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## **Executive Summary**

The SD-WAN market is in the early growth stage of the product lifecycle. Key factors driving market adoption include: cost savings from efficient usage of private and public networks, ability to optimize hybrid cloud/multi-cloud connectivity, and application-aware routing. Below is a summary of key research findings provided in this report:



The 2H of 2018 witnessed a higher growth rate than predicted in our mid-year update, with full year 2018 revenues exceeding \$580 million. The global SD-WAN market is forecast to grow at a CAGR of 50.7% from 2018 to 2023. SD-WAN market revenue growth in 2018, and the 1H of 2019 is validated by a 2018 Frost & Sullivan end user survey, in which 61% of the respondents indicated they will deploy SD-WAN in the next 12-24 months.



United States continues to lead in global sales, with a 78% share of the market. However, sales are picking up in Europe, followed by Asia Pacific and Latin America.



Hybrid cloud/multi-cloud connectivity was a huge focus for SD-WAN vendors in 2018, with multiple vendors announcing integration with leading cloud platforms. As enterprise applications get distributed across multiple clouds, the traditional WAN architecture of backhauling traffic to a hub site, and then routing to cloud, is inefficient and expensive. SD-WAN enables enterprise IT to predefine business policies through the SD-WAN controller, to specify which cloud applications are suitably accessed directly through the internet versus backhauled to a hub site.



Network and application security remains a key priority for enterprises. While most leading SD-WAN vendor solutions come with a stateful firewall, businesses need more than that. To address this need, SD-WAN vendors are continuing to add technology partners to support a wide variety of cloud-based security solutions.



SD-WAN vendors continued to build partnerships in the second half of 2018. The SD-WAN vendor partner channel typically includes network service providers (NSPs), managed service providers (MSPs), system integrators, application service providers (ASPs), and value added resellers (VARs). In 2018, vendors focused on building partnerships with small MSPs, master agents, and VoIP/UCaaS providers, to take their offerings further down market.

## **Business Benefits of SD-WAN**

The key business benefits of SD-WAN for enterprises are described below.



#### Agility

With SD-WAN solutions, transport routing changes can be made in real-time. The underlying transport infrastructure is abstracted, pooled and assigned to applications, based on software-defined policies. For example, a branch site can use a high capacity internet link as a primary circuit, and a low speed MPLS circuit as backup. If the primary link does not deliver the requisite QoS, mission-critical applications can be dynamically re-routed to run on the MPLS link. Alternatively, sites can eliminate MPLS completely, and use Internet links in active-active mode, wherein the controller chooses the link that fulfills the QoS requirements of a given application.



#### **Speed to Market**

SD-WAN CPE dramatically reduces the time required to add new branch sites, as the CPE is a plug-and-play device that can be configured without oversight by on-site network personnel. The zero-touch provisioning feature enables the device, once plugged into the network, to automatically connect to the controller, and self-configure. New branch locations can deploy SD-WAN equipment, and start with readily available wireless LTE service, while waiting for a network service provider to provision wired services (Internet or MPLS). MPLS services provisioning times can run into multiple weeks in some scenarios; SD-WAN ensures that new branch addition initiatives are not deterred due to long provisioning cycles of wired services.



#### Cost savings

An SD-WAN enables cost-efficient use of public Internet and private networks. Enterprises can use aggregated, inexpensive Internet links to achieve high-speed bandwidth for less critical applications, while continuing to use private networks to run mission-critical applications via higher cost, private WAN services (MPLS or Ethernet). In addition, the ease of deployment and centralized control eliminates the need for a network engineer at every location, resulting in lower network management costs. The ability to centrally control and manage thousands of edge devices can be of immense value for highly distributed enterprise verticals such as retail, healthcare, and banking.

## **Business Benefits of SD-WAN (cont.)**

The key business benefits of SD-WAN for enterprises are described below.



## **Application-aware Routing**

SD-WAN solutions leverage real-time performance monitoring of transport networks to make application-aware, policy-based network selections. The controller defines the network policies for applications on branch routers, and chooses a path that best suits the application traffic. Real-time monitoring of traffic paths ensures that problems related to availability (sufficient bandwidth) and reliability (latency, jitter, and packet loss) are sensed before they affect the users; and traffic can be routed to a different path, if necessary. This reduces reliance on MPLS-only links (which typically offer WAN performance visibility and management features), as network engineers monitor both public and private networks to ensure suitable application performance, irrespective of the underlying infrastructure. Leading SD-WAN vendor solutions automatically recognize traffic associated with popular enterprise applications (e.g., Office 365, Skype, Gmail, YouTube, SAP), and optimally route that traffic based on cost and performance policies. Vendor solutions are also evolving to offer differentiated features in application recognition and routing. For example, Silver Peak's Unity EdgeConnect solution offers First-packet iQ that recognizes applications on the very first packet received. This feature eliminates the need to backhaul all apps to the data center for identification, and instead, immediately routes traffic through the internet.



## **Branch Office Connectivity**

Branch site connectivity and management is time consuming and complex for large distributed enterprises. Most large enterprises have a hybrid WAN in place today, wherein they may use MPLS to connect critical locations; and IPsec VPNs to connect less critical branch sites. However, the current hybrid WAN architecture they have in place is likely static in nature. Any needed changes could involve truck rolls and also require network engineers to make the changes—which is time consuming and expensive.

The centralized, policy-based routing capability of SD-WAN can increase the performance and reliability of branch networks, as real-time monitoring of traffic paths ensures that the chosen network (MPLS or internet or LTE) meets the QoS requirements for each application.

## **SD-WAN Market Trends**



## **Market Trends**



## Hybrid Cloud / Multi-cloud Connectivity Continues to be a Huge Focus for SD-WAN Vendors

In the 2019 Frost & Sullivan Global Cloud Survey, 75% of global IT decision makers agreed with the statement "the cloud is the most integral part of our digital transformation strategy." In the same survey, 37% of the respondents indicated they currently use a hybrid cloud; with another 35% indicating they plan to use a hybrid cloud in the next 2 years. Additionally, it is common for enterprises to use a multi-cloud deployment for various workloads. Frost & Sullivan 2019 cloud survey results indicate that 43% of the enterprises use three or more clouds, and they expect usage to increase significantly (more than 50%) in the next 2 years.

As enterprise applications get distributed across multiple clouds, the traditional WAN architecture of backhauling traffic to a hub site, and then routing to cloud, is inefficient and expensive. SD-WAN enables enterprise IT to predefine business policies through the SD-WAN controller, to specify which cloud applications are suitably accessed directly through the internet versus backhauled to a hub site. A physical or virtual SD-WAN appliance, deployed at the cloud service provider's data center, communicates with the SD-WAN appliance at the customer site, to ensure that the internet links meet the required QoS for a given application. Most SD-WAN vendors have announced cloud on-ramp connectivity to public cloud with their SD-WAN solutions, by partnering with leading cloud providers—AWS, Google Cloud, Azure. Additionally, some vendors have announced SD-WAN solution integration with Azure virtual WAN. The integrated capability enables enterprises to make use of Microsoft Azure's network to connect branch locations securely; and efficiently connect to Azure Cloud. For example, Citrix, Silver Peak, Versa Networks and CloudGenix are SD-WAN connectivity partners on Azure virtual WAN.



## **SD-WAN Vendors Continue to Add Support for Multi-vendor Security**

Network security is top-of-mind for enterprise IT managers as they evaluate SD-WAN solutions. While the initial SD-WAN offerings came with basic cloud-based security features, in partnership with security vendors such as Zscaler or Palo Alto Networks, enterprise IT decision makers are looking for support across a broad range of vendor solutions, and a broader set of security features. Leading vendors have partnerships with security vendors to ensure interoperability of their solutions. For example, Riverbed, Silver Peak, Nuage Networks, VMware-VeloCloud, and Versa Networks joined the Fortinet Fabric-Ready Partner Program that allows partners to leverage Fortinet's APIs for deep integration with the Fortinet Security Fabric. These partnerships enable enterprises to choose best-of-breed, interoperable security solutions with their SD-WAN.

## **Market Trends (cont.)**





#### Mobility, Internet of Things (IoT) and Big Data Trends to Contribute to SD-WAN Demand

The current business environment is experiencing an influx of new technologies—including mobility and IoT—requiring WAN managers to connect geographically-dispersed teams and nodes. Mobile users are using their own smartphones and tablets to access corporate resources. As corporate data gets distributed among hybrid cloud deployments in an SD-WAN deployment, remote users accessing cloud-based applications can be automatically routed to cloud-hosted applications over the internet. Big Data and IoT applications, distributed across cloud and on-premises data centers, are putting immense pressure on WAN bandwidth, which MPLS alone cannot fulfill in a cost-effective manner. The traditional WAN architecture—with traffic passing back and forth from remote sites into central data centers, and back via MPLS—does not work well for distributed deployments. This is particularly true in the case of IoT applications where the number of connected nodes can be extreme, making the use of private networks cost prohibitive. Furthermore, data from IoT nodes is typically sent to the cloud for storage and analysis. With SD-WAN, IoT nodes can connect directly to the internet via high-speed broadband, while ensuring that the links adhere to QoS and compliance requirements defined by the controller. Even if a private link is used by certain IoT nodes, users can make use of the WAN optimization features of SD-WAN to optimize bandwidth usage.



#### Vendor Sales Channels are Evolving to Reach Broader Market Segments

The initial stages of SD-WAN witnessed SD-WAN vendors partnering with VARs and network service providers to expand their market reach. However, most vendors have expanded their channel partnerships to include master agents, managed service providers, system integrators (SI) and application service providers (ASPs). The diverse nature of partnerships is to ultimately reach various market segments, and provide customers with a wide variety of choice in terms of how they want to buy and manage SD-WAN. While NSPs bring deep network management expertise, and can integrate their networks and other enterprise solutions with SD-WAN, SIs can act as true carrier-neutral managed SD-WAN providers for businesses looking to take that route. Similarly, ASPs can integrate SD-WAN with other IT or cloud applications that they currently manage for end customers. Additionally, while the NSP and MSP channels help vendors tap into the large enterprise segment, small and midsize segments remain untapped. The VAR and master agents can help SD-WAN vendors reach the midmarket customers effectively

## **Market Trends (cont.)**



#### **Managed SD-WAN Continues to Gain Traction**

- In a recent Frost & Sullivan survey of network decision-makers, over 50% of the respondents indicated their preference for buying a fully managed SD-WAN service. In a managed SD-WAN, the service provider installs and manages the edge devices, procures and manages access links from multiple NSPs, and manages the day-today network management aspects of the solution.
- Managed SD-WAN also allows customers to evaluate and adopt SD-WAN in phases. With some services, enterprises can pay a flat monthly subscription fee to install, monitor and maintain networking equipment (such as routers) at branch offices, instead of making a CAPEX investment. While leading network service providers and managed service providers have quickly formed partnerships with SD-WAN vendors to offer a fully managed SD-WAN, system integrators and value added resellers are also seeing significant success with their managed SD-WAN offerings.
- Market trends also indicate that, at a minimum, most SD-WAN customers are looking for a comanaged service wherein they retain at least some level of control over the SD-WAN deployment; while the service provider takes on the day-to-day management aspects.



Figure 1: U.S. Businesses' preference in buying and managing an SD-WAN solution

Percentage of Survey N=330

Do-it-yourself: procure SD-WAN hardware (and software) directly from the vendor and have the internal network/IT team deploy and manage



Co-managed: buy SD-WAN service from a service provider that deploys the SD-WAN solution and related network services, and co-manages the solution along with our internal IT team



Fully managed: buy SD-WAN service from a service provider that deploys and manages the SD-WAN solution and related network services, end-to-end



**Excerpt Prepared for Silver Peak** 

Source: 2018 SD-WAN End User Survey Results

## **SD-WAN Vendor Market – Market Forecasts**



## **SD-WAN Vendor Market: Forecast Assumptions**

Frost & Sullivan conducted primary interviews with leading SD-WAN vendors, researched the quarterly and annual reports of publicly listed companies, and utilized internal and external databases to perform a detailed analysis of customer wins, existing site deployments, pricing and contracting models, and sales and marketing channels, to arrive at revenue estimates for the global SD-WAN market. The revenue and sites estimates for leading SD-WAN vendors were sent to individual companies for feedback; and responses were analyzed further, and compared to Frost & Sullivan's forecast model. The resulting SD-WAN revenue and sites market size is the total of individual companies' estimates. The following assumptions were made to arrive at the 5-year forecast:



SD-WAN has evolved from the early adopter stage, and entered the growth stage, with vendors reporting strong growth in 2018. The market grew faster than our predicted growth rate in the second half of 2018, with revenues exceeding \$550 million. Furthermore, the momentum has continued into the first half of 2019.



Leading SD-WAN vendor solutions come with integrated security, WAN optimization, and routing capabilities. Cost savings from using hybrid networks, superior WAN performance from application-aware routing, and simplicity and ease of use from integrated functions such as stateful firewall, routing and WAN opt are expected to drive market migration from single function, hardware-centric approach to a software centric approach, where a single composite image of software can deliver multiple functions.



A majority of the SD-WAN deployments in place today use a physical appliance at the edge, which involves a start-up fee and a monthly recurring fee for the CPE and software licensing, respectively. While the CPE is available for upfront purchase, most users choose to pay through a budget-friendly monthly rental. As NFV-based services gain traction, and the market moves to a uCPE model that can host multiple VNFs on a single appliance, the fee earned through hardware rental will diminish in the future. Instead, customers will incur a licensing fee for the vCPE.



The NA market still constitutes a majority share of the global SD-WAN revenues, currently; with adoption picking up pace in Europe and APAC. Europe, specifically, has seen significant growth in 2018, with companies like Nuage Networks and InfoVista reporting a majority of revenues from the region. LATAM has seen some deployments in the last three quarters, but has generally been slower than other regions in terms of adoption.



Enterprises continue to show a preference for managed SD-WAN solutions versus the DIY approach. This is driving SD-WAN vendor initiatives to build strong channels consisting of NSPs, MSPs, system integrators, ASPs, and VARs.

## SD-WAN Vendor Market: Revenue Forecast, Global, 2018 & 2023

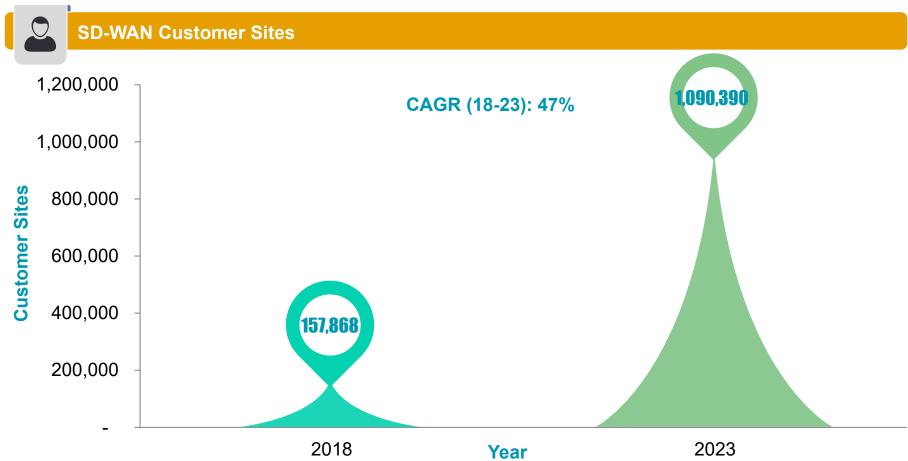


SD-WAN vendor market revenue growth rate in 2H of 2018 was higher than predicted in our mid-year update, resulting in a whopping 94% YoY growth rate from 2017 to 2018. Vendors have reported equally strong growth in the 1H of 2019, as businesses continue to embrace SD-WAN. Frost & Sullivan predicts this trend will continue, resulting in higher double digit growth rates throughout the forecast period.

**Excerpt Prepared for Silver Peak** 

Note: All figures are rounded. The base year is 2018. Source: Frost & Sullivan.

# SD-WAN Vendor Market: Total Customer Sites Forecast, Global, 2018 & 2023



The number of SD-WAN sites is expected to grow at a CAGR of ~47%, to reach the 1 million mark by 2023. The strong channel partnerships that vendors have invested in building in the last 2 years are expected to pay off throughout the forecast period. SD-WAN adoption is increasing rapidly, as validated by the end user survey results and the strong sales numbers reported by leading vendors—in terms of both sites and revenues. Additionally, vendors report a shorter proof of concept cycle now—approximately 3 months as opposed to 6-8 months in the past—resulting in reduced sales cycle time and faster rollout of sites.

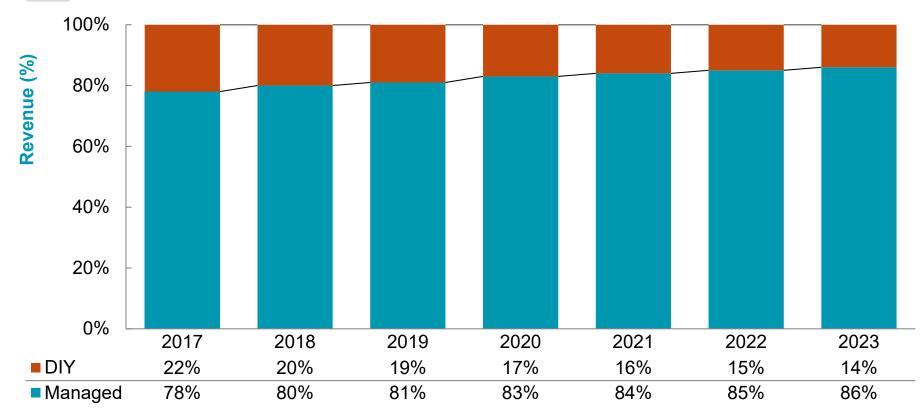
**Excerpt Prepared for Silver Peak** 

Note: All figures are rounded. The base year is 2018. Source: Frost & Sullivan.

# SD-WAN Vendor Market: Customer Sites Split by Managed vs. DIY, 2017-2023



SD-WAN Market: Customer Sites Deployed by Managed vs. DIY Model, Global, 2017-2023



Managed SD-WAN sites are expected to continue to represent a majority percentage of the total SD-WAN market, as businesses continue to prefer a provider managing the solution end-to-end, which frees-up network personnel time to focus on strategic activities.

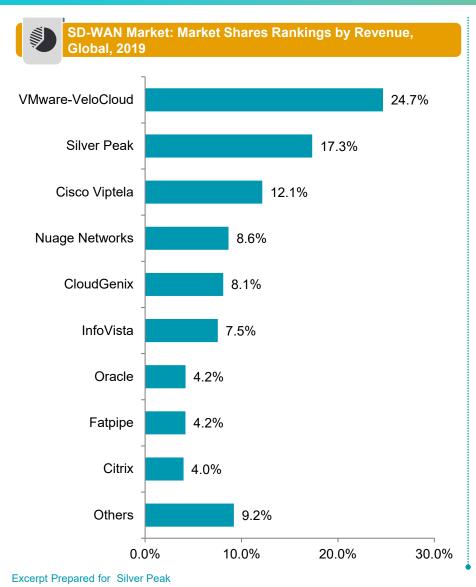
Excerpt Prepared for Silver Peak

Note: All figures are rounded. The base year is 2018. Source: Frost & Sullivan.

# SD-WAN Vendor Market: Market Share Rankings & Competitive Analysis



## SD-WAN Vendor Market Share Rankings, 2019



Market revenues for 2H of 2018 exceeded our forecast, resulting in a whopping 94% YoY growth rate from 2017 to 2018. The market share rankings for the full year is based on latest data provided by vendors. 2018, in general, and 2H of 2018 in particular was a stellar year for some of the vendors based on customer wins, deployed sites, and revenue data that Frost & Sullivan has reviewed.

- VMware-VeloCloud, Silver Peak and Cisco are the top three vendors in the market, respectively. Cisco's ranking is based on the solution offered on Viptela platform, and excludes the Meraki solution.
- CloudGenix has seen some significant wins in 2018. The company's revenues were grossly understated in our mid-year report due to insufficient information. Based on full year data provided by the company, CloudGenix is ranked #5 on our market share chart.
- Nuage Networks and InfoVista continued to witness growth in the 2H of 2018 with a majority of their revenues coming from the European region as opposed to North America for most other vendors.
- Oracle (Talari Networks was acquired by Oracle in 2018), Fatpipe and Citrix are other vendors that continue to feature on our market share chart.

The Others category includes several small SD-WAN vendors, each with market shares varying between 0.5-2.0 percent, with the exception of Versa. Versa Networks has more than 4% share but the company chose to be included in the Others category as its revenues are from SD-WAN software licensing only, which skews its ranking when comparing with other vendors whose revenues include CPE plus software licensing.

Note: The rankings are based on full year 2018 revenue data

## **Competitive Analysis**

The global SD-WAN vendor market continues to be fragmented with close to 30 vendors competing in the market. However, not all vendors offer complete SD-WAN solutions. The following section provides a brief summary of leading SD-WAN vendors:



VMware-VeloCloud retained its #1 market share ranking by maintaining the momentum the company has garnered since its inception. VMware SD-WAN by VeloCloud fits perfectly into the Virtual Cloud Network family of products by VMware that includes VMware Data Center and VMware Cloud. The company is uniquely positioned to provide network virtualization solutions that extend from the enterprise edge to data center and the cloud, end-to-end. Furthermore, access to the broad network of VMware global partners and channels has enabled the VeloCloud team to tap into a wider market segment, resulting in sustained double digit revenue growth. Given the increased focus on security, the VeloCloud team is now focused on adding more security features natively to its platform.



Silver Peak is ranked #2 on our market share chart, based on the tremendous success the company has seen (1500+ customers so far), owing largely to its extensive channel partnerships. The company has managed to remain independent in the market, and grow organically, which has attracted investors (latest funding from TCV for \$90 million). The capital has enabled Silver Peak to expand its sales and marketing efforts, globally, and also invest in R&D to evolve its solutions to compete effectively in the market.



Cisco SD-WAN is ranked #3 on our market share chart, based on the company's revenue from the Viptela solution. Revenues from Cisco Meraki is not included in our analysis. The Cisco SD-WAN (Viptela) solution is a cloud-first solution with superior routing and segmentation functionalities, which appeals to enterprises evaluating SD-WAN solutions. According to the company, enterprise security features are now integrated with its SD-WAN solution, and can be managed in vManage. Cisco has also made significant progress in selling to ultra conservative verticals such as government and utilities.



**Nuage Networks** is ranked #4 on our market share chart. The company has seen immense success in the EMEA region through its service provider channels. Nuage Networks' VNS is the core of an SD-WAN 2.0 solution, which combines support for multi-cloud, end-to-end security, and a flexible approach to value added services. The latter is unique in that Nuage Networks VNS can support embedded functions, hosting VNFs on a uCPE as well as service chaining to a CO/POP/DC/Cloud where a VNF or a physical appliance is available. This flexibility, combined with its expanding eco-system of 70+ partners, gives customers the choice of building services that meet their specific needs.



CloudGenix is ranked #5 on our market share chart. Insufficient input from the company in the past had resulted in CloudGenix revenues being understated in our previous report. The company's intent-based networking capabilities, and integrated cloud-based services, with its CloudBlades platform that integrates high-speed cloud access using Equinix and other backbones, offer enterprises a superior SD-WAN solution. CloudGenix has been successful in selling to enterprises directly and through SI/VAR/MSP channels. The company has also replaced Gen1 SD-WAN solutions for some customers.

## **Competitive Analysis (continued)**

The global SD-WAN vendor market continues to be fragmented with close to 30 vendors competing in the market. However, not all vendors offer complete SD-WAN solutions. The following section provides a brief summary of leading SD-WAN vendors:

infovista

InfoVista is ranked #6 in our market share chart. The company has over 400 customers, globally, and has seen continued growth in Europe where it has a strong foothold. The company has over 155 channel partners, which include large service providers such as British Telecom, Orange Business Services and Telefonica, to list a few. InfoVista's Ipanema SD-WAN offers superior application and network performance monitoring (APM/NPM) capabilities, which include full understanding of application usage and performance over the global network—from the smallest detail up to SLA-based application performance management. Dashboards provide conversation- and session-level detail for performance analysis.



**Talari Networks**, acquired by Oracle in 2018, was an early proponent of SD-WAN when it launched its solution in 2007. The company's Failsafe SD-WANs<sup>™</sup> delivers a multi-link WAN and focuses on high availability and superior application performance for both TCP-based apps and real-time apps like VoIP and videoconferencing. Talari is deployed by over 500 customers in more than 9,000 locations in over 40 countries.



**FatPipe** product has evolved in the past 15 years from multipath VPN (MPVPN)—a single VPN tunnel multiplexed across multiple connections to provide business continuity/disaster recovery for a VPN—to its current Symphony SD-WAN product family. The SD-WAN solution is also available as FatPipe-as-a-Service, which enables cloud service providers and managed service providers to offer managed hybrid WANs and intelligent multi-path control for WAN-as-a-Service. FatPipe mostly sells through channel partners, including AT&T, TCS, Accenture, HPE, and CDW.



Citrix SD-WAN incorporates application-aware virtualized WAN connectivity, dynamic routing, separate routing domains, WAN optimization, firewall, security and end-to-end visibility. Citrix SD-WAN is the evolved version of an earlier product called CloudBridge. Citrix announced integration with Microsoft Azure Virtual WAN, which is a completely integrated service that is scaled dynamically, based on total traffic and connections. It operates through a set of secure API's that Citrix uses on Azure to manage connections from the enterprise to Azure. Citrix sells through multiple channels including managed service providers, application service providers, and VARs.



Versa Networks has chosen to be included in the Others category in our market share chart. Based on recent data provided to F&S, the company has 600+ customers. Versa Networks' Cloud IP platform offers a holistic solution that includes SD-WAN, routing, and advanced integrated security features, which include integrated next-generation firewall and unified threat management (UTM) capabilities. The company's native security features are unmatched by any other SD-WAN vendor in the market. The cloud-native protocols, multi-tenancy and advanced NFV features, including open APIs offered by the platform, make it easy to drop FlexVNF (Versa's SD-WAN VNF) into any cloud for Versa's MSP partners.

## **Competitive Analysis (continued)**

The global SD-WAN vendor market continues to be fragmented with close to 30 vendors competing in the market. However, not all vendors offer complete SD-WAN solutions. The following section provides a brief summary of leading SD-WAN vendors:

riverbed

**Riverbed** declined to provide input to this report. The company is going through organizational changes, and seems to have chosen an alternative route to the SD-WAN market by partnering with Versa Networks.



**Fortinet** is not listed in the market share rankings as the company doesn't charge a fee for SD-WAN functionality, but rather offers it as an in-built feature with its FortiGate solution to drive adoption of security services.

Aryaka and Cato Networks are providers who have taken a cloud-based approach to offering SD-WAN in an "as a service" model. The companies are not ranked on our market share chart as their revenues include connectivity services, which creates inconsistencies while comparing with other vendors that do not include network services. Aryaka and Cato's revenues are instead included in Frost & Sullivan's managed SD-WAN analysis that includes connectivity services.



Aryaka's global SD-WAN consists of a purpose-built, fully meshed, private network that uses Layer 1 and Layer 2 services purchased from global network service providers. Aryaka's private network uses SDN and NFV principles at its core. The SDN-enabled network is tightly integrated with Aryaka's proprietary, cloud-based WAN optimization stack—consisting of WAN optimizers and application delivery controllers (ADC). Aryaka's business is comprised of a 50/50 split between direct and channel. The company has more than 100 global partners, with over 10,000 agents in the referral program in the Americas.



Cato Network's SD-WAN solution combines an optimized WAN and cloud connectivity with built-in enterprise-grade security and unified network and security policy. Cato uses its in-house firewall and routers, rather than partnering with an OEM. Cato Socket SD-WAN goes over a Tier 1 backbone instead of MPLS, and the solution uses identity-aware routing, enabling enterprises to maximize last mile connectivity. Cato networks has 50+ software-based PoPs around the world, serving over 400 customers, with over 3500 sites globally.

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