

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 timeframe¹. 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.

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.

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**.

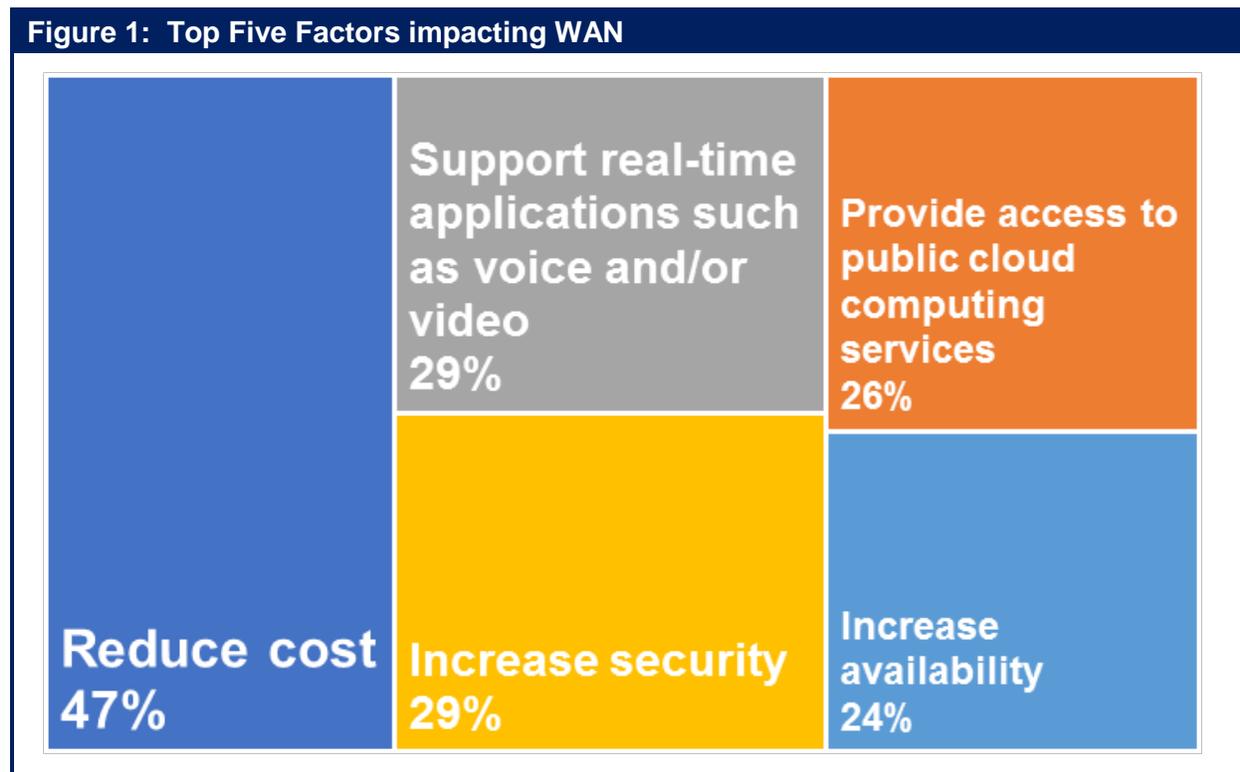


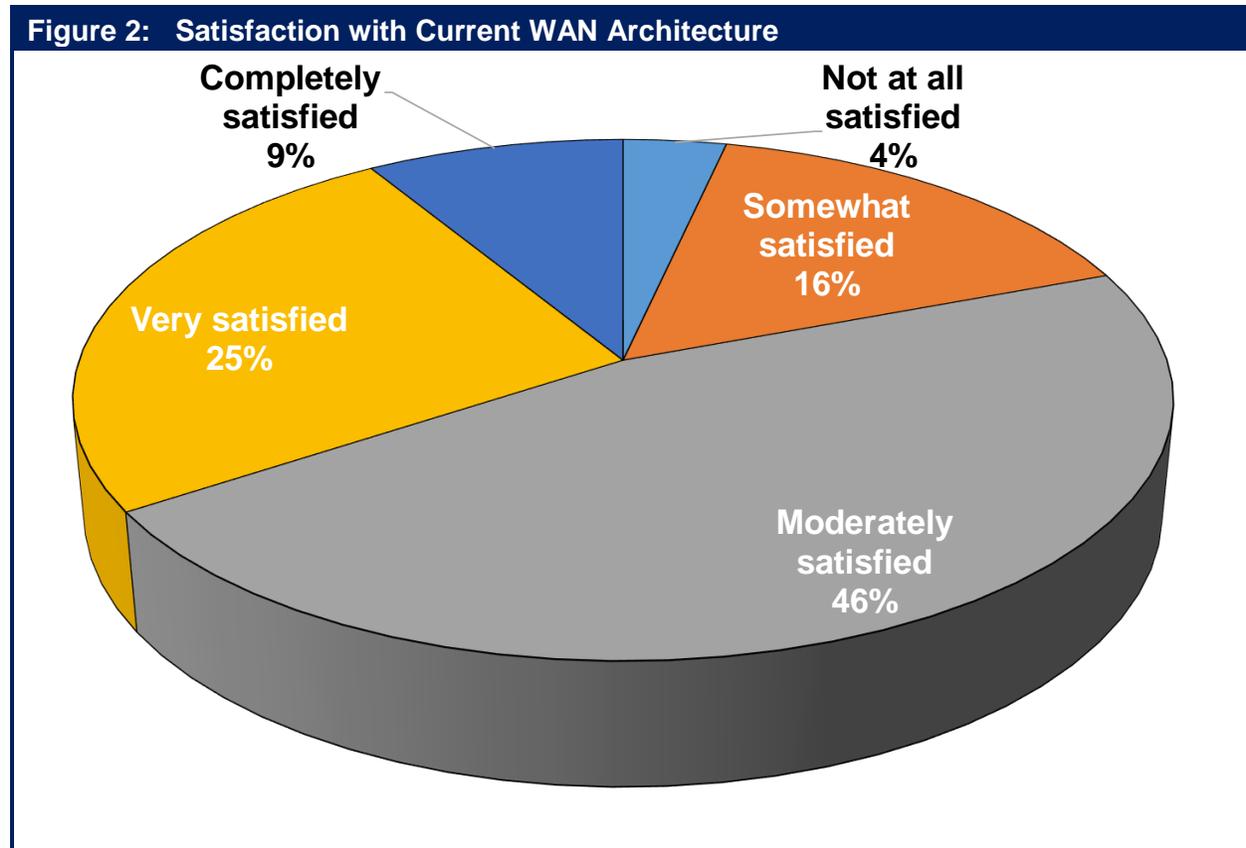
Figure 1 highlights the fact that WAN use cases have changed significantly since MPLS-based branch office WANs were first deployed roughly fifteen years ago. For example, fifteen years ago providing access to public cloud computing services was not a concern when architecting a WAN. Today it is one of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



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.

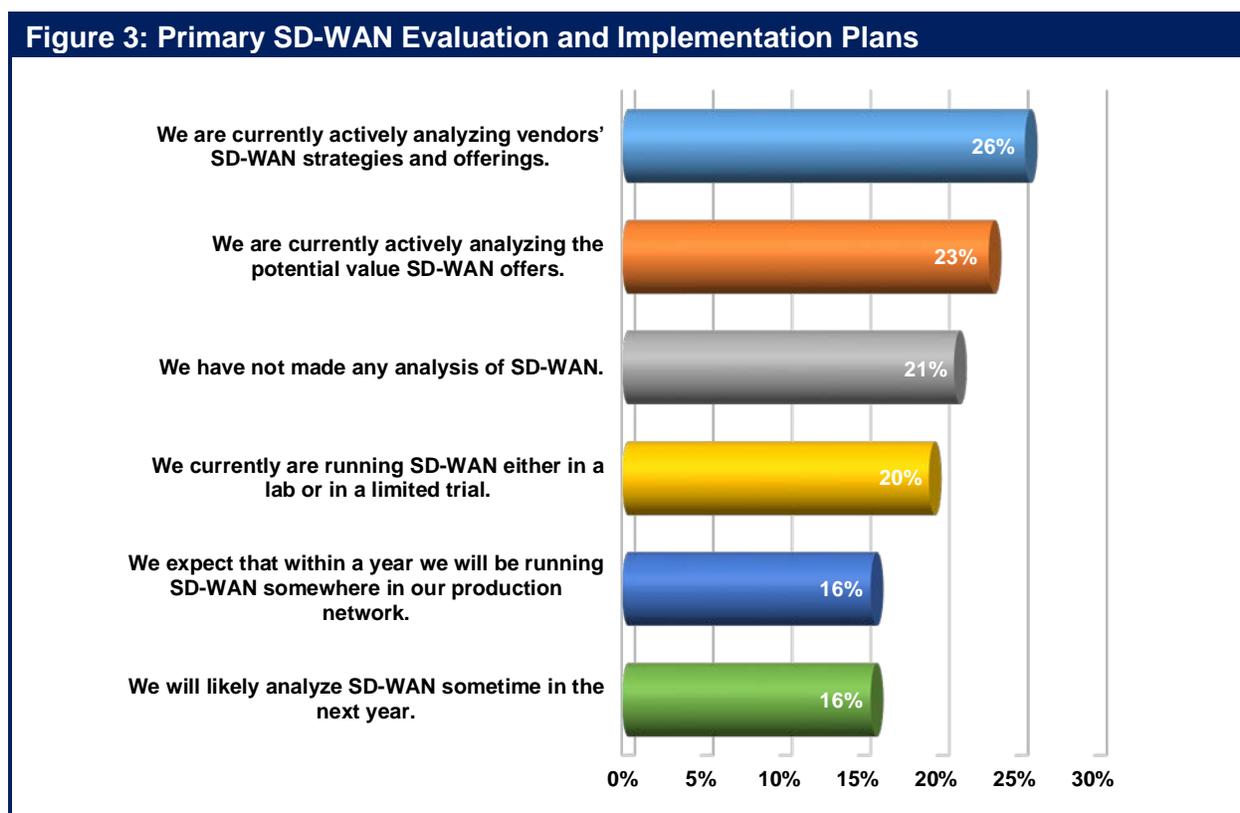


Software Defined WANs (SD-WANs)

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%.



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.

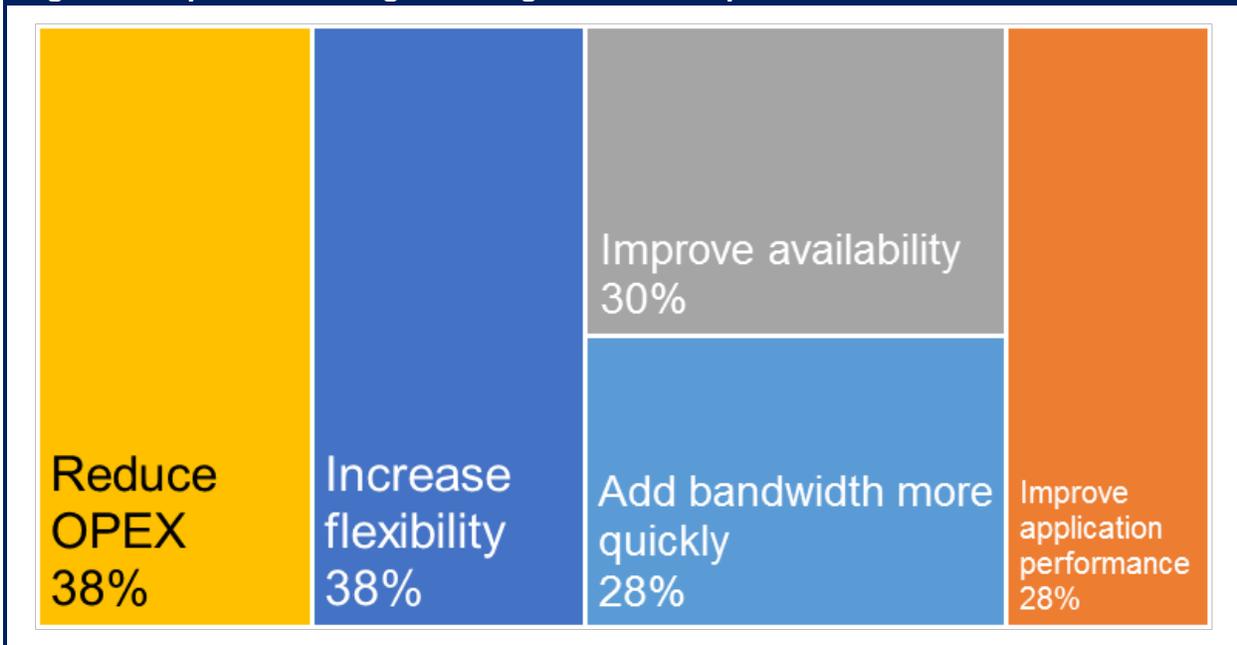


The Drivers of SD-WAN Adoption

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



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.



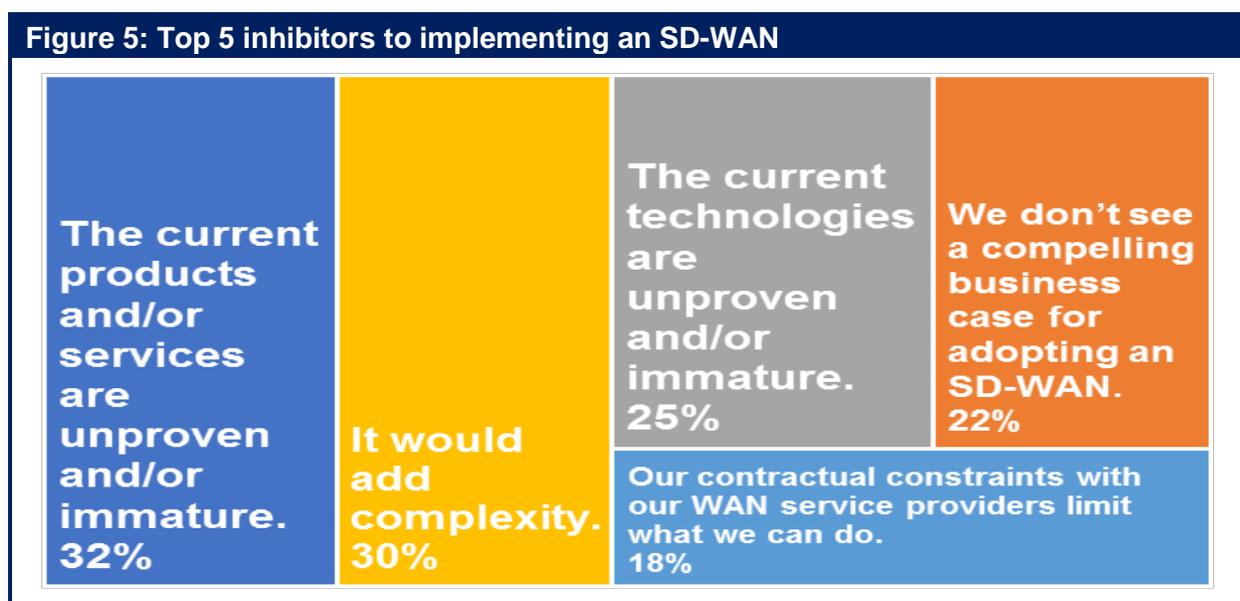
The Inhibitors to SD-WAN Adoption

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%.



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.

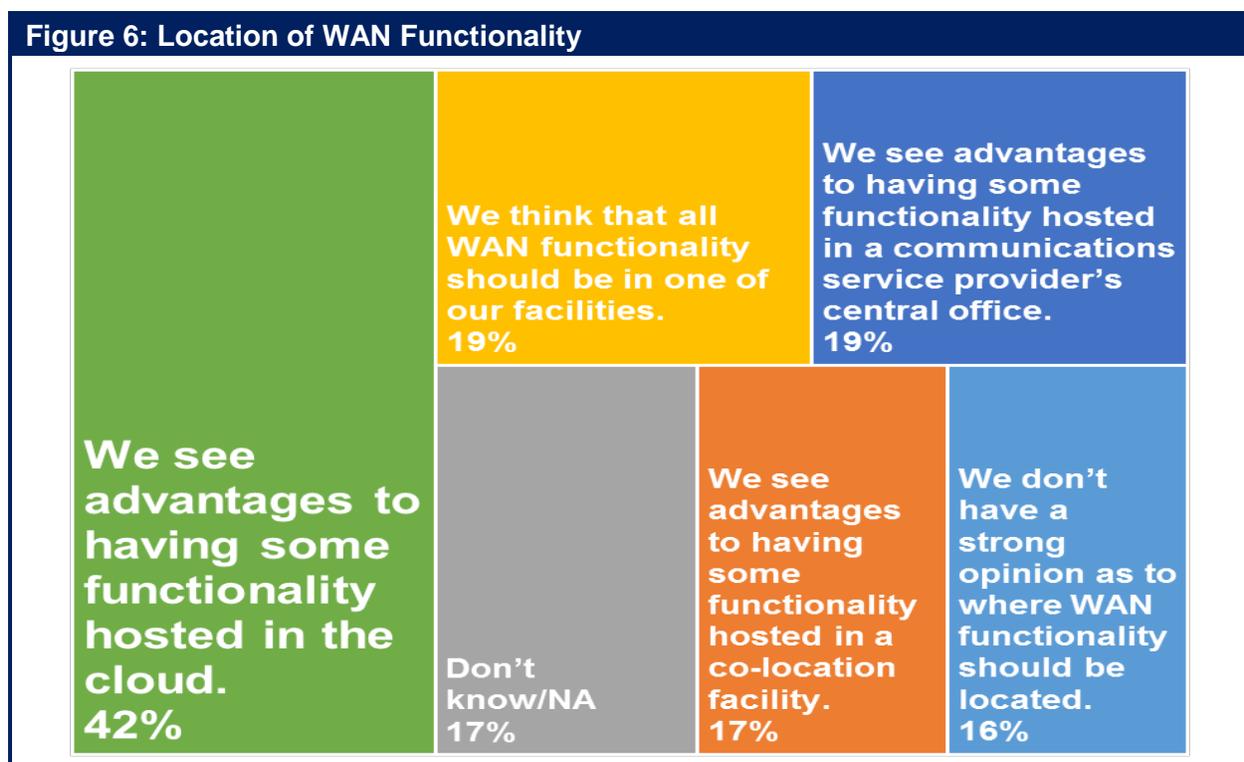


Preferred Location of WAN Functionality

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**.



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.

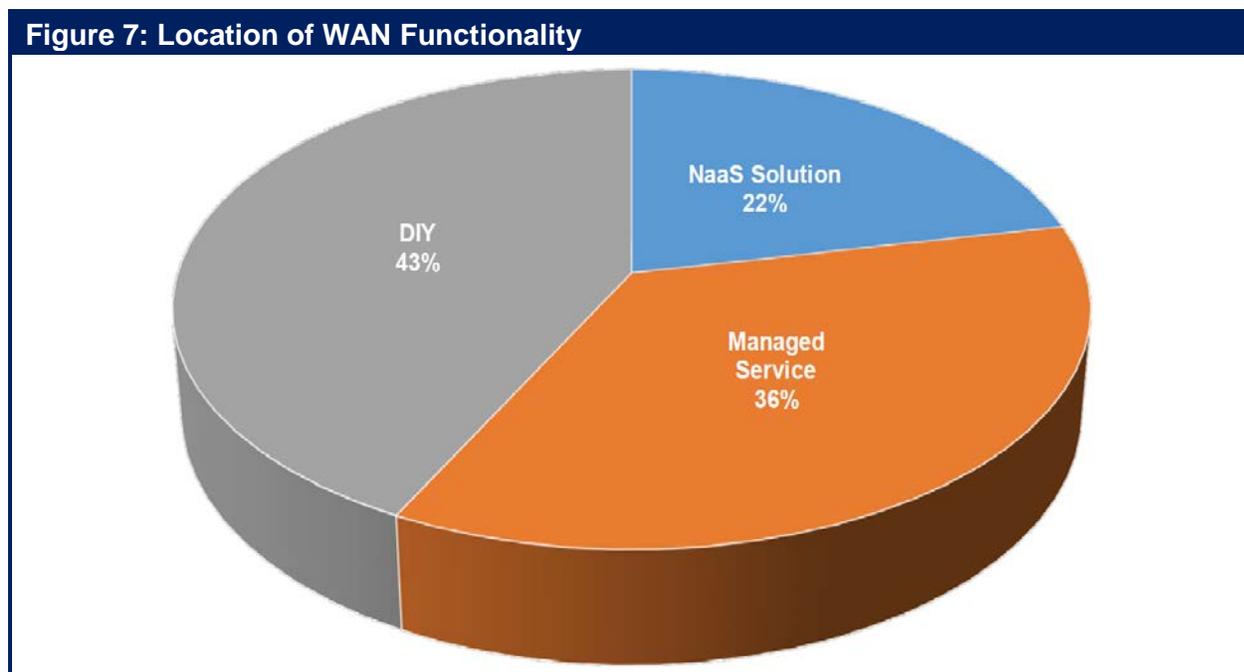


Choice of Implementation Options

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**.



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**.



Why is this important?

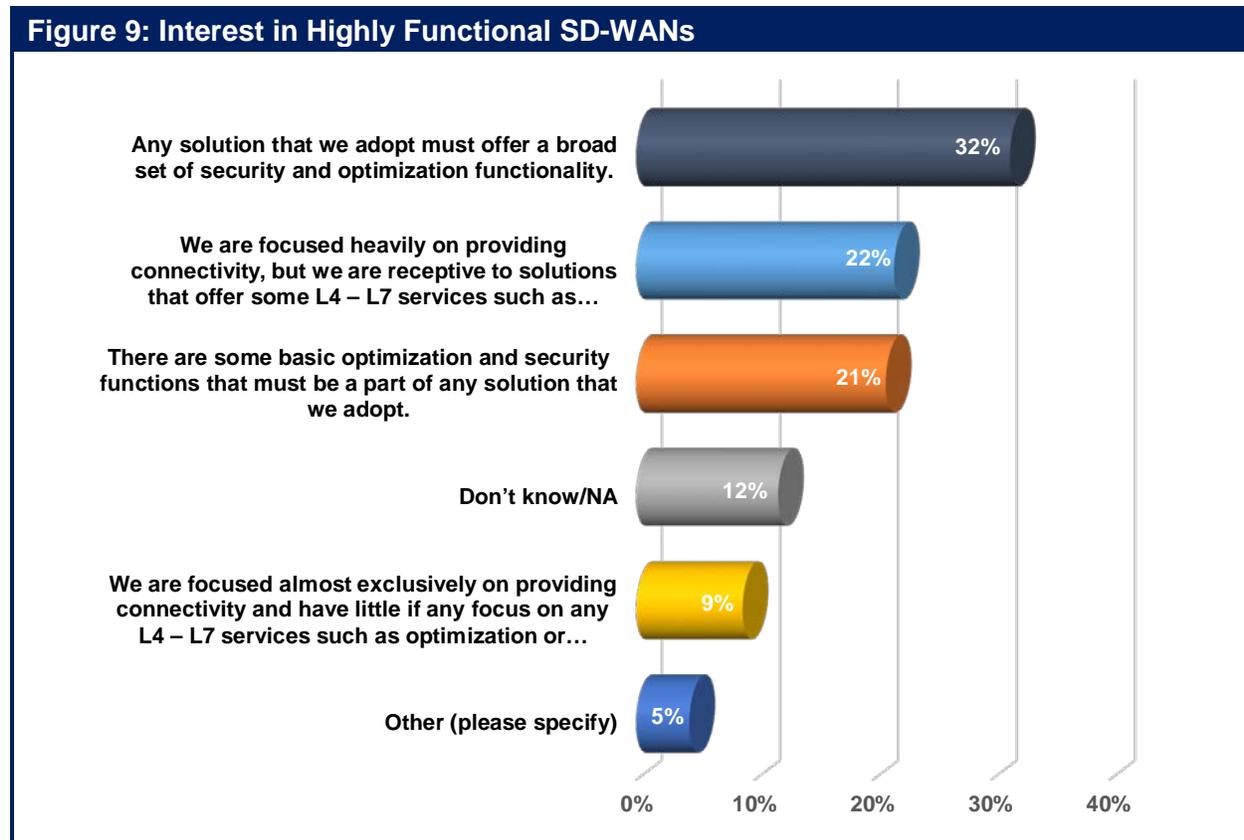
The fact that so many network organizations are willing to explore alternative vendors puts pressure on the incumbent vendors and makes it unlikely that the market will converge onto a small number of providers in the short term.



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.



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.

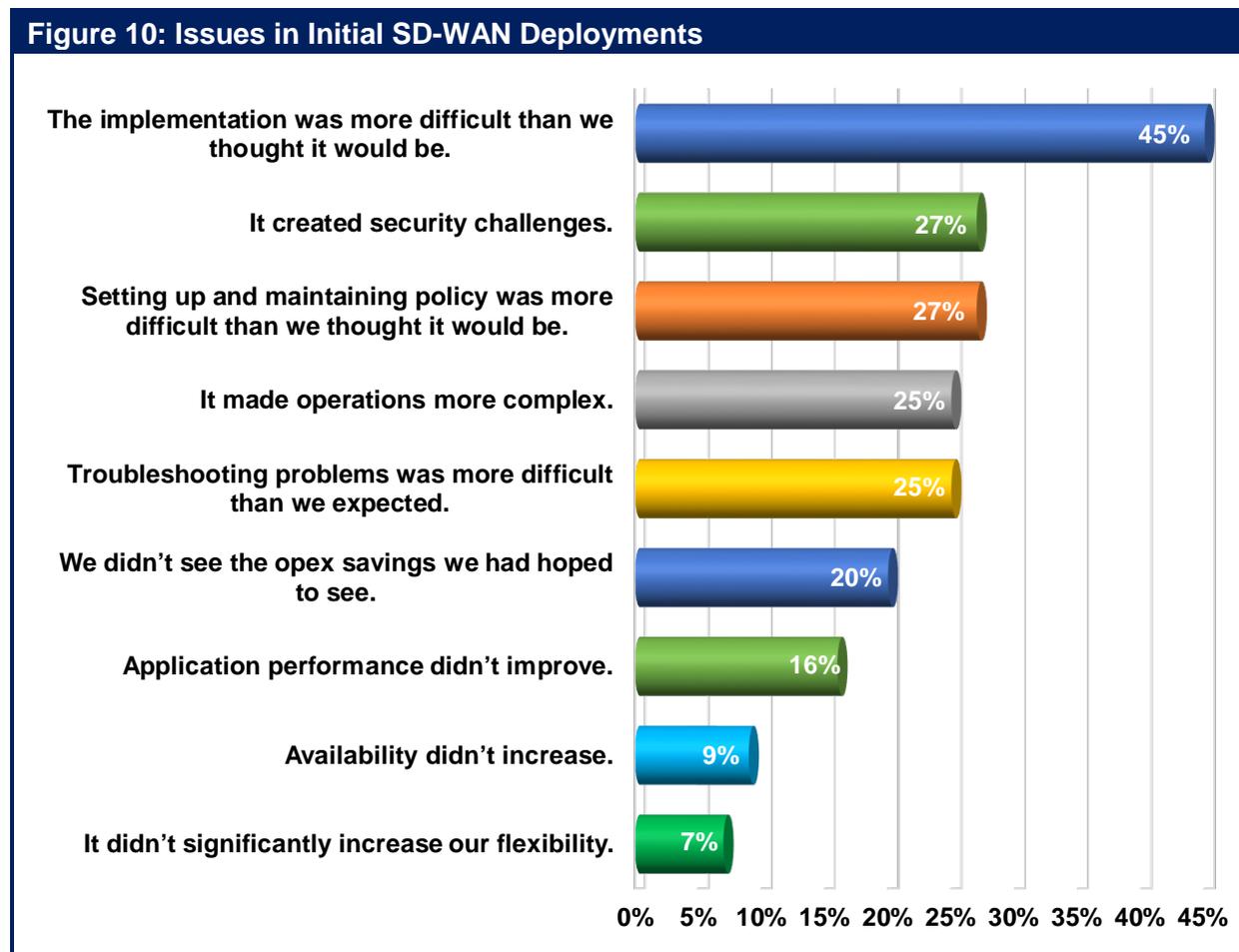
Why is this important?

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**.



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.



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**.

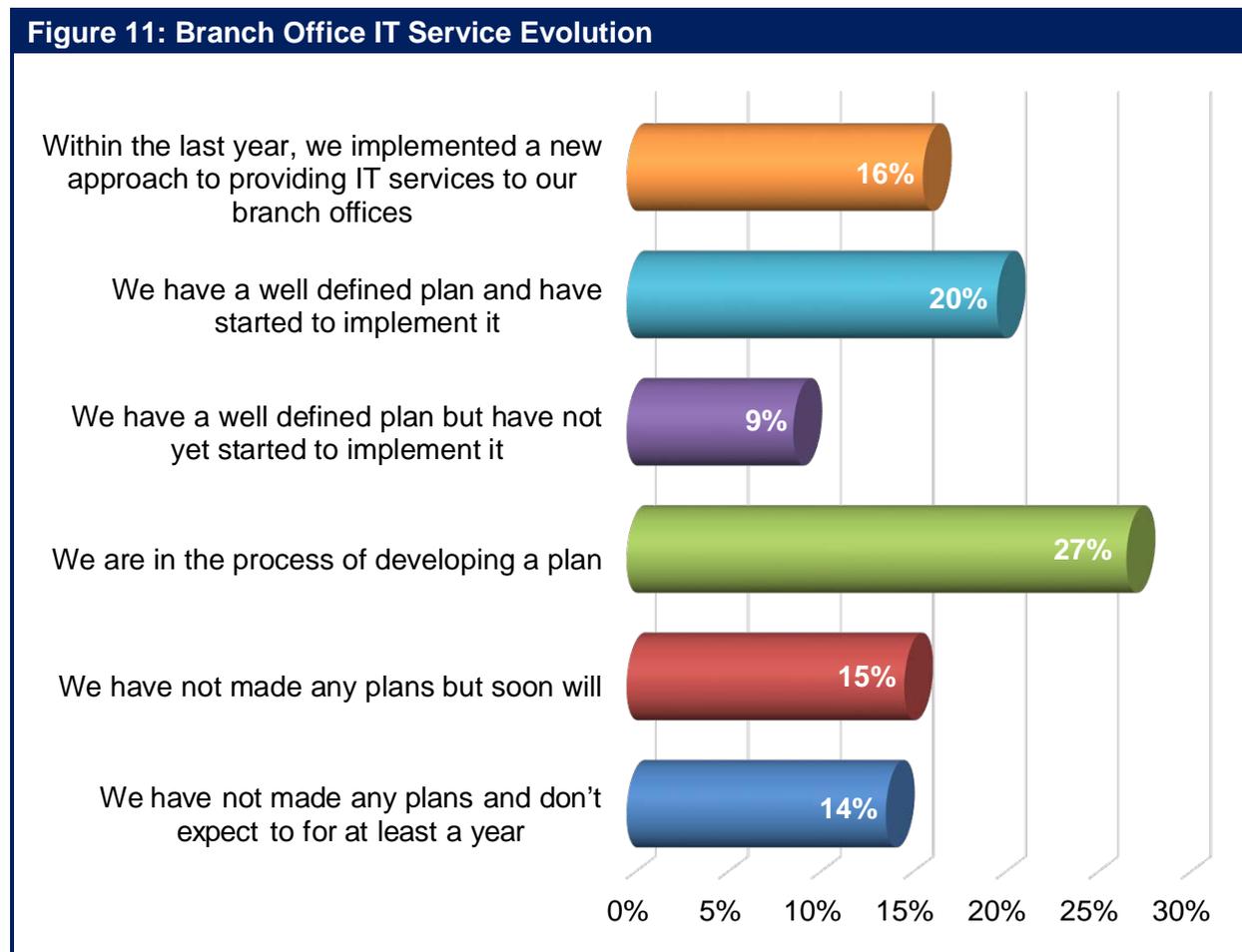
Table 2: Presence of Servers and Appliances in a Medium Sized Branch Office						
	None	1 or 2	3 or 4	5 or 6	7 or 8	9 or more
Physical servers	23%	45%	11%	8%	3%	9%
VMs	40%	21%	10%	10%	9%	10%
Physical appliances	17%	45%	14%	10%	2%	11%
Virtual appliances	55%	20%	8%	5%	4%	8%

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.	
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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**.



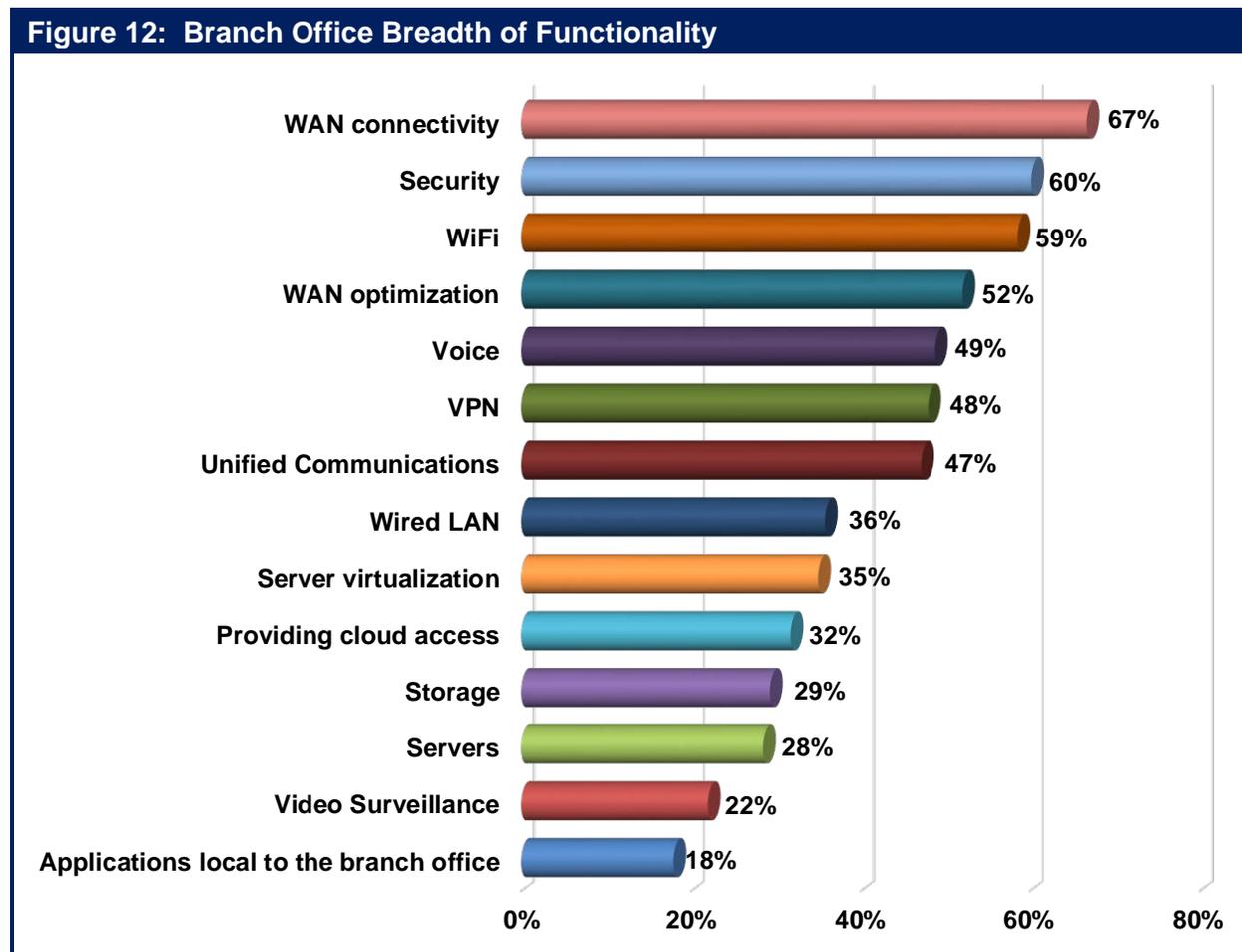
Why is this important?

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.



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**.



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.

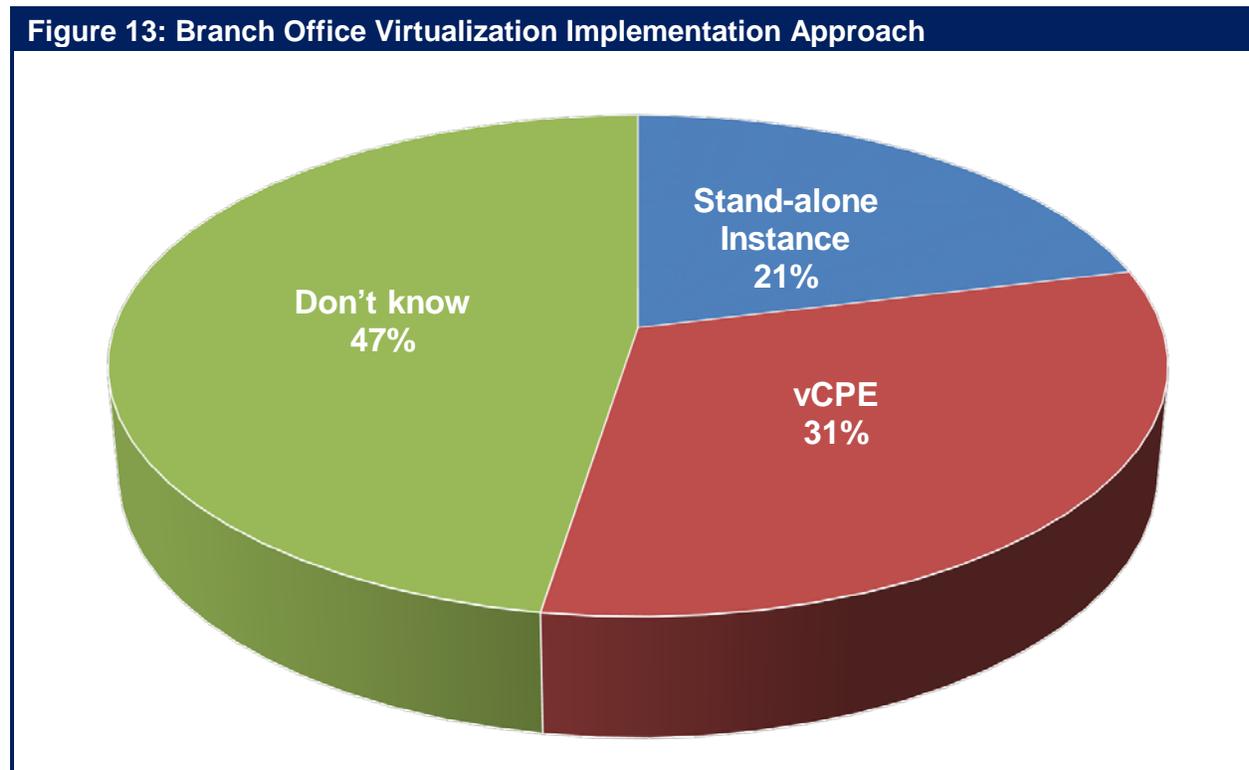


How Branch Office Virtualization will be Implemented

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**.



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.



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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.

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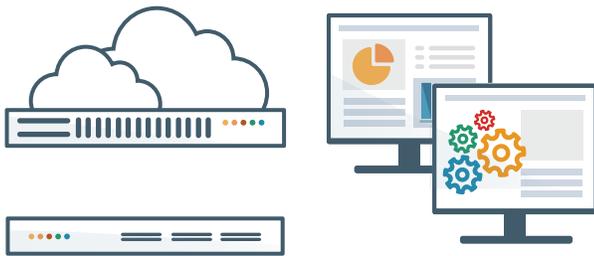
SD-WAN SOLUTION OVERVIEW

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

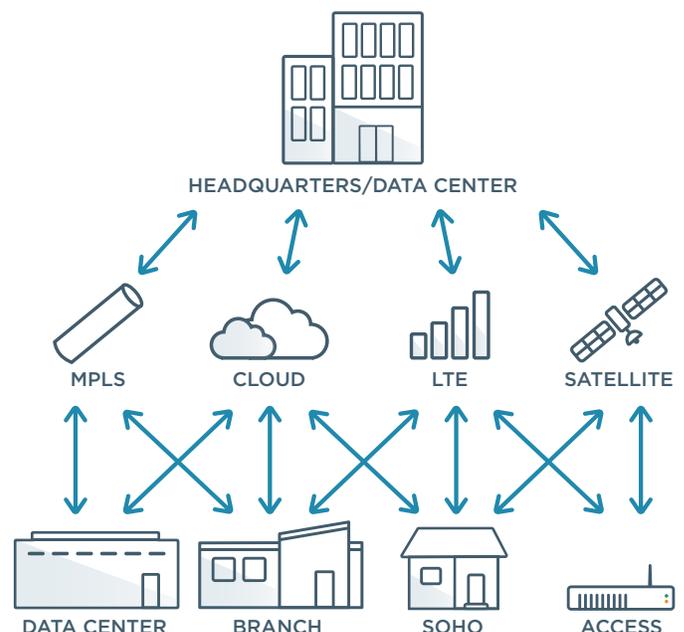
Talari extends the reach of the corporate WAN into the cloud by delivering an encrypted infrastructure with the performance, reporting and control capabilities a company requires to ensure a successful deployment.

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.



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



“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**



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



“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**



“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**



“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**



“Talari provides the bandwidth we need to sustain our growth in an efficient and reliable platform.”
- **United Federal Credit Union**

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