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Beyond the Basics: How SD-WAN Is Evolving to Improve Performance and Reliability

The software-defined WAN space is heating up as enterprises look for faster, secure and cheaper ways to connect their offices, which is creating new business models and services for partners and network providers.

By Kurt Marko

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TABLE OF CONTENTS

| | |
|--|----|
| SD-WAN Market: Small, Growing and Consolidating. | 5 |
| Expanding the Service Portfolio | 6 |
| Centralized Management in Focus | 6 |
| Simplifying Management With Intent-Based Semantics and AI | 7 |
| Converged Infrastructure and SD-WAN: Adding Virtual Network Services. | 9 |
| Changing Business Models for Service Providers | 10 |
| SD-WAN Action Plan | 10 |



[Previous](#)[Next](#)

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KURT MARKO is an IT industry analyst, consultant and regular contributor to a number of technology publications, pursuing his passion for communications after a varied career that has spanned virtually the entire high-tech food chain from chips to systems. Upon graduating from Stanford University with bachelor's and master's degrees in electrical engineering, Marko spent several years as a semiconductor device physicist, doing process design, modeling and testing. He then joined AT&T Bell Laboratories as a memory chip designer and CAD and simulation developer. Moving to Hewlett-Packard, he started in the laser printer R&D lab doing electrophotography development, for which he earned a patent, but his love of computers eventually led him to join HP's nascent technical IT group. Marko spent 15 years as an IT engineer and was a lead architect for several enterprisewide infrastructure projects at HP, including the Windows domain infrastructure, remote access service, Exchange email infrastructure and managed web services.

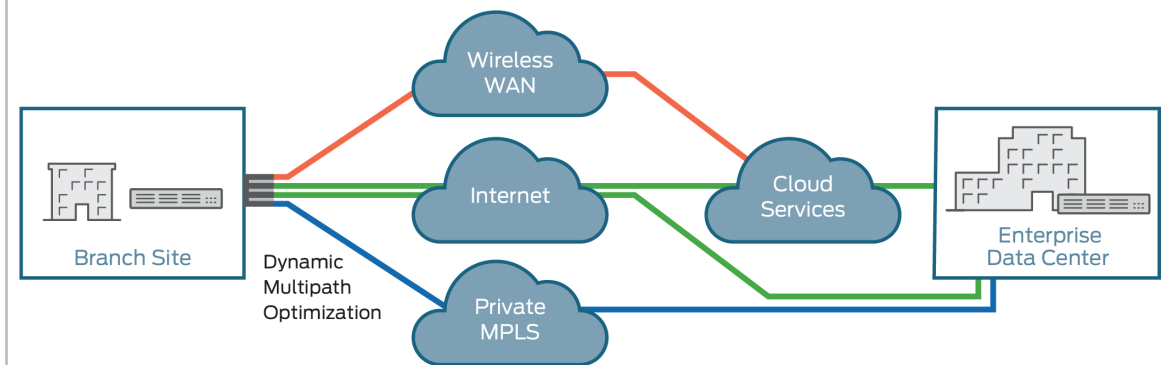
Beyond the Basics: How SD-WAN Is Evolving to Improve Performance and Reliability

IT'S BEEN YEARS SINCE THE HYPE OVER SDN settled into disappointment, cynicism and eventual resignation that it won't be as revolutionary as IT organizations had hoped. So, it's ironic that the most consequential network software technology for the vast majority of organizations that aren't cloud operators or major carriers is being propelled not by deficiencies within the data center, but the needs for enhanced wide area connectivity.

SD-WAN is the SDN offshoot that finally delivers on the promise of software-abstracted networks. While SD-WAN isn't a new topic for network experts and vendors, it has slowly evolved into a mainstream alternative or supplement to traditional WAN links by virtue of software-defined improvements to network versatility, scalability and operational efficiency.

We have previously [covered the basics](#), along with the most common SD-WAN use case for [remote site connectivity](#). However, SD-WAN is a dynamic field, and both the market and technology have subsequently evolved, as small, pure-play startups have been acquired by traditional IT

Basic SD-WAN Operation



Source: SDxCentral

vendors and early SD-WAN users have increased their understanding and usage of the technology, prompting demands for new features. In this report, we'll examine the state of the SD-WAN market; highlight emerging needs and product trends; and discuss how the nexus of SD-WAN, data center SDN, server virtualization and associated virtual network functions enables new business models and services for partners and network providers.

SD-WAN Market: Small, Growing and Consolidating

Size estimates for the SD-WAN market vary widely due to imprecise and inconsistent product categorizations and the difficulty of measuring any emerging product type, but everyone agrees on two things: The market is small, but it is rapidly expanding. [Gartner figures](#) SD-WAN sales will grow 59 percent compounded annually through 2021, reaching \$1.3 billion, which implies a current size

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of about \$200 million. [IHS Markit](#) is more optimistic, estimating SD-WAN revenue will hit \$862 million this year, up 12 percent in the last 12 months. It has an [equally rosy prediction for 2021](#), expecting total SD-WAN sales of \$3.3 billion, with an implied CAGR of 40 percent. Splitting the difference, it's safe to assume that SD-WAN sales will be about half a billion dollars this year, growing to about \$2 billion to \$2.5 billion over four years. Yes, it's a small market, but one with plenty of upside for vendors and service providers that establish a leadership position now that we've passed the early-adopter phase.

SD-WAN was pioneered by either pure-play startups or niche networking companies specializing in WAN optimization. Like most technologies, SD-WAN has gone through a wave of consolidation as it has matured into a mainstream product, with VMware acquiring VeloCloud and Cisco snapping up Viptela in the last year. Consequently, it's not surprising that IHS Markit estimates that the top four vendors — VMware (post-VeloCloud), Aryaka, Silver Peak and Cisco — accounted for about 62 percent of total SD-WAN spending in the first quarter of 2018.

The list is noteworthy since it is dominated by software and equipment vendors, not service providers. Indeed, Aryaka and FatPipe are the only SD-WAN services in the entire HIS Markit

ranking. The skew toward product vendors is likely a combination of methodological bias, the difficulty of measuring SD-WAN-derived revenue at the large carriers and the fragmented nature of the SD-WAN services market. Nevertheless, it does indicate that the market is still focused on selling picks and shovels (products) and not ore extraction and refining (services), a situation that leaves ample room for partners and providers to build a sizable SD-WAN business.

Expanding the Service Portfolio

As we [discussed in an earlier report](#), the foundation of SD-WAN is the ability to virtually bond any type of WAN circuit, whether carrier Ethernet, cable broadband or wireless LTE, into a single logical link and dynamically route traffic over the individual physical circuits based on its performance, capacity, congestion or predefined policies. As we detailed, other critical SD-WAN features are:

Central control, management and security policy enforcement over all links and virtual circuits in an organization, or those operated by a service provider, from a single management console.

The ability to **add features and insert network and security services** such as WAN optimization, firewalls, content filters or data loss prevention systems on any link by using virtual network functions (VNFs).

Early SD-WAN deployments concentrated on the basics, namely providing network connectivity or expansion to remote sites, many of which are underserved by traditional carriers and where conventional enterprise WAN circuits are either unavailable or prohibitively expensive. Now, as early adopters and vendors have gained experience and honed the technology, an evolving SD-WAN market is focused on improving features in those two bulleted areas: central management and virtual service insertion.

Centralized Management in Focus

A principal benefit of SDN, SD-WAN included, is the ability to centrally control and manage network configuration and policies for all network segments, devices and locations in an organization. However, management features weren't the focus of early SD-WAN products or buyers, who were simply drawn by the ability to use cheaper alternatives to traditional WAN circuits and bond multiple connections to improve performance and reliability.

As SD-WAN deployments have evolved from small pilots at a few hard-to-service locations to a wholesale alternative to more expensive MPLS service, management consoles and features have become a critical component, particularly for large enterprises and network service providers.

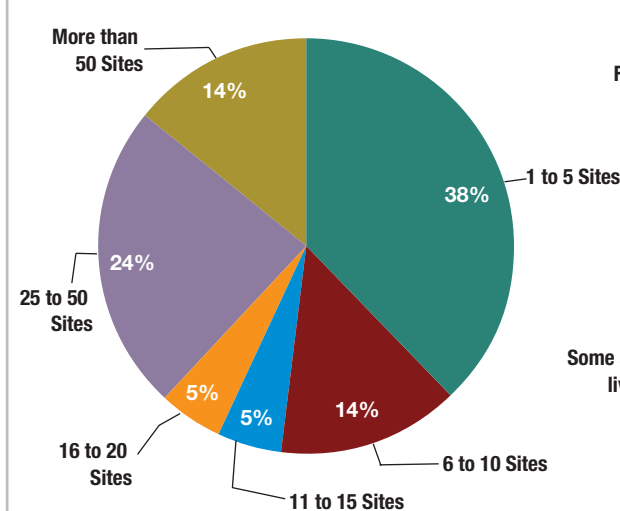
Indeed, a [Gartner guide to WAN edge infrastructure](#) notes that management and usability are areas of product differentiation between vendors. In characterizing the market, Gartner finds that ease of management, network visibility and analytics rank with price and performance as significant factors in making buying decisions.

Most products provide a graphical web UI with multiple views of the network, its performance and link configuration. For example, VeloCloud, whose management UI gets excellent reviews from Gartner's clients, [features a map view](#) showing the location, site, and network status and basic information about the edge device. The Citrix and [Silver Peak](#) management products, both adopting the popular Orchestrator label, feature a similar map view.

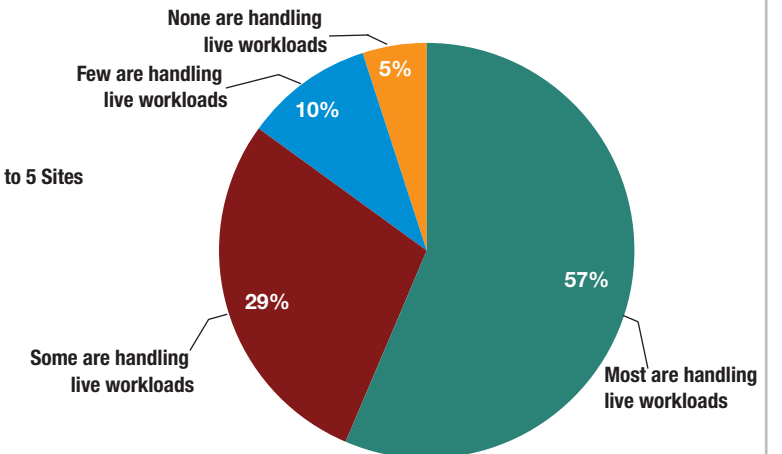
Many products, such as the aforementioned [Citrix SD-WAN Orchestrator](#), are designed for multi-tenant operation and provide management dashboards tailored for different user groups. For example, the Citrix UI has a provider interface that shows an overview of all SD-WAN customers; a customer dashboard with a global map of sites, network condition and usage; and a site view that provides details about a particular location, such as usage trends, including splits by application, and alerts. Such versatility is required for partners operating an SD-WAN-based service for multiple clients, and products lacking the ability to both aggregate various

SD-WAN Deployment

At roughly how many sites has your organization deployed SD-WAN?



What best describes the sites where SD-WAN is currently deployed?



Source: Gartner Inc.

customer accounts and provide individualized dashboards for each client should be avoided.

Simplifying Management With Intent-Based Semantics and AI

Network management has always been complicated, tedious and, hence, error-prone, which is why the move toward so-called intent-based networks (IBNs) is so needed and valuable.

Cisco was an early adopter of the concept, and while [we were critical of its initial announcement](#) that was heavy on vision and light on details, in the intervening year-plus the company has started delivering on the promise including for WANs via the Viptela acquisition and [recent feature additions](#).

Cisco has been perhaps the most prominent traditional networking vendor to embrace IBNs. However, the concept was pioneered by pure-

play startups, notably Apstra. [Its CTO defines the core elements that](#) make IBN so powerful **(emphasis added)**:

*“At the highest level, **intent is a declarative specification of the desired outcome. And the desired outcome is complete automation of the whole network service lifecycle, which consists of the following phases: design, build, deploy, validate.***

*“At a high level, **Intent defines the ‘what’ not the ‘how’.** A key observation is that intent is dynamic, and **a fundamental requirement of an IBN system is that it should be capable of ensuring that intent’s expectations are met in the presence of change. And changes can come from either the operator (business rule change) or the infrastructure (operational status change).**”*

As the Viptela technology demonstrates, IBN can be applied to any software-defined network, and SD-WAN is particularly appropriate since it entails balancing the performance needs and security requirements of a diverse set of users and applications sharing the same network pipes. By making it easy to prioritize different types of traffic like IP voice and video, or set security policies for individual applications such as credit card processing and in-store Wi-Fi using the physical same links (albeit, on different logical networks),

IBN can reduce management overhead, eliminate configuration mistakes, and improve the overall quality and consistency of SD-WAN operations. IBN is still in its infancy, and its application to SD-WAN is virtually non-existent. However, we expect that most vendors will embrace the concept over the coming years as they continue to refine their network management capabilities.

By translating natural language semantics into network policy particulars, IBN can be seen as adding intelligence to network management. We fully expect vendors to bring other artificial intelligence (AI)-inspired management features to SD-WAN products and services in the next few years. For example, whether we’re talking about aircraft engines or credit card transactions, the nexus of granular device telemetry, aggregated big data repositories and machine learning (ML) enables predictive analysis of trends and early detection of anomalies. Applying ML to SD-WAN can allow much better optimization of traffic flows and path priorities, proactive warning of failing circuits or equipment, and improved detection of security threats and attacks.

As with IBN, the application of ML and other AI techniques, such as chatbot virtual assistants as a management UI, is just beginning. However, there are signs that vendors are ramping up their development investments. For example, [Silver](#)

[Peak recently acquired another \\$90 million in venture funding](#) that will undoubtedly accelerate its efforts to develop [what it calls the “self-driving WAN.”](#) In the service provider business, [Netrolix](#) calls its offering AI-WAN, which it describes [as using](#) ML algorithms to automatically route traffic based on real-time performance and conditions.

The application of AI to SD-WAN could also solve the festering problem of application performance management (APM) in an environment where the network topology is non-deterministic and circuit performance highly variable (particularly when using wireless or consumer-grade links). The latency, jitter and packet loss of such circuits aren’t consistent, making predictable application performance nearly impossible. Applying predictive intelligence to SD-WAN traffic routing and prioritization decisions could mitigate these performance problems and eventually enable service providers to guarantee performance limits.

Expect to see a furious pace of development as SD-WAN vendors discover how to apply their unparalleled ability to collect network measurements with advanced ML and deep learning techniques to improve performance and security.

Converged Infrastructure and SD-WAN: Adding Virtual Network Services

A prime example of how the marriage of SD-

WAN and NFV allows the insertion of network services is what [VMware has done with VeloCloud](#). In less than a year, the company has incorporated it into a growing NSX virtual network portfolio as a WAN overlay that seamlessly connects to an NSX data center network and is managed via an existing NSX console. Indeed, [VMware recently illustrated the power of network service insertion](#) by enabling the Palo Alto Networks security platform to inspect and secure WAN traffic by routing it through Palo Alto's GlobalProtect Cloud Service. [Cisco does similar L4-7 service insertion](#) with technology from Viptela that uses a routing protocol to advertise services across a virtual network and a central controller to create a service chain and manage route policies that direct traffic based on particular attributes like application type, user or network segment.

The Cisco and VMware examples illustrate the insertion of external, cloud services into an SD-WAN flow. However, such network applications can also run locally on a virtual server. The combination of compact, hyperconverged systems and virtual network applications means that the days of having a handful of discrete appliances at every remote location are over. All-in-one network devices such as the Cisco 5000 [SD-Branch system](#), Fortinet [FortiGate VM series](#) and others can converge branch office routing, SD-WAN and various network security services onto a single, expandable box.

We expect to see further functional convergence as networking vendors adopt virtual appliances and commodity server and switching hardware to create branch-in-a-box products that can be preconfigured for easy deployment and centrally managed to eliminate remote administration. Similarly, for organizations using hyperconverged servers (HCI) like Nutanix, Dell-EMC VxRail and

HP Enterprise SimpliVity, the ability to run SD-WAN, other network services and enterprise applications on an expandable, centrally managed HCI chassis that can include several server nodes is a compelling way to reduce both CapEx and OpEx. HCI products that combine one or more VM servers, local storage and virtual network appliances into a single, centrally managed box

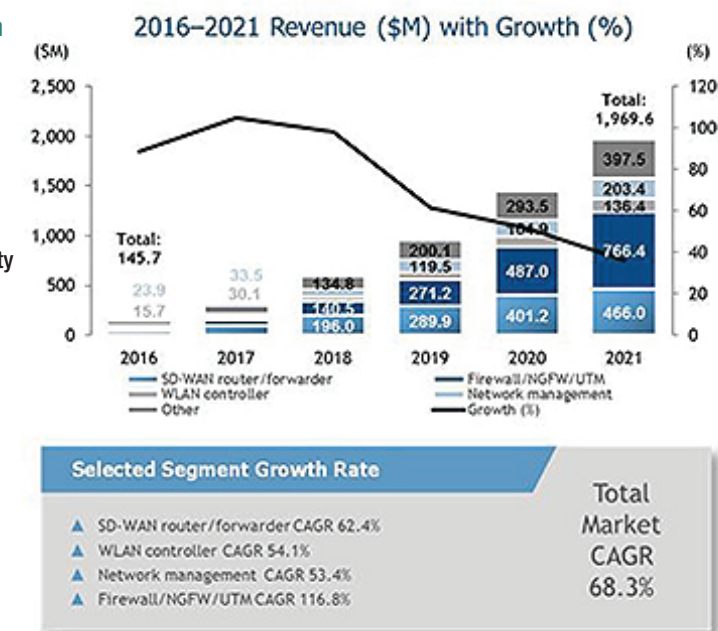
SD-Branch: Telco vCPE/uCPE Opportunity

Telcos seek to address the SD-Branch with vCPE/uCPE services

- Router (includes SD-WAN)
- Firewall (NGFW/UTM/IDP/IDS)
- WLAN Controller
- WAN optimization
- Session Border Controller (SBC)
- Network Management
 - Network monitoring and visibility

Enterprise benefits

- Operational simplicity
- Flexibility
- Agility



Source: IDC

are ideal for partners offering multiple services to customers with many remote locations.

For example, Citrix NetScaler SD-WAN, Fortinet and Silver Peak join several other routing and network security products in being [supported on Nutanix](#). Aside from the benefits of consolidating devices and admin overhead to a single platform, such convergence of application workloads and network services can improve security and network visibility through the aforementioned VNF service insertion and centrally enforced policies that ensure that all traffic passes through embedded security services or is optionally routed to an auxiliary cloud service for more detailed inspection.

Changing Business Models for Service Providers

SD-WAN is a powerful tool that partners can use to expand their network footprint and service portfolio. Today, it is implemented atop an assortment of conventional WAN circuits from carriers, cable companies and ISPs. Indeed, many partners resell SD-WAN services provided by a larger telecom company. Over time, SD-WAN might reshape the market for network services by enabling a new type of virtual network operator that [PwC calls the software-defined carrier](#) (SDC). Atop a foundation of virtualized networks, servers and services, and using SDN and NFV as the software

substrate, an SDC, similar to a mobile virtual network operator (MVNO), insulates customers from the details of physical carriers and circuit types behind a software and service abstraction layer.

An SDC can provide services from any access carrier, changing or updating the underlying networks without affecting its services or customers. Similarly, building its software services atop a cloud foundation such as AWS, Azure or Google Cloud Platform insulates the SDC from infrastructure disruptions and offers greater scalability, reliability and agility as it exploits the rapid innovation cycle of the cloud. We concur with PwC that “The migration towards virtualized networks is not a trivial undertaking, but the business and cost efficiency opportunities on offer are too large to ignore,” and offers a business model that allows partners to provide differentiated services while exploiting the enormous capital investments of the hyperscale cloud operators and large carriers.

SD-WAN Action Plan

Hopefully, partners have heeded recommendations in our earlier reports and begun using SD-WAN in select situations, since now is not the time for evaluation, but execution and expansion of SD-WAN-based service plans.

Production-level SD-WAN projects must build upon a base understanding and use of SD-WAN technology by focusing on management features that increase operational efficiency, deliver customer portals with information dashboards and self-service options, and enable upselling of other network services such as firewalls, security scanning, DLP, APM and content distribution.

One’s zeal to expand SD-WAN service must always be tempered by attention to efficiency and cost and ease of use. We reiterate a point made in an [earlier Channel Online article](#) by Rhonda Trainor, ScanSource’s director of merchandising and an editorial advisory board member, who said, “SD-WAN providers must be competitive to traditional connectivity, while making the product simple to implement and monitor.” Trainor makes another critical point about ensuring that SD-WAN services are tightly connected with your customer’s requirements when she says, “Many suppliers may fit into an area or two, but adapting to what the customer’s real needs are is the key to providing the best overall cutting edge SD-WAN solution.”

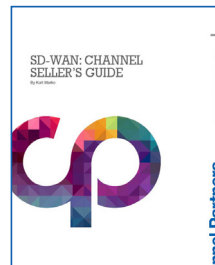
Today’s SD-WAN products offer the platform for impressive new network services, but it’s up to partners to turn the technology into a profitable business that wins customers and benefits their bottom line.

Related Reports



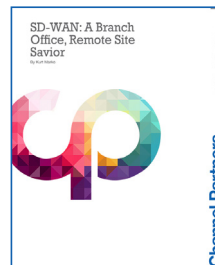
[Software-Defined Everything: 5 Trends for 2018](#)

If you only think of SD-WAN when you think software-defined services, you're missing a big, broad and fast-growing ecosystem. Yes, delivering a service to, say, integrate public clouds and customer data centers to better deliver applications and enable IoT will take some technical know-how. But the opportunity is worth that investment.



[SD-WAN: Channel Seller's Guide](#)

The SD-WAN trend is on fire, especially in lucrative verticals like retail. The trend is sparked by inexpensive yet blazingly fast broadband, more use of the cloud and a new “mobile-first” mentality. This report explains how value-added services, bundling and upsell opportunities can increase already rich monthly recurring revenues.



[SD-WAN: A Branch Office, Remote Site Savior](#)

Got clients that want to transition to SD-WAN but see remote site connectivity as a roadblock? That's where you come in. This report explains how a hybrid WAN can bundle multiple connection types and provide customers with business-class features, security and connectivity to locations where traditional circuits would be prohibitively expensive.