN, or WAN optimization devices. Those may be eliminated since the VMware SD-WAN device includes similar functionality, making the WAN edge less complex.

- **Data center infrastructure CapEx savings:** The IT-maintained data center head-ends can be minimized or potentially eliminated by leveraging the network of VMware SD-WAN Gateways. This model requires no data center installs or changes to the network design. Redundancy, often deployed via MPLS High Availability, is included in the VMware SD-WAN Gateway cloud head-end, so there's no need for the customer to maintain it.

- **Branch OpEx savings:** Organizations can realize upfront savings in deployment time and troubleshooting efficiency by reducing truck rolls by leveraging VMware SD-WAN Orchestrator. Traditional methods require truck rolls for deployment and installation, as well as configuration changes. Configuration is not a one-time event and may be a recurring occurrence to modify VNF, link configuration, QoS, and security settings.

- **Data center OpEx savings:** As mentioned earlier, the architectural changes enable elimination or reduction in devices. Fewer devices mean fewer devices to maintain and troubleshoot, which reduces operational expenses. The reductions come from the hosting of virtual network functions (VNFs) within the VMware SD-WAN Edge appliances or virtual machines, which have integrated firewall and VPN functions. Many functions previously hosted within the enterprise data center are now hosted in the cloud. For example, VMware SD-WAN Gateway is cloud-delivered at a top tier data center, which eliminates gateway capacity within the data center, and is a service that is sold as part of the VMware SD-WAN subscription. Replacing IT-maintained hardware with a SaaS service reduces the installation OpEx on top of the data center CapEx. VMware SD-WAN Orchestrator provides install, configuration, and monitoring

functions. This simplifies management and training, as well as troubleshooting and coordination, since one vendor will provide them. VMware SD-WAN Orchestrator provides a single point of visibility for the network, applications, and security.

These changes together reduce the need for specialized IT staff on-premises or on-call to dispatch to branches. ESG believes that a branch office manager without IT training should be able to perform many tasks with VMware SD-WAN Edge appliance management automation. This eliminates truck rolls and enables the change in remote IT staffing to use less highly trained personnel.

Since dynamic multipathing provides the most clearly understood savings, we will provide details on other paths to SD-WAN adoption. The schedule may be aligned with a migration to a SaaS-based app infrastructure and the decommissioning of legacy data center applications.

SD-WAN Method—Different Paths to Adoption

- **Migrating to SaaS:** As organizations move more applications to SaaS, it is appropriate to re-architect network paths to optimize access to the cloud, as well as to the data center. This is accomplished by implementing VMware SD-WAN and utilizing the VMware SD-WAN Gateways to bifurcate traffic between the cloud and the data center as necessary. This will work for any location where the VMware SD-WAN Edge device is deployed and whether new network links are added.

- **New branch or starting afresh:** Organizations looking to add new branches can simply purchase two broadband links from two different Internet providers. There is no need to purchase an MPLS link and a router to connect it. This design works since VMware SD-WAN provides remediation and traffic steering—combining these networks via SD-WAN can provide enterprise-grade network service similar to an MPLS network. This is the least expensive solution.

- **Augment what you have:** Organizations that want to augment an existing branch's network with broadband Internet prior to the expiration of the existing MPLS network's contract agreement term can add the VMware SD-WAN and install the SD-WAN device behind the existing MPLS network router. This will improve service levels and eliminate the need to augment the MPLS network with another link. SD-WAN that combines MPLS and broadband provides the service quality needed by applications that are sensitive to network quality, such as VoIP or video conferencing. This choice also reduces the need to install WAN optimization to defer the MPLS network upgrade.

- **Contract expiration**: If the MPLS network contract is expiring, it's possible to treat the network as a new branch, or augment it, since there is no early termination of contract fee. Once the decision to go with SD-WAN is made, it's possible to terminate the MPLS contracts in other branch offices and convert them to broadband-only connections, or use a hybrid approach with a lower tier MPLS network.

Let's examine the scenario of starting with a branch office connected by a traditional three Mbps MPLS network, which may run out of capacity soon, but is still within contract. Given the limitations of the existing network, the enterprise is forced to choose a solution to procure additional bandwidth. We will focus on bandwidth costs in this case and assume the existing network infrastructure costs are the same.

Continue along with the status quo: Order additional MPLS network ports, simply expanding upon the existing path, and place the enterprise on a contract that extends a commitment further into the future. The network costs increase by two times, but this option preserves the per-Mbps cost.

Stage 1 SD-WAN: This is an incremental choice to augment the MPLS network with broadband and SD-WAN. The additional SD-WAN traffic is steered between MPLS and broadband links according to policies applied on the VMware SD-WAN Edge to provide business class service.

End of MPLS contract: The MPLS network contract ends, at which point there is a choice: either eliminate MPLS altogether and rely on broadband (skip to Stage 3) or perhaps reduce the MPLS network to a lower speed (move to Stage 2). Some companies see sufficient savings in skipping directly to Stage 2, even with contract termination fees. This is feasible if the IT group evaluates VMware SD-WAN in several sites, calculates the reduction in TCO, and determines the benefit of making the switch directly.

Stage 2: Continue using VMware SD-WAN, reduce the MPLS bandwidth tier, and perhaps add a single (or even dual) broadband link(s) to augment the total bandwidth at a lower cost.

Stage 3: Eliminate MPLS altogether and rely on SD-WAN based on broadband. Note that this method can offer the same reliability as a hybrid MPLS/Internet method. Other options include leveraging LTE or emerging 5G networks. These choices can be effective for locations that are poorly serviced by other options or for locations that need to be deployed rapidly.

Table 4 show how the Stage 3 infrastructure can handle over 13 times the traffic, with one-fourth the bandwidth cost. This provides headroom and expansion capability for additional demand. Using an MPLS and broadband combination immediately provides headroom to handle future demands at slightly higher bandwidth costs. Once one moves to Stage 3, the cost is now reduced, while the bandwidth is expanded.

Table 4. Adoption Stages and Bandwidth Costs

	MPLS network costs	Broadband costs	VMware SD-WAN monthly subscription (depends on Mbps usage)	Total	Cost per Mbps
Existing MPLS-only network	~ $600 for 3 Mbps network ports	N/A	N/A	$600 for 3 Mbps	$200
Stage 1: Expanded MPLS-only network	~ $1,200 for 2x 3 Mbps network ports	N/A	N/A	$1,200 for 6 Mbps	$200
Stage 2: VMware SD-WAN hybrid solution with 1 MPLS and 1 broadband	$600 for 3 Mbps network port	$75 for one 20 Mbps down/5 up broadband connection	$50*	$675 for 23 Mbps	$29
Stage3: VMware SD-WAN with two broadband networks	Use no MPLS network	$150 for two 20 Mbps broadband connections from two providers	$50*	$150 for 40 Mbps	$3.75

Source: Enterprise Strategy Group

*Illustrative cost for this example. Will vary with customer deployment.

Savings may be realized through other methods, such as the use of multiple DSL links, or combining 4G or emerging 5G wireless links (which are charged on bandwidth usage, as opposed to a fixed rate, which may lower effective monthly costs when usage is low). Many metropolitan areas offer a wide range of broadband networks, but some areas, particularly residential zones, may have limited choices.

It is important to note here that the availability of WAN bandwidth for the critical traffic is an important consideration. Unlike many other SD-WAN solutions that rely solely on the MPLS connection for critical traffic, the VMware SD-WAN solution assures MPLS-comparable SLAs on the Internet links to provide an aggregate bandwidth of 21.5 Mbps for critical traffic. In summary, the VMware SD-WAN solution provides increased bandwidth for critical traffic as though the customer upgraded their MPLS network by comparable capacity.

The WAN cost savings discussed cover only direct WAN circuit costs. VMware SD-WAN also provides IT operations savings and equipment capital expenditure savings. IT operations savings is achieved by eliminating or reducing on-site remote office or branch office visits by IT with zero-touch deployment and changes, enabling quick remote troubleshooting, and optionally eliminating the need to install devices in or reconfigure data center networks. With fixed IT staffing, the effort and hours saved can be reallocated toward other, perhaps more strategic, projects. The ability of SD-WAN to run on off-the-shelf x86 servers and enable the migration of network services from the branch to cloud or regional enterprise data centers can yield significant equipment expenditure savings as well.

The Bigger Truth

As application usage evolves, the WAN needs to evolve in response. Apps are moving to be hosted in the cloud by SaaS and IaaS vendors, and communication increasingly relies on VoIP and video conferencing, which require reliable and increasing network bandwidth. However, the WAN has continued to rely on MPLS networks for its quality, but the capabilities increasingly do not match the needs imposed by modern applications.

VMware SD-WAN provides a modern approach to providing network services to branch offices. It delivers benefits on multiple fronts: 1) more "private network-like" bandwidth at lower costs, 2) direct access to the Internet for SaaS apps, and 3) better visibility for operational simplicity and troubleshooting. The end result is an infrastructure that provides more than these economic benefits. It provides choice and flexibility.

The choice in network providers stems from the ability to mix and match networks into a unified environment. The flexibility comes from being able to add capacity in increments you choose, when you want to. Ultimately, it's an infrastructure that provides a combination of pure economic benefits and flexibility that helps organizations to operate their businesses for the long term.