2018 Guide to WAN Architecture and Design

Applying SDN and NFV at the WAN Edge

Part 1: State of the WAN

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Executive Summary

One of the goals of the 2018 Guide to WAN Architecture and Design (The Guide) is to discuss the state of WAN architecture and design with an emphasis on the current SD-WAN solutions. Another goal of The Guide is to provide insight into the emergence of solutions that leverage the key concepts of SDN and NFV to support all components of the WAN edge. Within The Guide these topics will be put into the context of the current state of the enterprise environment and the solutions being brought to market by industry-leading vendors.

A discussion of wide area networking is extremely timely for two reasons. One reason is that for most of the last fifteen years there has been little investment in the development of new WAN technologies and services. Hence, until recently there hadn't been a fundamentally new WAN technology or service introduced into the marketplace since the turn of the century. That situation began to change a couple of years ago with the introduction of a new class of WAN solution that is typically referred to as a Software Defined WAN (SD-WAN). Most of these SD-WAN solutions focus on providing connectivity between the users in a company's branch offices and the resources they need to access in both internal and external data centers.

A discussion of the WAN edge is also very timely. One reason for that is the burgeoning use of the Internet of Things (IoT). For example, Gartner has forecasted that 8.4 billion connected things will be in use worldwide by the end of 2017, up 31% from 2016, and that there will be 20.4 billion connected things by 2020. Another reason why a discussion of the WAN edge is timely is that several branch office solutions that leverage SDN and NFV are being brought to market. These solutions are often referred to as software defined branch office solutions (SD-Branch). While these solutions exhibit many similarities, there are many fundamental differences amongst the solutions.

The Guide will be published both in its entirety and in a serial fashion. This document is the first of the serial publications and it will focus on providing insight into the current state of the WAN, the status of SD-WAN adoption and the state of the branch office. This document contains the results of two surveys that were distributed in the March to August 2017 timeframe[1]. Throughout The Guide the network professionals who completed the survey will be referred to as The Survey Respondents. Where appropriate, the recent survey results will be compared to similar survey results that are contained in the 2017 Guide to WAN Architecture and Design.

The remaining sections of The Guide will be:
- Part 2: This section will discuss several considerations that network organizations need to keep in mind as they evaluate alternative SD-WAN and SD-Branch solutions. The goal of this discussion is to ensure that network organizations choose solutions that meet their current and near-term requirements and are future-proof to the maximum degree possible.
- Part 3: This section will discuss the ecosystem of WAN vendors and will present a profile of each of the sponsors of The Guide. This profile will focus on how the solutions fit into the overall ecosystem and the value add that the solution provides. Each profile will also contain some proof points that highlight the value add that the solution(s) provide.
- Complete copy: The final publication will consist of Parts 1 - 3 plus an executive summary.

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[1] In many cases the questions allowed for multiple answers and so the results often sum to more than 100%.

Background

Concerns with WAN Services

Network organizations currently make relatively little use of wired WAN services other than MPLS and the Internet. The concerns that network organizations have with those two WAN services are shown in **Table 1** in descending order of importance.

Table 1: Concerns with WAN Services	
Concerns with MPLS	**Concerns with the Internet**
Cost	Security
Uptime	Uptime
Latency	Latency
Lead time to implement new circuits	Cost
Security	Packet loss
Lead time to increase capacity on existing circuits	Lead time to increase capacity on existing circuits
Packet loss	Lead time to implement new circuits
Jitter	Jitter

Wireline services are not the only WAN services that have limitations. Some of the limitations that are associated with cellular services include:

- Variable signal coverage;
- Link setup latency;
- Constantly evolving specs; e.g., 3G, 4G, LTE, XLTE, 5G;
- Security;
- Effectively supporting multiple carriers at once.

Another concern was highlighted in The 2017 Guide to WAN Architecture and Design. As that document highlighted, only 13% of network organizations have all of the visibility they need to troubleshoot WAN-related performance problems while 20% of network organizations stated that the visibility they have is barely adequate.

State of the WAN

Factors Impacting the WAN

The Survey Respondents were presented with fifteen factors and asked to choose the three factors that would likely have the most impact on their WAN over the next twelve months. The factors that were the most important are shown in **Figure 1**.
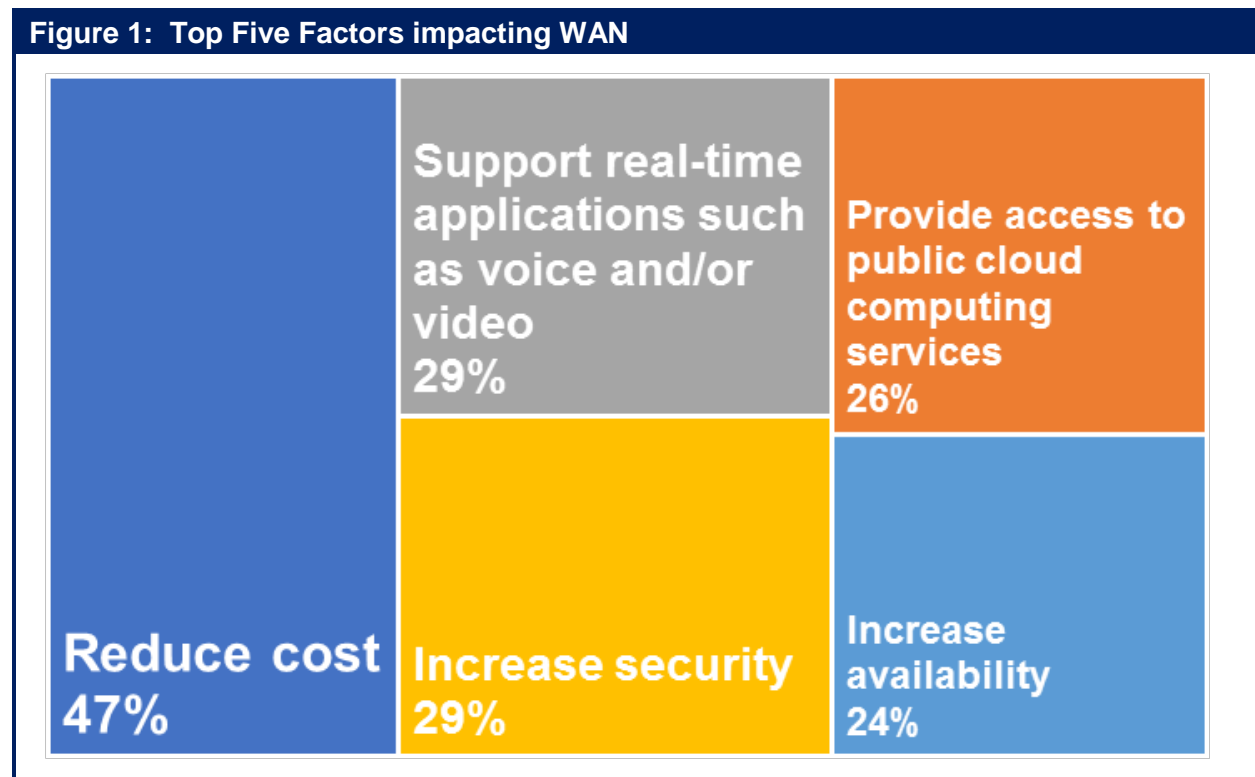

Figure 1: Top Five Factors impacting WAN

Figure 1 highlights the fact that WAN use cases have changed significantly since MPLS-based branch office WANs were first deployed roughly fifteen years ago. For example, fifteen years ago providing access to public cloud computing services was not a concern when architecting a WAN. Today it is one of the top concerns.

In addition, while not shown in **Figure 2**, thirteen percent of The Survey Respondents also indicated that supporting mobile users is one of the top factors impacting their WAN and twelve percent of The Survey Respondents indicated that supporting the IoT was one of the top factors impacting their WAN. These concerns were of little if any importance as recently as a few years ago.

Why is this important?	Given the pressure to support these new use cases, network organizations should evaluate WAN architectures in large part based on their ability to effectively provide access to public cloud computing services, support mobile workers and support the IoT.	✔

Satisfaction with the Current WAN Architecture

The Survey Respondents were asked to indicate how satisfied their organization was with their current WAN architecture. Their responses are shown in **Figure 2**.

Figure 2: Satisfaction with Current WAN Architecture
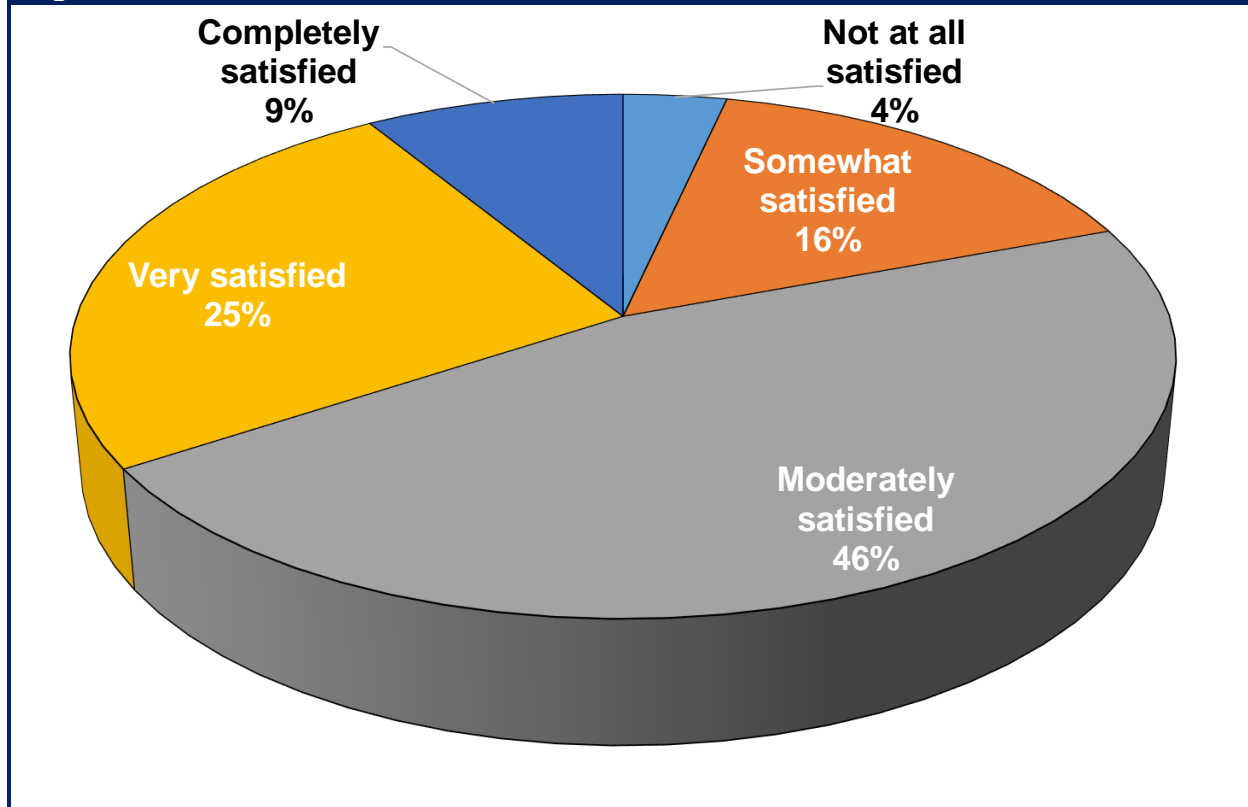
| Why is this important? | The fact that two thirds of network organizations are at best only moderately satisfied with their current WAN architecture indicates that a large portion of the WAN marketplace would likely be receptive to alternative WAN architectures. | ✔ |

Elements of a Successful Digital Transformation and the Role of SD-WAN

apcela

A network evolution is happening and at the heart are applications. Apps, once secured and accessed via enterprise data centers, are moving to the cloud at an accelerating pace and users have moved beyond enterprise firewalls, requiring remote access and mobility.

Enterprise IT is now distributed and apps are delivered across hybrid IT environments resulting in performance challenges and complexity. This fragmented landscape requires a new application delivery model – hybrid WAN – supporting an evolution in how applications are delivered, secured and managed to ensure optimal performance and end-user experience. However, to ensure speed, performance and security in this model, companies are turning to SD-WAN solutions to enhance and extend the key functions of their enterprise for a higher performing, next-generation, distributed IT infrastructure.

Hybrid IT at the Foundation

Hybrid IT, an enterprise approach that manages some IT resources in-house and uses cloud-based services for others is a reality. Previously, IT utilized public cloud computing for non-critical IT services such as development and test applications or for turnkey SaaS applications like web analytics. All of which could replace internal applications and enable access for a mobile workforce. Today, enterprises aggressively pursuing digital transformation are running behind cloud first mandates and deploying new applications as SaaS wherever practical. Additionally, public IaaS platforms are no longer the domain of development and test environments as enterprises re-factor and even re-architect legacy, mission-critical applications to run in public cloud environments.

To stay ahead of this accelerating transformation, network infrastructure must evolve as rapidly as the cloud environment. Unfortunately, many legacy enterprise network architectures cannot keep pace. Traditional enterprise network architectures are built around a hub-and-spoke, carrier MPLS network anchored on the legacy premises-based data center. These typically interconnect the business operations of the enterprise, including regional offices and branches - bringing all traffic back through the datacenter. Any users and traffic destined for the cloud, typically go through a centralized, security DMZ (demilitarized zone of firewalls and web gateways) in the datacenter. This worked in the past when applications were in the datacenter, but it's becoming obsolete. So, what is the solution?

Consider Hybrid WAN

Because the internet is critical to enterprise cloud connectivity, its performance is not consistent making it impossible to rely on for business and mission-critical applications. This is where hybrid WAN comes into play. Hybrid WAN leverages both internet and MPLS - meeting the requirements of broad and increasingly distributed application deployments. Hybrid WAN also keeps the MPLS network interconnected to the distributed enterprise operations and legacy applications in the enterprise datacenter and local internet connections. This allows direct transit to cloud-based applications and services without the latency and costs associated with bringing all traffic back through a centralized, security DMZ.

While a hybrid WAN architecture solves hybrid IT performance challenges, it poses security challenges. DMZs are centralized for easier management. This leaves enterprise IT managers with a potentially costly and complex alternative of deploying firewalls in front of every internet connection. This is why enterprises have turned to a software-defined WAN (SD-WAN), which in a hybrid WAN environment overcomes many of these challenges - with additional benefits. Most SD-WAN technologies include at least some basic firewall functionality such as packet filtering, while others include fully featured, next-generation firewalls.

Add SD-WAN for Success

A fully functional hybrid WAN includes a range of architectural enhancements built for true cloud interoperability that includes a high-performance core network, carrier-neutral commercial data centers and extensive interconnection with both SaaS and IaaS cloud platforms. The combination of hybrid WAN and SD-WAN enables users and traffic destined for more critical cloud applications to reduce reliance on the unpredictable performance of the public internet and makes the interconnection with cloud applications directly to the user. Carrier-neutral commercial datacenters also serve as distributed security points and when combined with SD-WAN, enterprises can deploy a number of smaller distributed security DMZs. SD-WAN provides a comprehensive, distributed security approach providing access to policies across the network. Additionally, to further reduce network costs, SD-WAN:
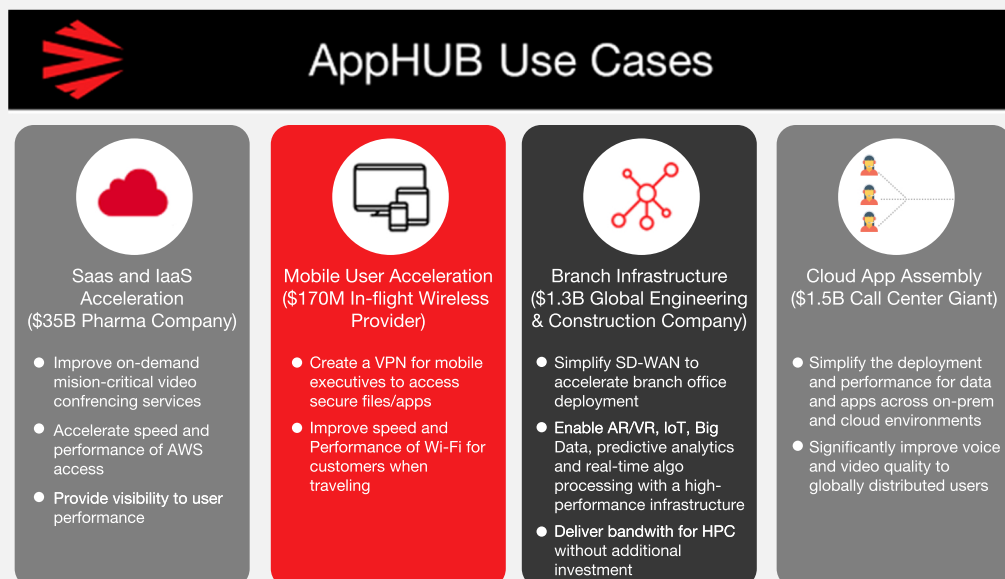
- ⬈ Addresses latency and capacity issues;
- ⬈ Provides an improved application performance – user location and application needs are not an issue;
- ⬈ Creates an automated and simplified network connecting multiple locations with one overlay; and
- ⬈ Offers telemetry that determines data traffic priorities.

Apcela, the high-performance application delivery company recognizes these three elements for a successful digital transformation. Apcela serves more than 100 of the Forbes Global 2000 including banks, exchanges, financial services and biopharma companies across 185 markets in 41 countries worldwide. Apcela enables enterprises to move to a cloud environment – keeping some of an organization's WAN and enhances and extends what companies already have with its AppHUB solution.

AppHUBs Enhance and Extend Key Functionalities with SD-WAN

AppHUBs are virtual datacenters deployed at network and cloud service provider-dense, carrier-neutral colocation facilities and datacenters. Built from colocation, network connectivity, hardware-optimized, virtualized network functions (VNFs) and hyper-converged compute and storage, each AppHUB is equipped with a complete network telemetry solution: AppMon. This ensures the underlay network and customer overlay networks meet SLAs. Additionally, AppHUBs' machine learning capabilities and run-over operating logs reduce the time-to-diagnosis for Apcela's NOC and in many cases, to the point where enterprises are unable to perceive an issue.

Enterprises can leverage computing capabilities with AppHUBs to eliminate bottlenecks in their networks, shorten the distance between edge locations and application hosting hubs, distribute security and improve overall performance of their WAN and application delivery platform. Apcela deploys SD router instances at each one of its AppHUBs to ingress- and egress-encrypted traffic to and from the AppHUB and network backbone. These instances are internet-connected, allowing enterprises to utilize Ethernet, DIA, broadband, or local access to securely connect to the WAN in the local AppHUB market. Additional AppHUB benefits include:

AppHUB Use Cases

Saas and IaaS Acceleration
($35B Pharma Company)
- Improve on-demand mision-critical video confrencing services
- Accelerate speed and performance of AWS access
- Provide visibility to user performance

Mobile User Acceleration
($170M In-flight Wireless Provider)
- Create a VPN for mobile executives to access secure files/apps
- Improve speed and Performance of Wi-Fi for customers when traveling

Branch Infrastructure
($1.3B Global Engineering & Construction Company)
- Simplify SD-WAN to accelerate branch office deployment
- Enable AR/VR, IoT, Big Data, predictive analytics and real-time algo processing with a high-performance infrastructure
- Deliver bandwith for HPC without additional investment

Cloud App Assembly
($1.5B Call Center Giant)
- Simplify the deployment and performance for data and apps across on-prem and cloud environments
- Significantly improve voice and video quality to globally distributed users

Distributed Security Extending across the Enterprise

AppHUB's suite of functions ensure security across its distributed system including:

● *Distributed Endpoint and Cloud Security:* Firewall, URL and file filtering, IDS/IPS, user Distributed Endpoint and Cloud Security: Firewall, URL and file filtering, IDS/IPS, user and application-based policies, malware detection and more.

● *Improved Performance:* By distributing firewalls closer to the edge, latency can reduced by more than 50%. VPNs can terminate closer to users and harness the low-latency backbone to move data across the WAN.

● *Latency Optimized Internet Routing:* AppHUBs include a network-based firewall with performance IP Internet. Performance IP leverages peering agreements with 6-12 ISPs and intelligently routes traffic to the ISP providing the best latency.

Network Connectivity for Best Performance

Carrier neutrality in an AppHUB facility ensures that WAN connectivity balances the best performance and best price. Carrier diversity ensures competition which drives carrier and path diversity as well as optimizes Apcela's opex for its underlay network infrastructure.

Cloud Gateways for Secure and Dedicated Connectivity

AppHUBs are Apcela's cloud gateways, offering secure and dedicated connectivity to the industry's leading cloud service providers like AWS, Google Cloud, Microsoft Azure and others. By leveraging the low-latency, core network connecting AppHUBs, along with Apcela's powerful telemetry tool AppMon, customer traffic can be routed to SaaS, IaaS and XaaS providers through the closest AppHUB location, lowering round-trip times and increasing application performance.

With innovation comes pitfalls. However, they can be avoided with these key elements: hybrid WAN, SD-WAN and with Apcela's AppHUB to ensure business and mission-critical applications function with the necessary speed and performance. No matter the location, company size, market or the amount of legacy infrastructure you have – AppHUB works to solve any issues you have moving to the cloud, while enabling growth for tomorrow.
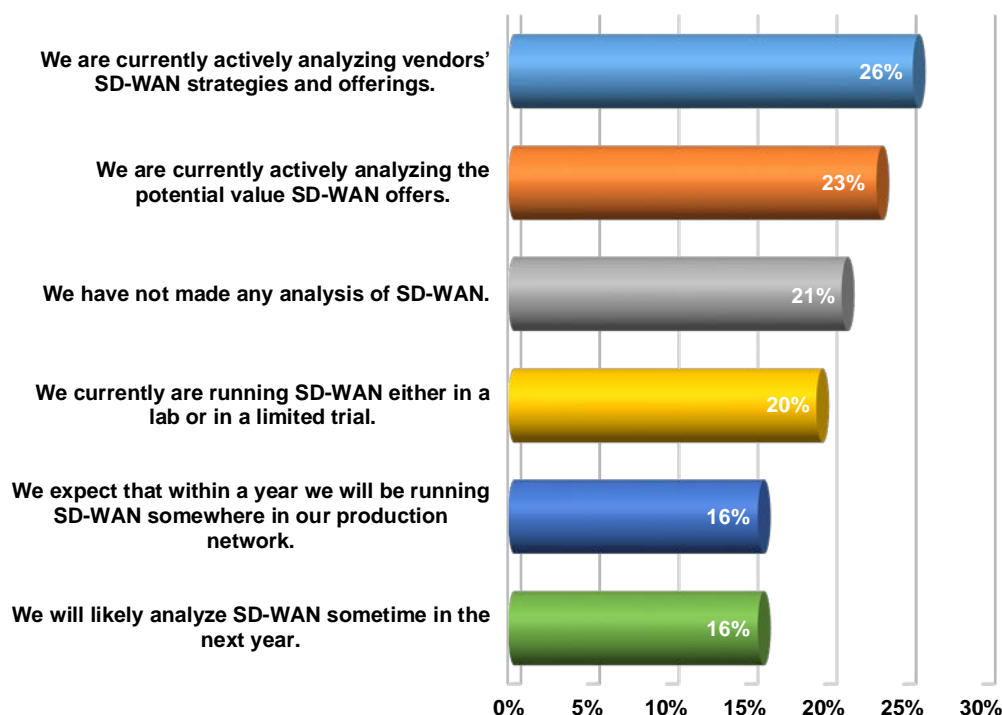
Software Defined WANs (SD-WANs)

Plans for Evaluating and Implementing SD-WANs

Figure 3 shows the six primary ways that network organizations are approaching SD-WAN adoption. The topic of how network organizations are approaching SD-WAN adoption was also analyzed in *The 2017 Guide to WAN Architecture and Design*. While the order has changed somewhat, the approaches shown in Figure 3 are the same approaches that bubbled to the top last year. In addition to the order, the relative popularity of each approach has also changed somewhat. Last year 17% of the respondents indicated that their organization was actively analyzing vendors's SD-WAN strategies and offerings This year that rose to 26%. Last year, 10% of respondents indicated that they expected that within a year that their organization would be running SD-WAN somewhere in their production network. This year that rose to 16%.

One of the most interesting changes in the year-over-year data doesn't show up in **Figure 3**. Last year, 5% of the respondents indicated that they were running SD-WAN functionality in their production network. This year that rose to 9%.

Figure 3: Primary SD-WAN Evaluation and Implementation Plans

We are currently actively analyzing vendors' SD-WAN strategies and offerings.	26%
We are currently actively analyzing the potential value SD-WAN offers.	23%
We have not made any analysis of SD-WAN.	21%
We currently are running SD-WAN either in a lab or in a limited trial.	20%
We expect that within a year we will be running SD-WAN somewhere in our production network.	16%
We will likely analyze SD-WAN sometime in the next year.	16%

Why is this important? The combination of the fact that year-over-year more organizations are running SD-WAN functionality in production, that more expect to put it into production within the next year and that more are actively analyzing vendor's SD-WAN strategies and offerings suggests that the adoption of SD-WANs will increase significantly over the next year.
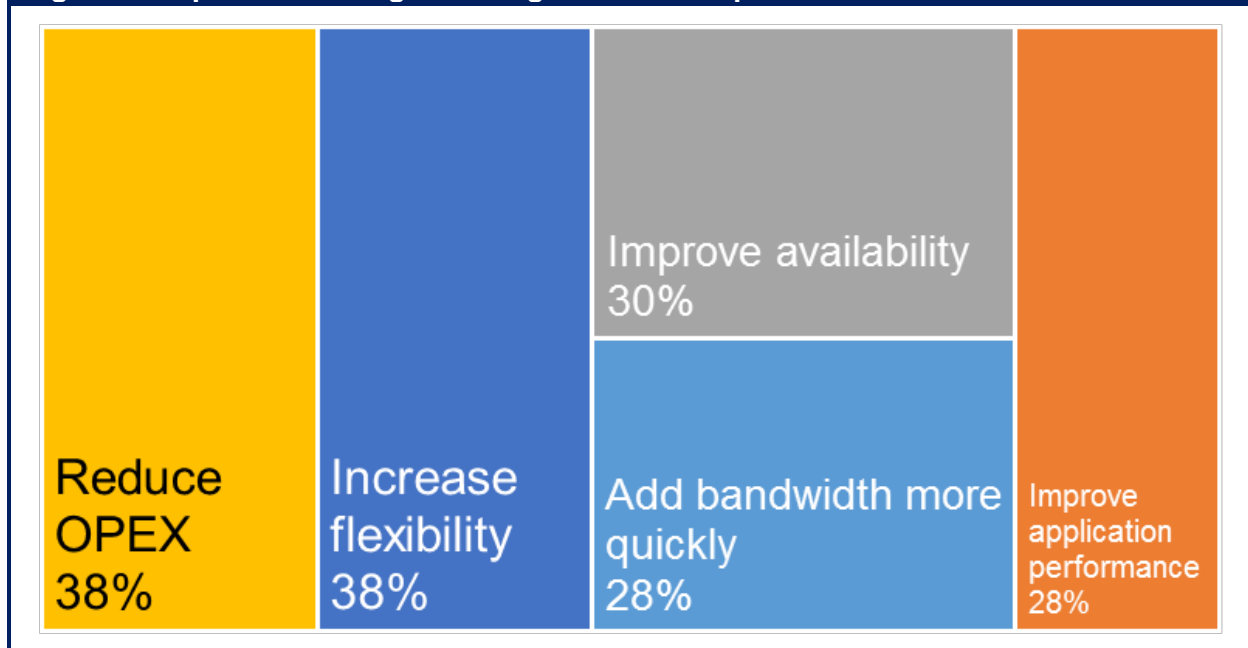
The Drivers of SD-WAN Adoption

The Survey Respondents were asked to indicate the three primary factors that would drive their company to implement an SD-WAN. The top five factors are shown in **Figure 4**.

The drivers and inhibitors of SD-WAN adoption were also analyzed in *The 2017 Guide to WAN Architecture and Design*. As shown in Figure 4, reducing OPEX and increasing flexibility are the two top factors currently driving SD-WAN adoption and these were the top two factors in last year's report. The biggest change in the top five factors year-over-year is that improve availability, which came in sixth last year, jumped up to third place in this year's survey and improve security, which came in fifth last year, dropped down to seventh.

Figure 4: Top five advantages driving SD-WAN adoption

| Reduce OPEX 38% | Increase flexibility 38% | Improve availability 30% | Improve application performance 28% |
| | | Add bandwidth more quickly 28% | |

Why is this important?	The fact that the perceived advantages of SD-WAN adoption match up so well with the primary factors currently impacting the WAN (**Figure 1**) indicates that at least at the conceptual level, SD-WANs are a very appropriate solution for most of the current and emerging WAN-related requirements.

The Future of SD-WAN. Today.

The WAN is Incompatible with Modern Enterprise

The migration to cloud applications and a mobile workforce is changing the shape of the business. The Wide Area Network (WAN) was built to connect and secure static, physical locations - not today's fluid and dynamic businesses. Enterprises pay the price of this incompatibility with expensive connectivity and convoluted topologies that are hard to manage and secure. Adding new locations, enabling secure internet access at remote locations and for mobile users, and optimizing network resources for cost and performance, all represent a growing challenge for most organizations. Traditional SD-WAN is offering flexible capacity and agility but persists the dependency on expensive MPLS connectivity and security appliance sprawl, and lacks optimized support for cloud resources and mobile users.

True WAN Transformation with Cato Networks

Cato Networks provides organizations with a global SD-WAN with SLA-backed backbone and built-in network security stack. The Cato Cloud reduces MPLS connectivity costs and branch office appliances footprint, provides direct secure internet access everywhere, and securely connects mobile users and cloud infrastructure into the enterprise network.

Secure And Optimized SD-WAN
Cato SD-WAN enables organizations to augment MPLS with affordable last mile services (Fiber, Broadband, 4G/LTE) and dynamically direct traffic based on applications needs and link quality. Unlike legacy SD-WAN solutions, Cato is uniquely capable to replace MPLS altogether with our global SLA-backed backbone.

Appliance Elimination
Cato eliminates branch office equipment such as UTMs, Firewalls and WAN optimization appliances. Cato protects all locations and users everywhere, without the need for unplanned hardware upgrades and resource-intensive software patches.
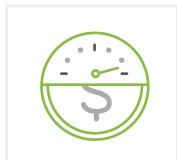
Affordable MPLS Alternative
Cato leverages cloud scalability, software-defined networking and smart utilization of a multi-carrier backbone to deliver a high performance and SLA-backed global WAN - at an affordable price.

Hybrid Cloud Network Integration
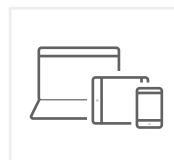Cato connects physical and cloud datacenters, across all providers and global regions, into a single, flat and secure network. Customers can seamlessly extend corporate access control and security policies to cloud resources, enabling easy and optimized access for mobile users and branch locations to all applications and data anywhere.

Secure Direct Internet Access
Cato connects all branch offices and remote locations to the Cato Cloud, providing enterprise-grade network security for any location without the need for dedicated appliances or traffic backhauling.

Mobile Workforce Secure Cloud Access
Cato connects every mobile user to the Cato Cloud and provides secure and optimized access to enterprise resources in physical and cloud datacenters, cloud applications and internet sites. Cato uses its global backbone to optimize routing and reduce latency to key applications like Office 365, and enforce application-aware security policies on all access.

Software-defined and Cloud-based Secure Enterprise Network

The Cato Cloud connects all locations, cloud resources and mobile users into an optimized and secure global SD-WAN. With both WAN and internet traffic, consolidated in the Cato Cloud, Cato applies a set of elastic and agile security services to protect access to enterprise applications and data, and protect users against Internet-borne threats.
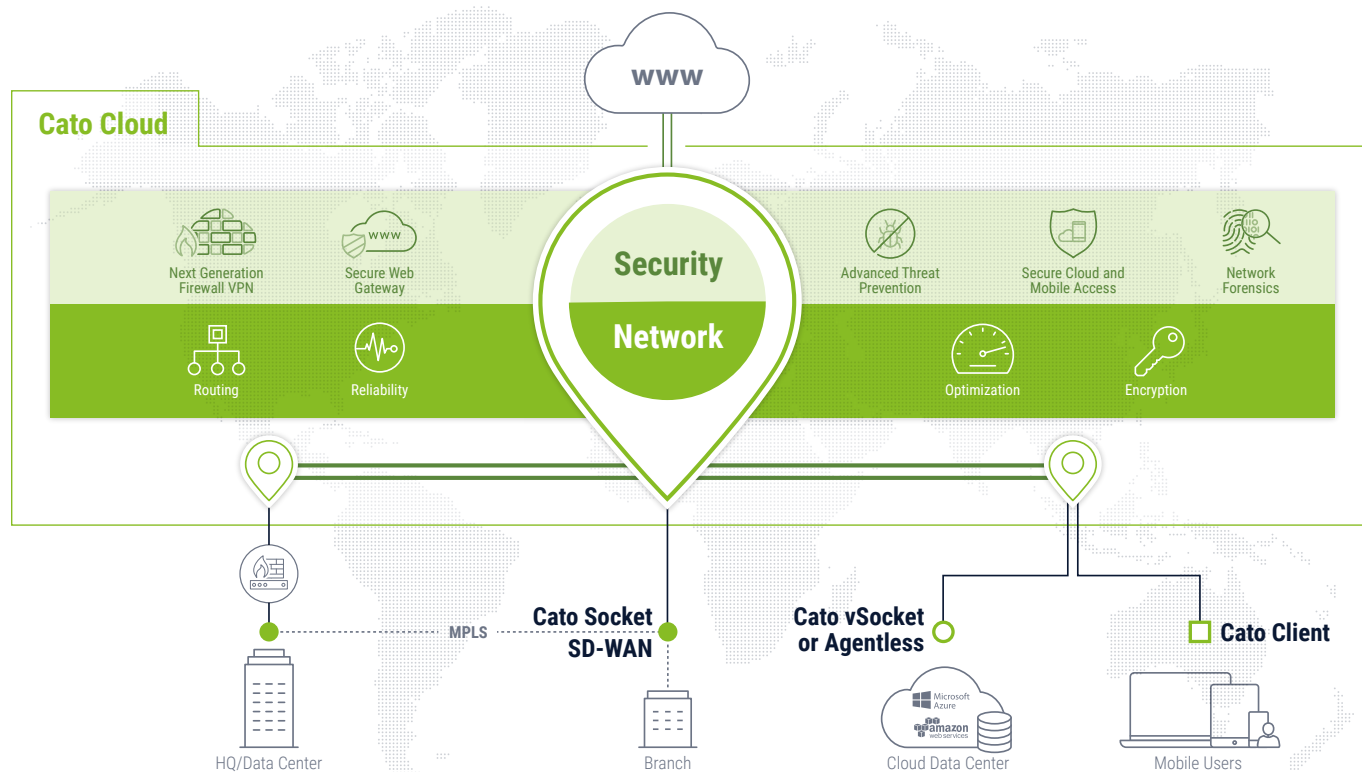
Cato Cloud Network

A global, geographically distributed, SLA-backed network of PoPs, interconnected by multiple tier-1 carriers. Enterprises connect to Cato over optimized and secured tunnels using any last mile transport (MPLS, cable, xDSL, 4G/LTE).

Cato Security Services

A fully managed suite of enterprise-grade and agile network security services, directly built into the network. The services have no capacity constraints and are continuously updated to introduce new capabilities and adapt to emerging threats.

From the Creators of Network Security

Shlomo Kramer
Co-Founder and CEO

Gur Shatz
Co-Founder and CTO

Cato Networks was founded by Shlomo Kramer and Gur Shatz. Kramer is one of the founding fathers of network security and one of the leading cybersecurity innovators of our times. He is best known for introducing the first firewall to the market as a co-founder of Check Point Software, and later the first web application firewall as a founder and CEO of Imperva. Shatz has engineered the Imperva SecureSphere platform and built DDoS protection service company, Incapsula.

For more information, visit www.CatoNetworks.com

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The Future of SD-WAN. Today.
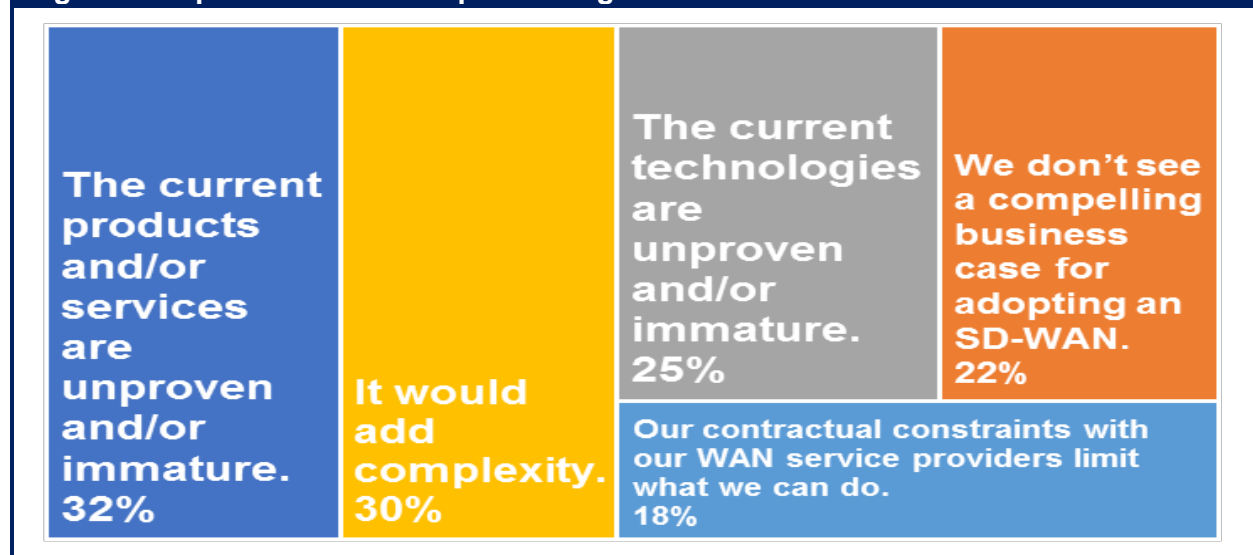
The Inhibitors to SD-WAN Adoption

In *The 2017 Guide to WAN Architecture and Design*, the top two inhibitors to SD-WAN deployment were that the current **technologies** are unproven and/or immature and that it would add complexity. These were followed by:

- We don't see a compelling business case for adopting an SD-WAN
- The current **products and/or services** are unproven and/or immature;
- It would increase CAPEX.

As shown in **Figure 5**, the top four inhibitors last year are the same at the top four inhibitors this year. One minor difference year-over-year in terms of the inhibitors is that concerns that an SD-WAN would increase CAPEX dropped out of fifth place and was replaced by concerns over contractual constraints.

A major difference year-over-year relative to the inhibitors to implementing an SD-WAN is that each of the inhibitors is less important this year than it was last year. For example, last year 37% of the respondents indicated that they didn't see a compelling business case for adopting an SD-WAN. This year that dropped to 22%.

Figure 5: Top 5 inhibitors to implementing an SD-WAN

The current products and/or services are unproven and/or immature. 32%

It would add complexity. 30%

The current technologies are unproven and/or immature. 25%

We don't see a compelling business case for adopting an SD-WAN. 22%

Our contractual constraints with our WAN service providers limit what we can do. 18%

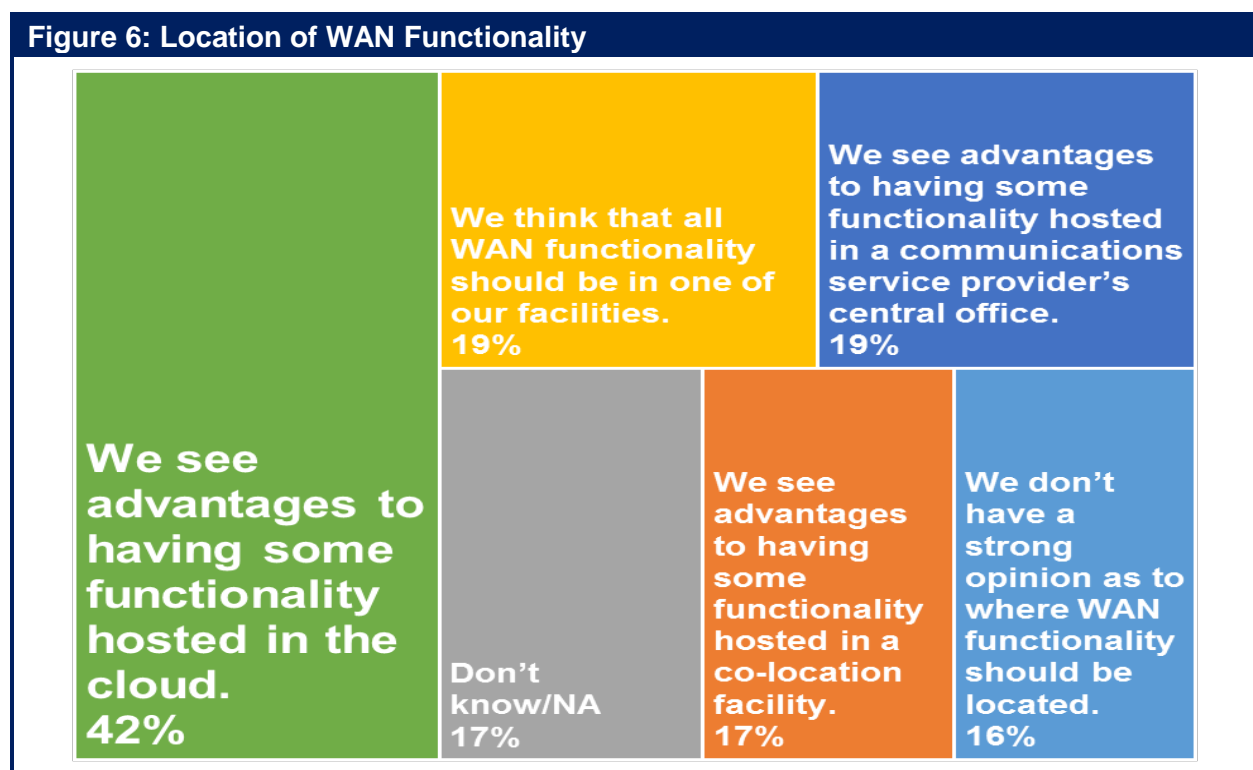| Why is this important?	The fact that each of the inhibitors to implementing an SD-WAN solution is less impactful than it was last year is an indicator that SD-WANs will soon be broadly adopted. However, if not resolved, the issue of complexity, which is raised again later in this document, could significantly hinder that adoption.

Preferred Location of WAN Functionality

In contrast to traditional WAN architectures in which most of the underlying functionality is hosted on premise, in the emerging WAN architectures there are several places to host functionality such as orchestration, control and security. Those locations include:

- At the customer's branch offices;
- In a service provider's central office;
- At the customer's regional office or data centers;
- At a co-location facility;
- At a public cloud provider's facility.

The Survey Respondents were asked to indicate where their organization thinks that WAN functionality such as control, optimization and security should be located. Their responses are shown in **Figure 6**.

Figure 6: Location of WAN Functionality

We see advantages to having some functionality hosted in the cloud. **42%**

We think that all WAN functionality should be in one of our facilities. **19%**

We see advantages to having some functionality hosted in a communications service provider's central office. **19%**

Don't know/NA **17%**

We see advantages to having some functionality hosted in a co-location facility. **17%**

We don't have a strong opinion as to where WAN functionality should be located. **16%**

| **Why is this important?** | There is a shift underway in terms of how network organizations are thinking about WAN architecture. One characteristic of that shift is that the interest in housing all WAN functionality onsite is relatively low. Another characteristic is that the interest in housing at least some WAN functionality in the cloud is very high. | ✔ |

Choice of Implementation Options

When network organizations evaluate new WAN solutions they have a variety of implementation options to consider. This includes:

- Do-it-Yourself (DIY)

  In this option, network organizations perform all facets of the lifecycle of a WAN solution; i.e., the planning, designing, implementing and ongoing management of the solution.

- Managed Service

  In this option a 3rd party takes on the responsibility for all facets of the lifecycle of a WAN solution.

- Network-as-a-Service (NaaS)

  Numerous Communications Service Providers (CSPs) have either already launched or have announced their intention to launch a NaaS offering based on SDN and/or NFV.

The Survey Respondents were asked to indicate which implementation option their organization was most likely to implement. Their choices are shown in **Figure 7**.

Figure 7: Location of WAN Functionality
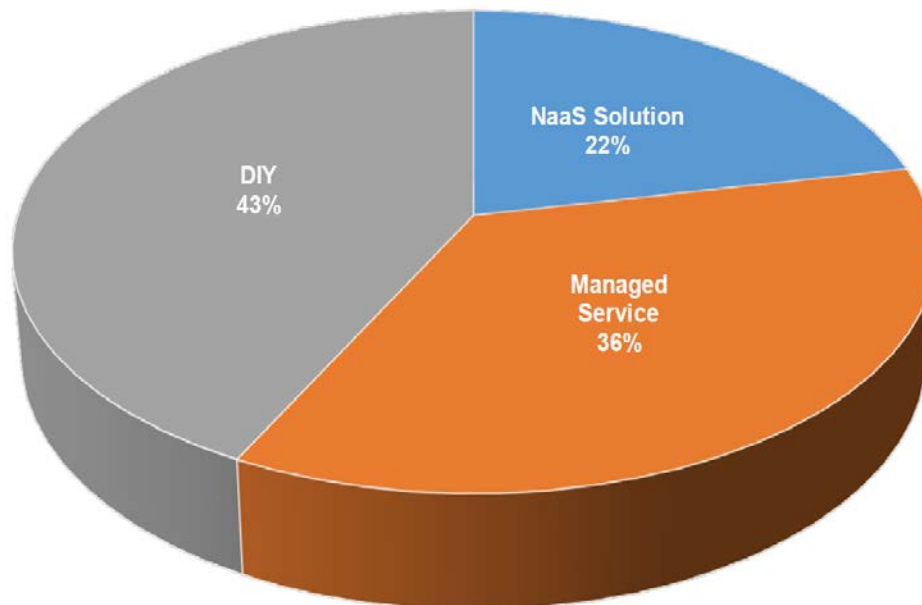
Why is this important?	One way to look at the survey results is to conclude that the DIY option is the preferred option. Another way to look at the survey results is to observe that a solution provided by a 3rd party, whether that is a managed service provider or a NaaS provider, is preferred over the DIY option by a wide margin.

Choice of Vendors

After more than a decade with little change in the available WAN products and services, the last few years has seen the emergence of a broad range of new WAN-related products and services from tens of vendors, many of them new to the WAN market. Whenever there is a transition point in IT, such as the one that exists now in the WAN market, there is the potential that some vendors will gain market share and that some will lose market share.

The Survey Respondents were asked to indicate how their organization would likely approach the selection of a WAN vendor. Their responses are shown in **Figure 8**.

Figure 8: Interest in Looking for New Vendors

We will actively look for alternative vendors. 33%

It is likely that we will stick with our incumbent vendor(s). 20%

We will put a moderate amount of effort into looking for alternative vendors. 11%

We will put a somewhat modest amount of effort into looking for alternative vendors. 10%

It is highly likely that we will stick with our incumbent vendor(s). 9%

Why is this important?	The fact that so many network organizations are willing to explore alternative vendors puts pressure on the incumbent vendors and makes it unlikely that the market will converge onto a small number of providers in the short term.

cradlepoint

Elastic Edge: Pervasive Connectivity for People, Places & Things

Software-Defined Branch

Cradlepoint's all-in-one branch network solutions are ideally suited for "Lean IT" organizations that demand business-critical 4G LTE connectivity. Powered by Cradlepoint NetCloud software and services, these solutions combine SD-WAN functionality with integrated WiFi, Ethernet switching with PoE support, advanced edge security, and multiple 4G LTE modems in a single platform. The entire branch network can be deployed, controlled and managed from a single of pane of glass in the cloud.
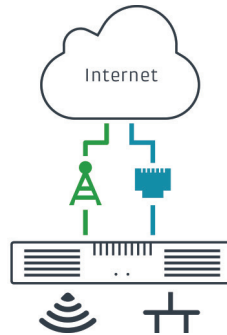
Feature Highlight: NetCloud SD-WAN functionality is optimized for LTE-dependent networks and utilizes a unique Active-Dynamic traffic steering algorithm that provides complete, policy-based control over hybrid WANs that include multiple 4G LTE connections. It can select the optimal path across any wired or wireless link based on a combination of signal strength, latency, jitter, service, carrier preference, and data plan consumption.

Cutting the Wire: LTE-Optimized SD-WAN

For highly distributed networks such as rural convenience stores and insurance offices, there are few options for reliable broadband. Even if wired options exist, building a nationwide network often requires stitching together more than 100 Internet Service Providers. In contrast, cellular networks provide pervasive, high-speed broadband data to cities and towns of all sizes, enabling a nationwide WAN with just a few providers. Cradlepoint leads the market in 4G LTE technology, from narrow-band IoT solutions to providing a pathway to gigabit LTE and 5G. Cradlepoint branch solutions have integrated software-defined modems supporting advanced capabilities offered by cellular providers.
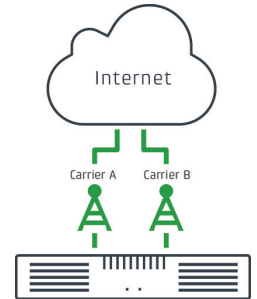
Feature Highlight: Cradlepoint branch routers accommodate two LTE modems and up to four carrier SIMs. NetCloud Manager lets customers centrally configure Smart WAN Selection and perform zero-touch deployments.

SD-WAN on Wheels

Many organizations—first responders, disaster response teams, mass transit, school districts, and more—rely on in-vehicle networks to serve their customers or the public. These mobile networks require a wireless WAN that delivers high availability, advanced security, and optimal application performance on the move.
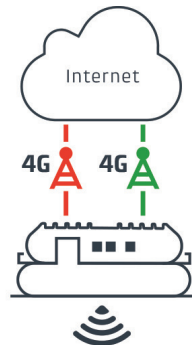
Cradlepoint delivers the SD-WAN capabilities of its NetCloud platform in a ruggedized mobile router that combines multiple 4G LTE modems, WiFi, advanced edge security, GPS tracking, and telemetry integration—keeping vehicles, and the people and things in them, connected and protected.

Feature Highlight: Cradlepoint is the only SD-WAN mobile router that supports FirstNet, the private 4G LTE network for first responders. Policy-based Active-Dynamic traffic steering delivers persistent application sessions during cellular disruptions, and can intelligently steer applications between FirstNet and commercial LTE.

Connected & Protected IoT Devices

The news of Reaper and Mirai botnet attacks affecting millions of IoT devices illustrates the ever-increasing WAN vulnerabilities of IoT deployments. Cradlepoint, a global leader in 4G LTE routers for M2M/IoT networks, is the only vendor to integrate Software-defined Perimeter (SD-P) technology to provide perimeter security, a private IP overlay for Internet and enterprise WAN isolation, and micro-segmentation. Enterprises use NetCloud to orchestrate and deploy—in minutes—secure overlays for M2M/IoT devices anywhere, with no configuration or Internet-routable IP addressing required.
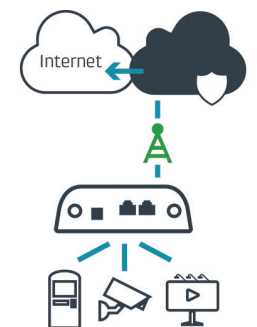
Feature Highlight: Cradlepoint's NetCloud Perimeter (NCP) feature is available on M2M and branch routers, enabling SD-P overlays that connect and protect M2/IoT devices in the branch or in the field. The NCP Client extends SD-P functionality to remote workforces that require secure access to Intranet and public cloud applications from laptops, tablets, or smartphones.

Stories of Software-Defined Networking in the Branch & Beyond

Stores Optimize Connectivity With SD-WAN

For its rapidly expanding restaurant chain, The Copper Cellar needed more flexibility, less hardware, better WAN uptime, and the ability to manage everything through the cloud.

The Copper Cellar streamlined its branches with Cradlepoint's SD-WAN solution, including a dual-modem router with wired broadband set up as the primary link and 4G LTE for failover.

Cradlepoint's NetCloud platform provides zero-touch deployment, single-pane-of-glass management, and SD-WAN services for optimized path selection. The IT team easily sets up business-based policies that seamlessly move traffic such as voice and video to the best-performing link.

Remote Sites Use LTE as Primary WAN

Professional Contract Services Inc. (PCSI) needed connectivity for its offices located in areas without access to wired WAN. With Cradlepoint's NetCloud Manager (NCM) and routers, PCSI's small IT team provides connectivity quickly and cost-effectively — with limited man-hours and simplified configuration, deployment, and remote management.

The IT team configures its routers at headquarters through NCM's single-pane-of-glass platform, then later can push out firmware upgrades, security patches, and other updates instantly.

"I was overwhelmingly impressed with how simple, quick, and easy it was to deploy Cradlepoint solutions," said Nathan Matarazzo, *systems analyst at PCSI.*

Cities Use SD-WAN in Police Vehicles

In major U.S. cities, police departments often face unreliable connectivity and insufficient bandwidth for their high-tech cruisers. With Cradlepoint's cloud-managed in-vehicle routers and extensibility docks with SD-WAN capabilities, officers are always connected to critical information and applications in the field.

This dual-modem SD-WAN solution enables cellular-to-cellular failover when a connection drops and dynamic traffic steering when it deteriorates. IT teams also can push out updates through the cloud rather than bringing each vehicle to headquarters.

Additionally, four-nines uptime enables officers to file report from anywhere instead of at the office, which improves incident response times.

Stores Protect IoT With Secure Perimeter

Many large retail and restaurant chains are installing video surveillance cameras to monitor employee and guest activity. However, without cloud access to their DVR systems, these enterprises lack PCI-compliant options for real-time monitoring.

IT teams address their IoT connectivity and security needs with cloud-managed Cradlepoint routers and NetCloud Perimeter (NCP), which enables a Virtual Cloud Network to be created in minutes. With NCP running on every router and on each manager's mobile device, a Software-defined Perimeter is established. With its own cloud-based network attached to a devoted VLAN, end-to-end encryption keeps data protected.
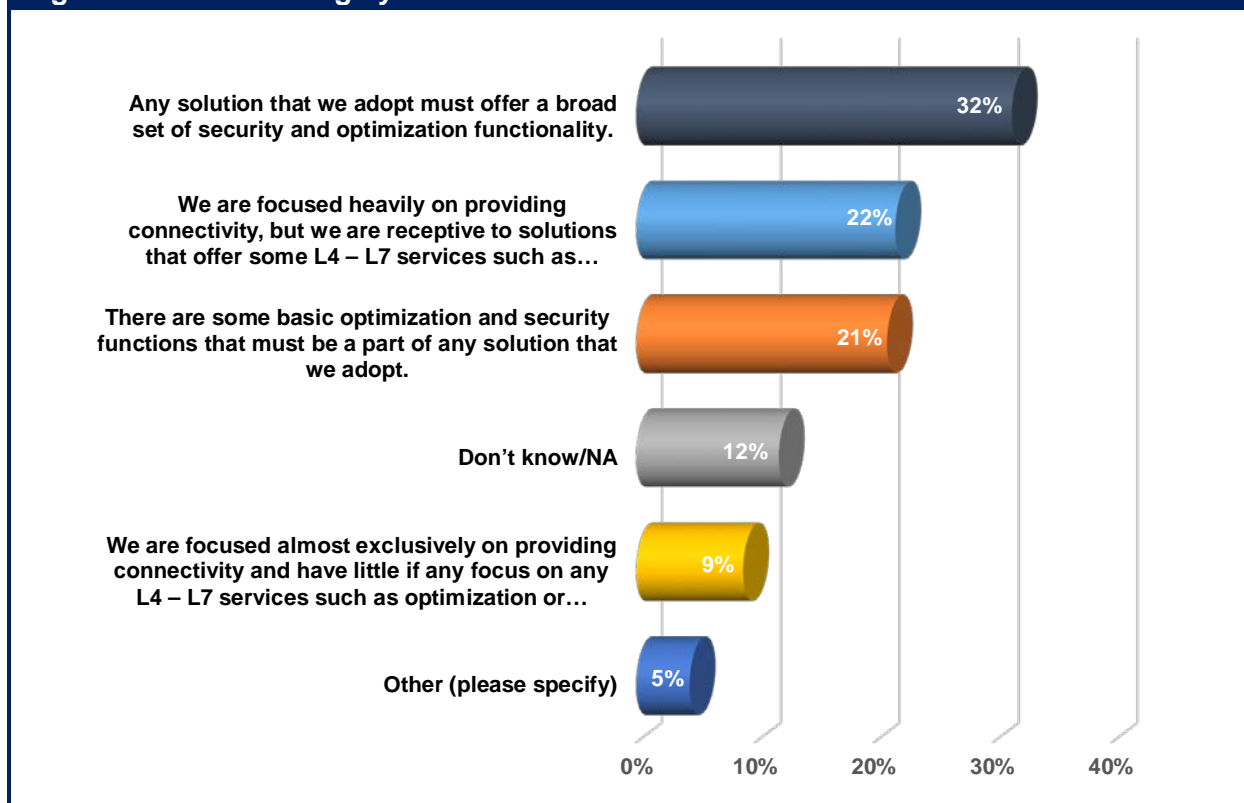
LEARN MORE ABOUT NEXT-GENERATION ELASTIC WAN CONNECTIVITY: **CRADLEPOINT.COM/ELASTIC-WAN**

cradlepoint

Desired Functionality

Most of the initial SD-WAN solutions focused very heavily on providing low cost WAN connectivity. For many providers, that focus has expanded over time by the provider adding more functionality either on their own or through partnerships.

The Survey Respondents were asked to indicate their interest in SD-WAN solutions that offered a range of L4 – L7 functionality. As shown in **Figure 9**, in the current environment, companies are more likely than not to want the SD-WAN solution they implement to have at least some basic optimization and security functionality.

Figure 9: Interest in Highly Functional SD-WANs

Category	Percentage
Any solution that we adopt must offer a broad set of security and optimization functionality.	32%
We are focused heavily on providing connectivity, but we are receptive to solutions that offer some L4 – L7 services such as…	22%
There are some basic optimization and security functions that must be a part of any solution that we adopt.	21%
Don't know/NA	12%
We are focused almost exclusively on providing connectivity and have little if any focus on any L4 – L7 services such as optimization or…	9%
Other (please specify)	5%

The survey question focused on functionality such as optimization and security. Another alternative was raised by one of the respondents who wrote in that his/her organization was focused on solutions which provide application performance visibility and management.
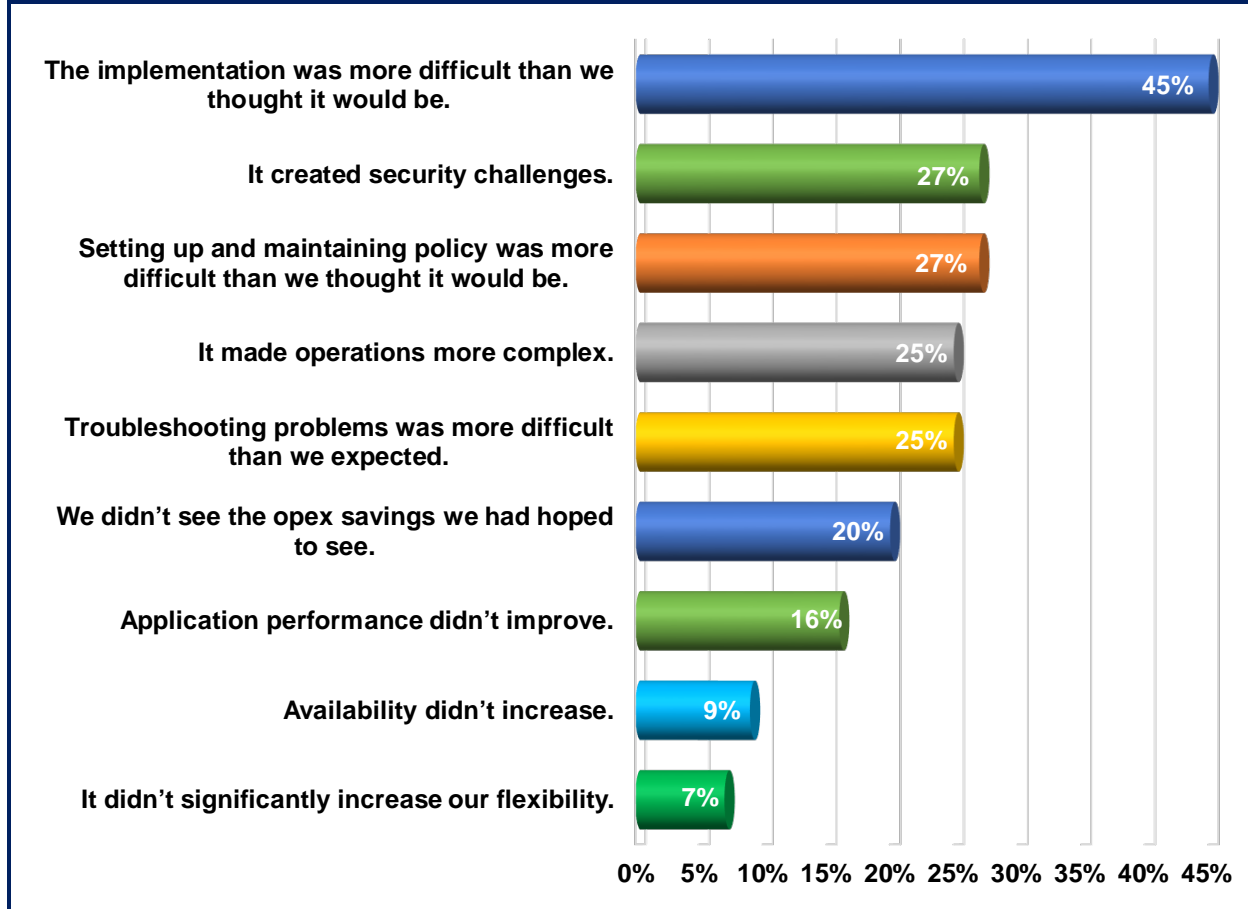
Why is this important?	Given how competitive the SD-WAN marketplace is, the strong interest that network organizations have in SD-WAN solutions that feature L4 – L7 functionality is likely to cause a virtuous cycle in which future SD-WAN solutions feature increasing amounts of higher level functionality. This raises two possibilities. One possibility is that SD-WAN solutions will become the basis of next generation branch office solutions. The other possibility is that SD-WANs will become just one feature of a next generation branch office solution.

Primary Deployment Issues

The Survey Respondents were asked to indicate the issues their organization experienced when they either conducted a POC of an SD-WAN solution or implemented a solution in their production WAN. Their responses are shown in **Figure 10.**

Figure 10: Issues in Initial SD-WAN Deployments

Issue	Percentage
The implementation was more difficult than we thought it would be.	45%
It created security challenges.	27%
Setting up and maintaining policy was more difficult than we thought it would be.	27%
It made operations more complex.	25%
Troubleshooting problems was more difficult than we expected.	25%
We didn't see the opex savings we had hoped to see.	20%
Application performance didn't improve.	16%
Availability didn't increase.	9%
It didn't significantly increase our flexibility.	7%

Some of the respondents also wrote in issues that were not included in the survey question. The two issues that were mentioned the most were:

- Integrating an SD-WAN solution with the existing WAN during the transition is very complex.
- Implementing an SD-WAN changes how operations are performed and changing how people work is a complex task.

Why is this important?	Knowing the issues that the early adopters have experienced should help network organizations anticipate those issues and hence either eliminate or minimize their impact. Unfortunately, **Figure 10** supports the previously stated belief that at least some of the current SD-WAN solutions are highly complex to implement and manage.

We're Ready When You Are

Dell EMC is ready to provide turn-key hardware and software solutions designed to simplify and accelerate production-ready SD-WAN deployments and services, with a choice of SD-WAN software from Versa Networks, Silver Peak, or VeloCloud.

Introducing Dell EMC SD-WAN Ready Nodes

At Dell EMC, we view SD-WAN as a critical and necessary component for Digital Transformation. For Service Providers, SD-WAN represents an opportunity for creating new services, accelerating time-to-revenue and increasing service agility. For enterprises large and small, SD-WAN represents an opportunity to lower cloud connectivity costs, while also optimizing WAN traffic patterns and usage. Dell EMC has double down on strategy of open and verified solution choices, to build SD-WAN for production, by offering validated product options for SD-WAN services, that is built upon the industry's foremost virtualization infrastructure, and hardware platforms.

We're meeting this need with a family of Ready Node offerings, designed for Service Providers and Enterprises alike intended to simplify and accelerate SD-WAN adoption. At the heart of our Ready Nodes are validated, pre-tested solutions comprising of Dell EMC compute platforms and industry leading SD-WAN software offerings from Silver Peak, Versa Networks, and VeloCloud. Included in the Ready Node offerings are Bill of Materials (BOM), partner software SKUs for the appropriate use-cases, pre-installed drivers and firmware settings.

The choice of multiple ready node hardware platforms provides maximum deployment flexibility for large, medium or small environments. Moreover, multiple SD-WAN partners furthers that flexibility by supporting many use cases.

24 x 1.8" configuration

PowerEdge - R640/R740

- 2S Intel Xeon E5-2600 v4 processors (22 cores max/ CPU)
- QAT option via PCIe
- BIOS, BMC for OOB, Internal PSU
- 18" + Depth
- TPM, SSD, NVMe SSD
- Up to 64GB memory ECC DDR4
- Multiple IO and expansion options; 2x PCIe lanes
- LTE available via USB/PCIe
- Up to 100G NICs available

PowerEdge R330/R430

- Single/Dual Socket Intel Xeon E5-2600 v4 processors
- QAT option via PCIe
- BIOS, BMC for OOB, Internal PSU
- 15" + Depth
- TPM, SSD, NVMe SSD
- 12 x DIMM slots supporting DDR4
- 2 x PCIe Gen3 I/O slots (half-length, low profile)
- 4 x 1GbE LOMs
- LTE option available

PC 5000

- Client Atom Intel chipset up to 4 Cores
- Dell BIOS and Intel vPro on select SKUs
- 9.5" x 10.5" x 4.2" (WXHXD)
- 4GB – 16 GB RAM DDR4
- 5x USB, 2 x 1 G and 2 PCIe x8.
- Mobile Broadband/WWAN (3G or LTE) WLAN
- TPM, SSD, external PSU

Figure 1. Dell EMC SD-WAN Ready Nodes

SD-WAN Ready Node use-cases

Service Providers can add new profitable managed services (e.g., cloud-managed SD-WAN or SD-Security service), and reduce their time-to-revenue for these new services.   Communications Service Providers, for example, can improve their competitive advantage by offering a hybrid WAN allowing current customers to add managed internet bandwidth to their branches, particularly for less critical traffic flows. Managed Service Providers can generate new revenue streams by adding Managed SD-WAN services; and can further benefit in productivity improvements with features such as zero touch provisioning.

Enterprises can choose to deploy a do-it-youself on-premise SD-WAN, using the Dell EMC SD-WAN Ready Nodes. Enterprises can benefit with lower capital and operating costs, by leveraging lower-cost broadband connections and improving application performance, through intelligent route selection.
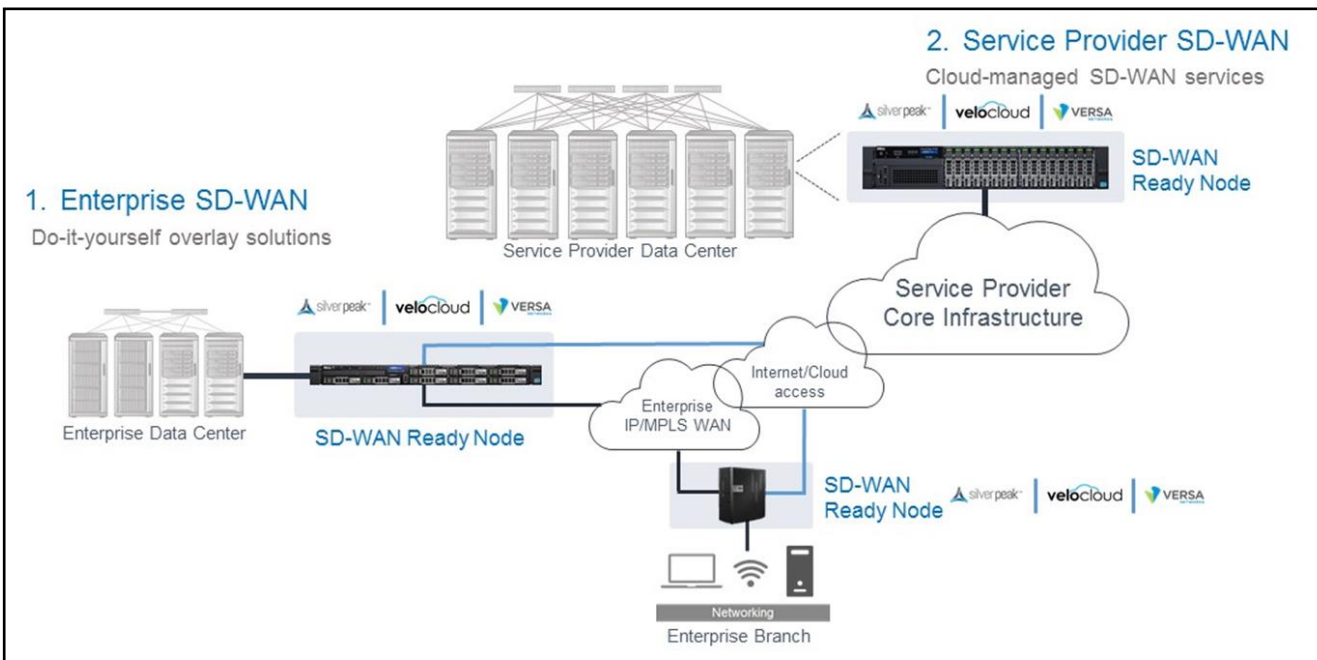

Figure 2. Dell EMC SD-WAN Ready Node use-cases

Take the next step
Contact your Dell EMC, Silver Peak, VeloCloud or Versa Networks representative to learn more about SD-WAN Read Nodes from Dell EMC.

Learn more about Dell EMC SD-WAN Solutions

Contact a Dell EMC Expert

D∈LLEMC | (intel)

State of the Branch Office

Current Deployment of Servers and Appliances

The Survey Respondents were asked to indicate how many physical servers, virtual machines, physical appliances and virtual appliances there are in one of their company's mid-sized branch offices. Their responses are shown in **Table 2**.

Table 2: Presence of Servers and Appliances in a Medium Sized Branch Office	None	1 or 2	3 or 4	5 or 6	7 or 8	9 or more
Physical servers	23%	45%	11%	8%	3%	9%
VMs	40%	21%	10%	10%	9%	10%
Physical appliances	17%	45%	14%	10%	2%	11%
Virtual appliances	55%	20%	8%	5%	4%	8%

Table 2 indicates that the vast majority of companies have at least one server and one physical appliance in each mid-sized branch office. It also indicates that roughly one third of companies have 3 or more servers in each of their mid-sized branch offices and a slightly higher percentage has 3 or more physical appliances in each of their mid-sized branch offices. It is reasonable to expect that there are more servers and appliances in large-sized branch offices.

| Why is this important?	The data indicates that there is a lot of distributed IT hardware that currently must be implemented and managed. The amount of distributed IT hardware is a measure of the possible operational and financial gains that could be made through the virtualization and consolidation of branch office functionality.

SD-WAN SOLUTION OVERVIEW

Talari Networks, SD-WAN technology innovator, is engineering the internet and branch for maximum business impact by delivering a Failsafe Software Defined WAN (SD-WAN) solution that offers increased capacity, improved reliability, higher quality of experience while lowering costs. Talari's solution also enables a secure and consolidated branch infrastructure which delivers application and service deployment flexibility, without sacrificing availability or performance.

With the explosive growth in real time applications, distributed workforces and cloud computing, a company's productivity and customer responsiveness have never been more dependent on the WAN infrastructure. Because of this, organizations are turning their focus to their wide areas networks (WANs) and cloud access networks, knowing that having enough bandwidth to support the increased demand and predictable reliability to ensure continuous application availability are keys to their success.

The cloud is rapidly changing demands on enterprise IT legacy resources. The traditional WAN deployment of the last decade - MPLS circuits and enabling devices, often augmented by separate WAN-Op and firewall equipment - no longer offer enterprise IT the necessary requirements for cost savings, flexibility, bandwidth, manageability and streamlined cloud connectivity. Talari's failsafe WAN offers organizations the unique combination of availability, performance and reliability, yielding a highly resilient remote site with platinum application Quality of Experience.
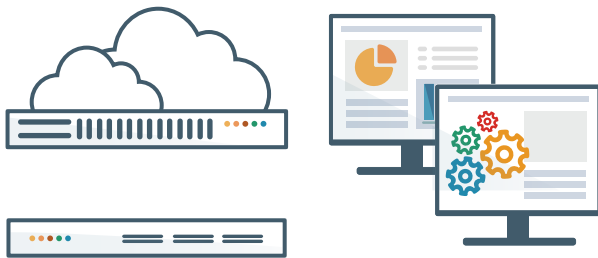
Talari Solution Components

A Talari Networks Software Defined WAN, built on a comprehensive physical and virtual appliances portfolio, engineers the internet and branch for application reliability and unparalleled resiliency. Customers have great flexibility in determining how a Talari SD-WAN solution is deployed at the physical edge, the virtual edge, or in the cloud through the use of Talari's Controller, a full suite of appliances and centralized orchestration and analytics platform.

Failsafe Software Defined WAN

A Talari SD-WAN solution delivers a resilient network that ensures application availability while lowering cost. The following are some of the leading capabilities and benefits of this solution:

**Secure Cloud Access with Visibility**
Talari extends the reach of the corporate WAN into the cloud by delivering an encrypted infrastructure with the performance, reporting and control capabilities a company requires to ensure a successful deployment.

Increased Application Quality of Experience
Talari ensures that applications work without interruption, even in the case of link failure or network impairments such as high jitter, delay, or packet loss.

Change WAN Economics with a Hybrid WAN
Companies can now modify their MPLS WAN infrastructure to incorporate low-cost, high-bandwidth broadband links that Talari technology converts into a business-class network.

HEADQUARTERS/DATA CENTER

MPLS CLOUD LTE SATELLITE

DATA CENTER BRANCH SOHO ACCESS
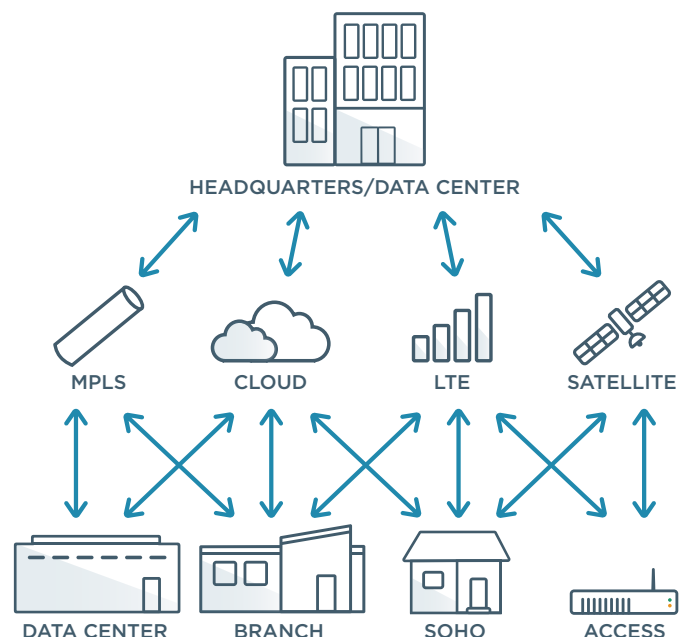
SD-WAN Resiliency Benefits

- Continuous per-packet, unidirectional performance analytics that factor in packet loss, latency, jitter, and bandwidth between all paths and aggregated links

- Adaptive, deterministic per-packet optimal WAN-path decisions, and in particular sub-second response to degrading network issues such as link/device failures and/or congestion-based disruption or outages

- Enabling "liquid" application flows that are not impeded even when heavy loss/jitter occurs, let alone link failure

- Enabling single priority flows across multiple links; using all m/x/n paths between location pairs

- Ability to leverage all available bandwidth across multiple links, even for a single high-bandwidth flow

- Customizable by bandwidth availability: highly efficient bandwidth utilization

- Replication of flows and packets across disparate links, especially real-time apps like VOIP that require platinum QoS support

- Enables unmatched support for real-time and highly interactive apps

- Extremely scalable (thousands of WAN links with continuous, real-time path measurement) to accommodate QoE standards set by cloud service access providers and edge-network co-location facilities (carrier agnostic)

- Superior inbound congestion avoidance; that is, "bandwidth reservation and control" that enables business-quality app predictability

TALARI'S LEADING IT BENEFITS

- ■ Gain resiliency, reliability and superior QoE

- ■ Maintain high availability and uptime of business-critical apps

- ■ Leverage bandwidth aggregation with commodity Internet services to reduce WAN legacy costs

DAYTON SUPERIOR
"Talari gives us the quality of service and guaranteed bandwidth we need to meet our service-level agreements for VDI and business applications." **- Dayton Superior**

Taft/
"I bought Talari to make the network more reliable, and it did exactly what it promised."
- Taft, Stettinius & Hollister, LLP

Driscoll's ONLY THE FINEST BERRIES
"After we implemented Talari...we went from paying $600 per Mbps to $100 per Mbps for bandwidth for our distribution centers. We scaled up the WAN bandwidth without scaling up the pricing." **- Driscoll Strawberry Associates**

Bremer Bank
"We can leverage Talari's capabilities to negotiate the highest bandwidth at the lowest cost without compromising reliability/availability in preparation for more rich content, video and streaming applications in the future." **- Bremer Bank**

Maricopa Region 911
"If a WAN link goes down, the call-takers are unaware. The peace of mind and visibility we get with Talari is invaluable." **- Maricopa 911**

United FEDERAL CREDIT UNION
"Talari provides the bandwidth we need to sustain our growth in an efficient and reliable platform."
- United Federal Credit Union

TO LEARN MORE OR REQUEST A DEMO, VISIT TALARI.COM

TALARI Networks™

SOLUTION-OVERVIEW-201707-007

Planning for the Evolution of the Branch

The Survey Respondents were given a list of alternatives and were asked to indicate which alternative best described the planning that their IT organization is currently doing or has done over the last year relative to re-thinking how it provides IT services to its branch offices. Their responses are shown in **Figure 11**.

Figure 11: Branch Office IT Service Evolution

Response	Percentage
Within the last year, we implemented a new approach to providing IT services to our branch offices	16%
We have a well defined plan and have started to implement it	20%
We have a well defined plan but have not yet started to implement it	9%
We are in the process of developing a plan	27%
We have not made any plans but soon will	15%
We have not made any plans and don't expect to for at least a year	14%

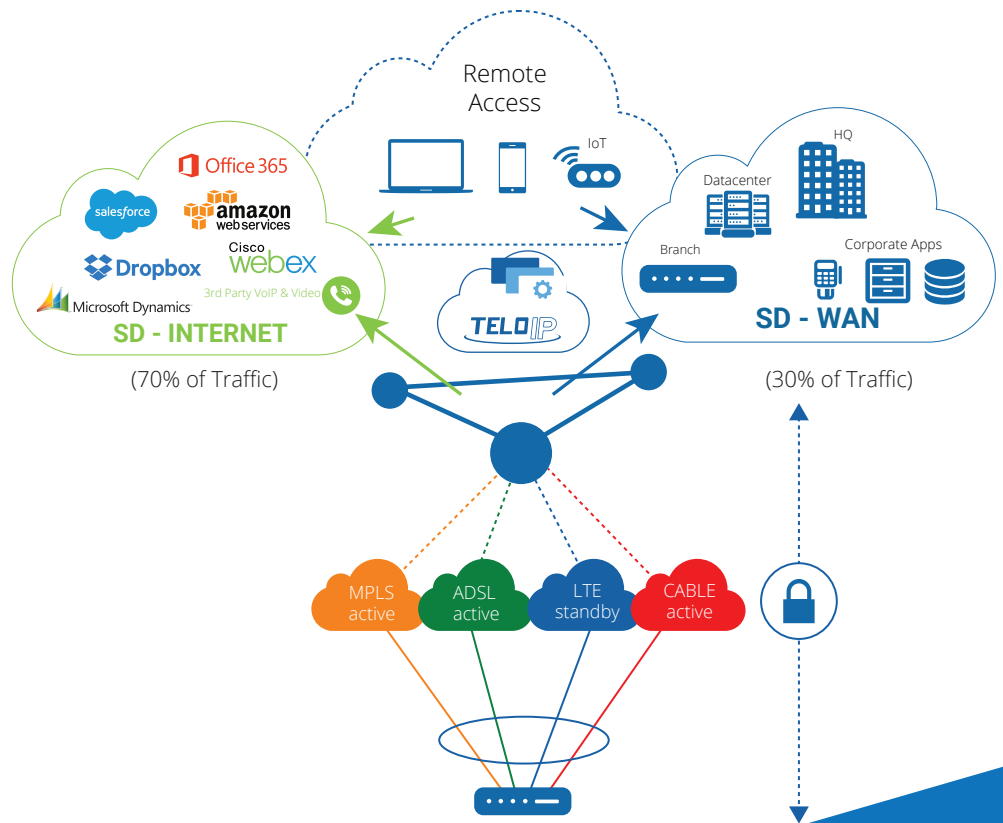| Why is this important?	The fact that only a small percentage of IT organizations have no interest in the short-term relative to the planning for the evolution of their branch office indicates how important this topic is to most IT organizations. That fact that 16% of IT organizations have recently implemented a new approach to providing IT services to branch offices has two important implications. One is that the movement to adopt a next generation branch office is in the early stages. The other is that the movement to adopt a next generation branch office is slightly further along the adoption curve than is SD-WANs.

TELOIP®

RISK FREE SD-WAN

Experience

For over 15 years, TELoIP has been managing converged voice, video and data solutions that deliver the promise of the internet for business customers.

Hardened Infrastructure

TELoIP Cloud network is carrier-class SD-WAN-as-a-Service infrastructure providing both high-availability and high-performance plus a long haul WAN transport network for the lowest overall cost.

Remote Access

Office 365
salesforce
amazon web services
Dropbox
Cisco webex
3rd Party VoIP & Video
Microsoft Dynamics

SD - INTERNET
(70% of Traffic)

HQ
Datacenter
Branch
Corporate Apps

SD - WAN
(30% of Traffic)

IoT

TELOIP

MPLS active | ADSL active | LTE standby | CABLE active

SIMPLIFYING CLOUD ACCESS
WITH SOFTWARE DEFINED NETWORKS

VINO SD-WAN

CLOUD CONNECTIVITY

We eliminate barriers to SD-WAN adoption by leveraging a turnkey, multi-tenant cloud (the TELoIP Cloud) with nine points of entry in North America. We located each point of entry in carrier-neutral facilities, allowing us to take advantage of a plethora of blended transit services co-located in these sites.

COST-EFFECTIVE

VINO SD-WAN allows enterprises to take advantage of broadband pricing and carrier diversity to create a non-stop network ensuring virtual private network reliability and performance at 'best effort' price points.

CLOUD MANAGED

The TELoIP Cloud creates a Virtual Intelligent Network Overlay (VINO) that unifies all branch traffic into a single cloud-managed SD-WAN overlay connection.

WHY IS TELOIP DIFFERENT

TELoIP has long held that the battleground is on the network edge, where our patented ANA/IPDE/MPDS technologies provide a measureable performance advantage over any other SD-WAN competitor — especially with poor underlays or under congested busy hour conditions..
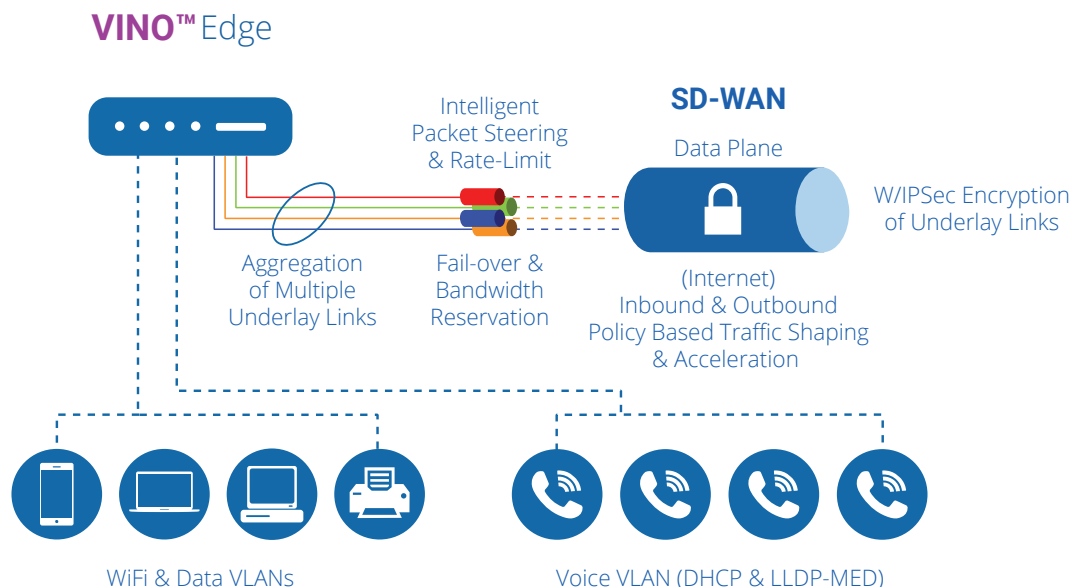
TELoIP's VINO architecture provides a patented Virtual Network Function (VNF) Control Plane that builds a full mesh topology between points of entry. The multi-patented Data Plane provides comprehensive underlay management and Virtual Network Functions (VNF) for IPQoS, Firewall, Link Aggregation, Failover and Routing. The VINO Portal offers complete Management Plane with service orchestration, move, add, change delete support and performance visualization.

TELoIP offers substantial differentiation, with patented technology in each of the data plane, control plane and management plane that delivers higher aggregated speeds and better quality of experience than competitive solutions when tested using the same underlay links and test scenarios. We believe that TELoIP is well-positioned in the SD-WAN market because:
• Only TELoIP provides both WAN and Internet optimization
• TELoIP enables high-quality voice and video calls with no drops
• We address the need to connect remote and mobile users securely
• We can address scalable security requirements for IoT ecosystems
• VINO SD-WAN aligns network services to user, application and business requirements

VINO SD-WAN DELIVERS

- VoIP Quality-of-Experience
- 'Hitless' VoIP/Video Fail-over
- Increased Performance
- Software Defined Perimeter
- Cloud Managed Network
- Centralized Orchestration
- Secure Remote Access Solutions
- Cloud Agility
- Lower WAN Costs

VINO™ Edge

Intelligent Packet Steering & Rate-Limit

SD-WAN

Data Plane

W/IPSec Encryption of Underlay Links

Aggregation of Multiple Underlay Links

Fail-over & Bandwidth Reservation

(Internet) Inbound & Outbound Policy Based Traffic Shaping & Acceleration

WiFi & Data VLANs

Voice VLAN (DHCP & LLDP-MED)

WHY VINO SD-WAN

INNOVATION

Deploy knowing TELoIP has the deepest intellectual property portfolio in the SD-WAN business. We turn business challenges into technology solutions, with award-winning technology that has been awarded 21 patents and counting

EASY TO BUY & DEPLOY

We ensure customer success by combining all the VINO SD-WAN components into a simple, predictable license fee that includes professional design, installation and ongoing 24/7/365 support.

NON-STOP BROADBAND

We build unbreakable cloud tethers backed with impeccable network engineering and support services. Working with our partners we ensure that you have a risk-free experience.

KEY CHALLENGES WE ADDRESS

- Network Reliability & Uptime
- VoIP & UCaaS Performance Issues
- Multi-Cloud Reliability & Performance
- End-User Productivity
- Network Capacity/Bandwidth
- Branch Office Security
- Branch Office Complexity
- Network Visibility and Control
- Remote/Mobile/IoT Device Access
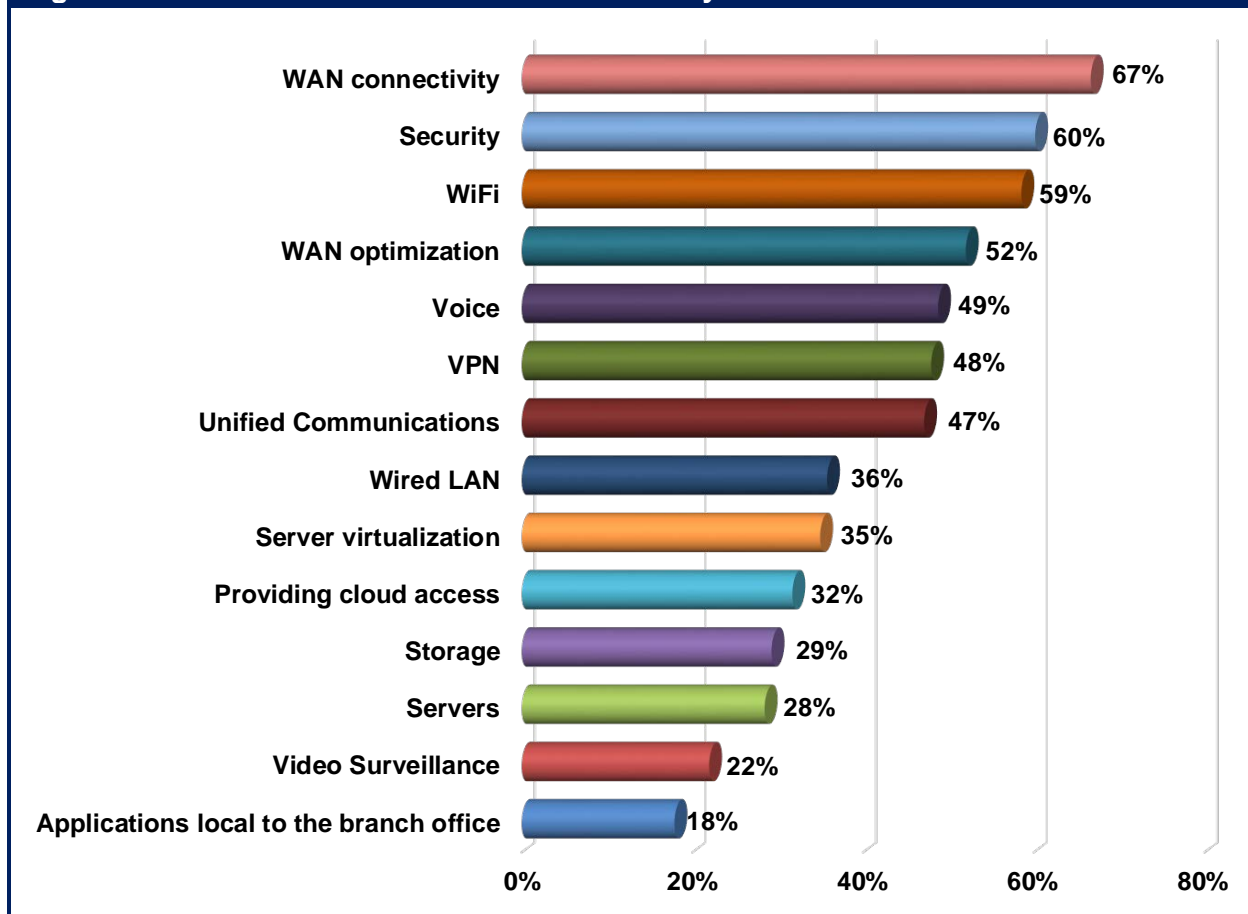- Support of Digital Transformation Efforts
- IT Budget Pressure

CONTACT

SMB or Enterprises – Call us for SD-WAN consultations from Network Design to ROI Calculation and Price Quotes at info@teloip.com

TELoIP

TELoIP Inc. | 1-5430 Timberlea Blvd., Mississauga, ON L4W 2T7 | TEL: +1 416 203 7838 | www.teloip.com | info@teloip.com

Breadth of Branch Office Functionality

The Survey Respondents were asked, "If your organization has recently developed a plan, or if you are in the process of developing a plan for how to provide IT services to your company's branch offices, which of the following functionality and/or requirements are included in that plan?" Their responses are shown in **Figure 12**.

Figure 12: Branch Office Breadth of Functionality

Functionality	Percentage
WAN connectivity	67%
Security	60%
WiFi	59%
WAN optimization	52%
Voice	49%
VPN	48%
Unified Communications	47%
Wired LAN	36%
Server virtualization	35%
Providing cloud access	32%
Storage	29%
Servers	28%
Video Surveillance	22%
Applications local to the branch office	18%

Why is this important?	The data shows that there is a strong linkage between planning for the evolution of branch offices and planning for the evolution of WAN connectivity. The data also shows that the plans that IT organizations are making relative to the evolution of their branch offices include a broad range of functionality.

Current and Intended Use of Virtualization

The Survey Respondents were asked to indicate the percentage of the network and security functionality that is in one of their company's typical mid-sized branch offices that is currently virtualized? They were also asked to indicate the percentage that will be virtualized by the end of 2018. Their responses are shown in **Table 3**.

Table 3: Amount of Branch Office Virtualization						
	0%	**1% to 25%**	**26% to 50%**	**51% to 75%**	**76% to 99%**	**100%**
Now	42%	26%	18%	5%	5%	3%
End of 2018	13%	38%	14%	15%	12%	7%

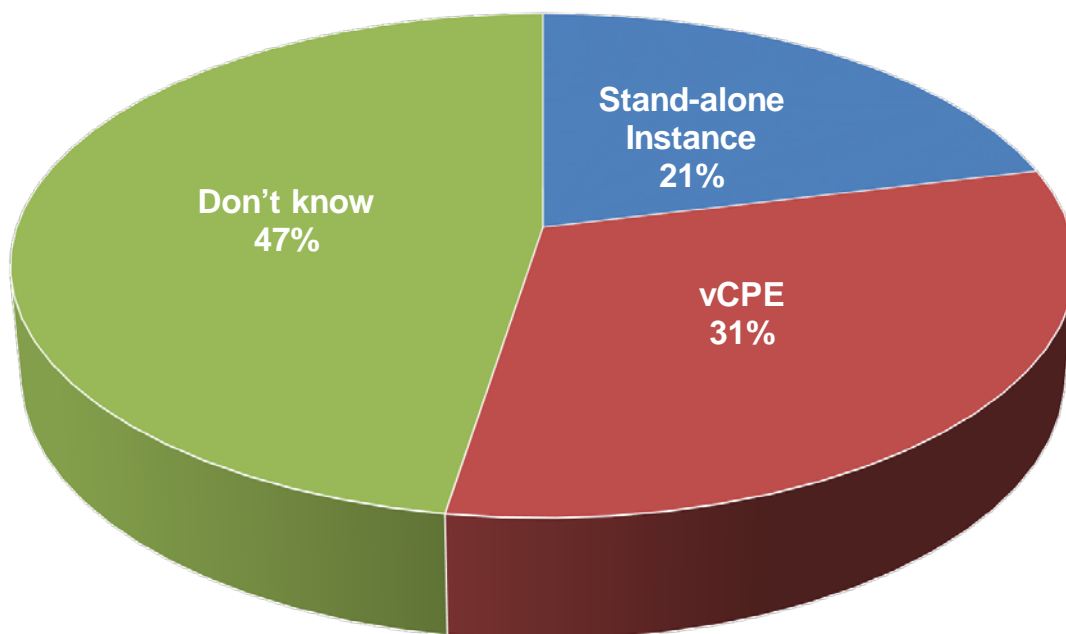| **Why is this important?**	The data shows that by the end of 2018 that the vast majority of IT organizations will have virtualized at least some of the network and security functionality in their branch offices. The data also shows that one third of IT organizations expect that by the end of 2018 that they will have virtualized the majority of the network and security functionality in their mid-sized branch offices.

How Branch Office Virtualization will be Implemented

The Survey Respondents were asked to indicate the approach that their organization will take to virtualizing branch office functionality by the end of 2018. They were given the following two approaches as options:

- The virtualized functionality will run as a standalone instance on one or more servers that we provide

- The virtualized functionality will run as a component on a virtualized CPE (vCPE) that was designed to integrate multiple virtualized network functions (VNFs)

Their responses are shown in **Figure 13**.

Figure 13: Branch Office Virtualization Implementation Approach

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Why is this important?	The data shows that there is significant interest in using virtual CPE as the basis for implementing virtualized functionality in branch offices. However, the data also indicates that there is still a lot of uncertainty about how IT organizations will implement virtualization in branch offices.	✔

About the Webtorials® Editorial/Analyst Division

The Webtorials® Editorial/Analyst Division, a joint venture of industry veterans Steven Taylor and Jim Metzler, is devoted to performing in-depth analysis and research in focused areas such as Metro Ethernet and MPLS, as well as in areas that cross the traditional functional boundaries of IT, such as Unified Communications and Application Delivery. The Editorial/Analyst Division's focus is on providing actionable insight through custom research with a forward-looking viewpoint. Through reports that examine industry dynamics from both a demand and a supply perspective, the firm educates the marketplace both on emerging trends and the role that IT products, services and processes play in responding to those trends.

Jim Metzler has a broad background in the IT industry. This includes being a software engineer, an engineering manager for high-speed data services for a major network service provider, a product manager for network hardware, a network manager at two Fortune 500 companies, and the principal of a consulting organization. In addition, he has created software tools for designing customer networks for a major network service provider and directed and performed market research at a major industry analyst firm. Jim's current interests include cloud networking and application delivery.

For more information and for additional Webtorials® Editorial/Analyst Division products, please contact Jim Metzler or Steven Taylor.