Technology Overview for SD-WAN

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Summary

SD-WAN is an emerging technology that offers several benefits compared with traditional, router-based WANs. Network decision makers can achieve cost savings, increased agility and simplification with an SD-WAN. This research defines SD-WAN and highlights its benefits, risks and alternatives.

Overview

Key Findings

- Software-defined wide-area network (SD-WAN) is a new approach to support branch office connectivity in a simplified and cost-effective manner.
- The emergence of public cloud computing has rendered traditional enterprise WAN architectures to be suboptimal, from a price and performance perspective.
- Organizations can pilot and test SD-WAN solutions with minimal impact to their overall network infrastructure.
- WAN carriers will increasingly incorporate SD-WAN capabilities into their new, enterprise-class service offers.
- The SD-WAN vendor landscape is rapidly evolving, and solutions are available from both new and established networking vendors.

Recommendations

- Network architects should modernize traditional WAN infrastructures that were previously optimized for delivering all services via corporate data centers.
- Enterprises struggling with device complexity and/or high WAN transport or equipment costs should pilot SD-WAN solutions in their branch offices.
- Organizations looking to build hybrid WANs and/or refresh branch WAN equipment should include SD-WAN solutions on their shortlists.
- Enterprises using managed WAN services should pilot SD-WAN solutions offered by their managed WAN service providers.

What You Need to Know

SD-WAN is a new and transformational way to architect, deploy and operate corporate WANs, as it provides a dramatically simplified way of deploying and managing remote branch office connectivity in a cost-effective manner.

SD-WAN is particularly beneficial as organizations adjust their networks to match prevailing user and application needs, stemming from increased use of public cloud services — which are forecast to grow at over 20% CAGR thru 2018 (see Note 1 and "Hybrid Will Be the New Normal for Next Generation Enterprise WAN").

SD-WAN is separate and unique from software-defined networking (SDN), but builds upon several of the principals associated with SDN including programmability and abstraction (see "Ending the Confusion About Software-Defined Networking: A Taxonomy").

SD-WAN solutions can be piloted in a small number of remote locations with very limited risk, due to a limited "blast radius," as branches have discrete network boundaries. This is in contrast to piloting data center SDN solutions, which often impact the larger application environment. As a result, we anticipate a rapid uptake of SD-WAN deployments in the near future, including:

- By year-end 2017, at least five global carriers will have incorporated SD-WAN as a key component of their managed network service designs, up from zero today.

- By year-end 2018, 10% of enterprises will have replaced their WAN routing with SD-WAN-based path forwarding, up from less than 1% today (see "Virtualization and SD-WAN Enable Branch Office WAN Simplification").

Analysis

SD-WAN provides new features that better handle changing network traffic patterns resulting from cloud computing. SD-WANs resolve some of the most pressing WAN problems clients currently face when building and managing hybrid WANs, and will face with growing frequency going forward, including:

- The high cost of WAN connectivity, which is exacerbated by difficulty in load sharing traffic across a mix of WAN connections
- Complex, static and manual network configurations that are not easy to adapt or scale to changing needs, or map to business-centric requirements
- The inability to provide security and visibility for WAN traffic

Technology Description

SD-WAN abstracts the underlying network transport/connectivity to present a business-centric or application-centric approach. In an SD-WAN implementation, traditional device-based command line interface (CLI) configurations can be replaced by centralized, network-wide control and orchestration. This enables enterprises to centrally configure and manage WAN traffic via graphical user interfaces, based on business-related policies, while providing increased visibility.

Technology Definition

SD-WAN solutions employ centrally managed WAN edge devices placed in branch offices to establish logical connections with other branch edge devices across the physical WAN. These logical connections create secure paths across multiple WAN connections and carriers, such as hybrid Internet and multiprotocol label switching (MPLS) architectures (see "Virtualization and SD-WAN Enable Branch Office WAN Simplification").

Standards

There are currently no new standards for SD-WAN implementations (see Note 2). SD-WAN solutions use existing standard network protocols such as IP, IPsec, etc., which are often combined with the vendors' proprietary overlay control mechanisms.

SD-WAN Operating Requirements

Gartner defines the following four key requirements for a solution to be categorized as SD-WAN:

1. SD-WAN solutions provide a lightweight replacement for traditional WAN routers and are agnostic to WAN transport (that is, support MPLS, Internet, LTE, etc.).
    - The branch component must have the capability to physically terminate carrier services
2. SD-WAN solutions allow for load sharing of traffic across multiple WAN connections in an efficient and dynamic fashion that can be based on business and/or application policies.
3. SD-WAN solutions dramatically simplify the complexity associated with management, configuration and orchestration of WANs.
    - The level of expertise required to configure the branch is akin to what is required to set up a basic home wireless network with consumer-grade equipment.
    - Configuration parameters are application-centric and/or business-centric and can be created/applied/changed by personnel that are not well-versed in networking technologies.
    - The solution must support zero-touch provisioning for new branches, which entails on-site branch personnel have to make physical (i.e., cabling) changes only and administrators not having to make configuration changes to bring new branches online.
4. SD-WAN solutions must provide secure VPNs and have the ability to integrate additional network services.

- The solution must support service-chaining of other network services and devices, such as WAN optimization controllers, firewalls, secure Web gateways, etc.
- The branch component must support secure VPNs and 128-bit encryption (with future support for 256-bit encryption).

These criteria exclude orchestration-only solutions that require separate third-party networking software to perform connectivity functions. Further, SD-WAN solutions do not require decoupling of the forward and control planes, hence are not necessarily SDN.

SD-WAN Uses

SD-WAN is specific to enterprise WANs and applies to branches of all sizes, geographies and vertical markets. SD-WAN provides the greatest benefit for organizations that exhibit any of the following characteristics:

- Are moving toward a hybrid WAN topology, to support public cloud services
- Seek to reduce traditional business-class carrier services' budgets
- Want to reduce management complexity of their WAN
- Want to reduce cost of existing WAN remote branch equipment, often during a refresh cycle
- Have a large number (more than 25) of remote branches
- Are aggressively deploying video to branch office locations
- Maintain limited or no IT personnel on-site in remote branches

In North America, 65% to 70% of enterprises manage their own WAN equipment, thus an enterprise will typically source SD-WAN solutions from the SD-WAN equipment vendor. [1] In Latin America, Asia/Pacific and Europe, Gartner estimates that 70+% of enterprises rely on their network service provider(s) for management of WAN equipment. Thus, in these geographies, SD-WAN solutions will typically be embedded in their carrier's managed service offering.

Benefits and Risks

The benefits of an SD-WAN approach are substantial compared to traditional WAN architectures, including reduced costs, improved provisioning times and the potential for enhanced branch availability/uptime.

Reduced Costs

Compared to traditional WANs, we anticipate SD-WANs can save at least 40% through:

- Reduced acquisition costs for hardware, software and support of vendor-provided remote office WAN equipment
- Reduced enterprise operational expenditures in managing/operating the WAN
- Carrier savings from implementing hybrid WANs, which varies by geography [2]

Faster Provisioning

Due to simplified configuration, orchestration, and zero-touch provisioning (ZTP), we anticipate 50% to 80% improvement in the time it takes enterprises (or relevant third parties) to provision network changes at branches. This is in line with what early adopters have experienced after implementation.

Network Availability

We anticipate improved branch network availability due to simplified and less-brittle configurations. In addition, ZTP reduces manual configuration of devices, and Gartner clients report that manual configuration error is a leading cause of network outages. However, it is worth pointing out that market adoption has yet to sufficiently scale to fully validate these outcomes.

Risks

The primary risks associated with SD-WAN are immaturity and limited ability to consolidate multiple network functions in a single platform.

IMMATURITY

As of 2Q15, we estimate there are less than 5,000 branches globally deployed using SD-WAN. Therefore, it is still unproven at this point. In addition, many of the SD-WAN vendors are smaller startups (that is, CloudGenix, VeloCloud, Viptela), which may lack the financial resources to sustain long-term market viability. Prior to purchasing from smaller vendors, organizations should request references of similar size/complexity and

confirm appropriate levels of sales and support resources (see "Cool Vendors in Enterprise Networking, 2015").

LIMITED ABILITY TO CONSOLIDATE NETWORK FUNCTIONS IN A SINGLE DEVICE

Traditional WAN designs often incorporate "heavier" CPE with the capability to run additional network functions on the router. This includes specific functions such as:

- WAN optimization
- Voice services
- Security (firewall and VPN)
- x86 compute, which can be used to further run additional network functions

Organizations that have consolidated multiple network functions into their existing physical router footprint will have to offload this functionality when moving toward a lightweight SD-WAN CPE. This process could undermine the capital and operational savings of moving toward an SD-WAN.

Organizations that have consolidated voice services within the router will have particular difficulty. However, this inability to consolidate functions is not inherent to the SD-WAN concept, and we anticipate more vendors to integrate and/or partner to deliver these services over the next two years.

Technology Alternatives

Traditional WAN Architectures

This approach combines fully featured, on-premises physical or virtual devices including routers, WAN path controllers, WAN optimizers and security products and services. This is currently the most mature approach to building and managing WANs and is employed by most enterprises, but is also the most expensive. It allows (but doesn't require) enterprises to select best-of-breed capabilities in each functional category. Although it is complex to deploy and manage, this complexity can be somewhat mitigated by using reference design templates and/or managed services from managed network services providers or system integrators. Though this solution is proven and mature, it is less agile and flexible than an SD-WAN approach.

Network Automation and/or Orchestration Tools

These software-based tools are applied to existing WANs, without the requirement to add or replace CPE. These tools are compelling for organizations that don't want to replace existing CPE and who are:

- Primarily struggling with network change complexity and/or
- Having difficulty in orchestrating WAN traffic across multiple links

Enterprise-class network automation tools are sold by most router vendors, including Cisco (Prime), HP (IMC) and Juniper Networks (Junos Space) and independent software vendors such as Infoblox and SolarWinds (see "Minimize Outage Exposure and Risk With Network Automation Tools"). Examples of vendors that provide advanced WAN network orchestration include Glue Networks and Anuta Networks (see "Cool Vendors in Communications Service Provider Infrastructure, 2013").

Network Functions Virtualization Services (Commonly Referred to as vCPE)

Network service providers are in the process of deploying new WAN services, underpinned by SDN and NFV. These services provide virtualized CPE (vCPE), delivered as hosted services, rather than on-premises devices. This includes network functions such as routing, security and WAN optimization.

This allows an even greater degree of flexibility than offered by SD-WANs, as virtual device capacity can be adjusted on-demand and new functions (such as security or WAN optimization) can be added or removed from the network in minutes via self-service portals or APIs. Device scalability ceases to be an issue, and network-based services should have higher availability than on-site devices.

However, this approach has disadvantages when access bandwidth is limited, unreliable or access latency is high. Also, at present, these services are immature, with large numbers of trials and pilots but only a handful of live production services (see "Market Guide for Carrier SDN and NFV Services").

Communications Hubs

For organizations looking to migrate most applications to the public cloud, colocation hubs are the best long-term strategy. In this design, organizations acquire connectivity to carrier-neutral colocation facilities that physically house their SaaS and IaaS services.

Communications hubs can be used both as an alternative to SD-WAN, and in conjunction with SD-WAN (see "Communications Hubs Improve WAN Performance").

SD WAN Selection Guidelines

At casual glance, it can be very difficult to differentiate between SD-WAN solutions as they provide branch connectivity in a simplified and cost-effective manner. In addition, this is a fast-moving market that will undergo substantial change within the next 18 months. When evaluating and selecting solutions, organizations should ask prospective SD-WAN vendor specific questions to determine which solution best meets their branch connectivity requirements.

Architecture and Deployment

- What is the scale (i.e., minimum and maximum number of remote branches) supported by the solution?
- How is resiliency achieved for the different components in the architecture (particularly the controller)? See "Bandwidth Doesn't Matter; Availability Drives Enterprise Network Costs."
- Within a corporate WAN, how do SD-WAN sites communicate with non-SD-WAN locations?
- How is the management capability delivered, via on-premises and/or as a cloud-managed (SaaS) offering? If SaaS, where and how are the platforms hosted?
- Does the solution include network-based infrastructure (points of presence) to monitor Internet performance and/or act as hubs for traffic routing? If so, where and how are the points of presence hosted and connected?
- How is direct Internet access supported? Is there an embedded firewall or does the solution offer or integrate with on-premises and/or cloud-based security services? See "Optimize Enterprise Networks to Improve SaaS Performance."
- Can the branch component can be delivered via physical appliance and/or software (VM or container)?
- Can the branch component support legacy WAN transmission interfaces, including T1, E1, DS3 and other WAN access types such as cellular connections, or is it

limited to Ethernet interfaces? See "IT Market Clock for Communications Services, 2014."

- Can the solution support multiple criteria for path selection, including business priority, latency, packet loss, jitter, etc.?
- Are full mesh and partial mesh for branch-to branch connectivity required and/or supported?

Application/Services Integration

- How does the solution support cloud-based applications? Does the enterprise have to create its own gateways/hubs or is the solution integrated into cloud services (both IaaS and SaaS)? See"Four Steps to Optimize Your Network for IaaS."
- Does the branch component contain built-in L4-L7 network services, including WAN optimization, secure Web gateway (SWG), firewall, intrusion detection systems (IDSs), data loss prevention (DLP), etc. and/or offer integration with devices and services that perform these functions? See"Magic Quadrant for WAN Optimization" and "Magic Quadrant for Secure Web Gateways."
- What commonly used applications and services can be natively identified with the solution?
- How are latency-sensitive (that is, real-time) applications prioritized over non-real-time applications?
- Does the solution have a northbound API that allows programmatic control of the network from external systems?

Price

- What is the three-year total installation/hardware/software/licensing/service cost?
- Can the solution be delivered via both a capex and/or a pure opex pricing model?

Visibility and Security

- What level of visibility and reporting for application availability and performance is supported?
- Is there an analytics engine with a global view of the network, from which the system can report and act upon in real time?

- What security mechanisms exist to ensure unauthorized devices are not added to the WAN?
- How are logical network segmentation and multitenancy achieved?

Price/Performance

Price/performance is one of the biggest advantages of SD-WAN over traditional approaches. We've observed early adopters dramatically reduce their WAN equipment and operations costs (by more than half) while maintaining or improving application performance. Cost savings come via several mechanisms, including:

- Reduced capital cost for networking equipment (see Appendix).
- Better utilization of WAN ports as SD-WAN improves load sharing across multiple ports (versus active/passive backup configurations); this can delay the need to add incremental carrier bandwidth.
- Reduced operational costs due to zero-touch deployment and central policy management.
- Reduced WAN services costs as SD-WAN allows easier transition from exclusive use of MPLS links to hybrid WANs, using broadband Internet connections. As choice of WAN services, relative price and even regulated use can vary by country, clients must verify their assumptions align with local conditions (see "Enterprises Can Successfully Navigate Net Neutrality").

Technology Providers

As of 2Q15, the following vendors provide SD-WAN capability: Cisco, CloudGenix, Nuage Networks (a subsidiary of Alcatel-Lucent), Ocedo, Silver Peak, Talari Networks, VeloCloud, and Viptela. However, it is important to note that this is a fast-moving market, and we anticipate additional competition will emerge over the next 18 months, including:

- Market entry from additional network equipment vendors such as Brocade, Dell, HP (Aruba), Juniper, Riverbed and others
- Network service providers will incorporate SD-WAN as a key component of their enterprise-class managed network service offerings

Appendix

SD-WAN Cost Savings

The following example identifies savings of over 60% from an SD-WAN deployment at a 250-branch WAN. This includes savings from the router capital and support costs, and operational personnel costs. This does *not* include savings facilitated by changing WAN transport services, which would lead to additional savings.

Table 1. Costs for SD-WAN

Example: Three-Year Costs for 250-Branch WAN		
Item	Traditional	SD-WAN
Router Capex	$1,000,000	$250,000
Router Maint/Support	$180,000	$150,000
Staffing Opex	$105,000	$52,500
Total	$1,285,000	$452,500

Source: Gartner (July 2015)

Evidence

[1] Gartner analysts have conducted more than 1,300 interactions with current and prospective Gartner clients on the topic of wide-area networking from July 2014 through early June 2015. The authors of this research have conducted more than 300 interactions with current and prospective Gartner clients on the topic of wide-area networking from July 2014 through early June 2015.

[2] The price of Internet versus MPLS service varies by country, as do regulations concerning the availability and use of both services. Both relative price and the local regulatory environment factor into the country-specific ROI of SD-WANs.

Note 1
Public Cloud Services Growth

Gartner forecasts indicate that public cloud services will continue to grow at or above 20% CAGR through 2018 for SaaS, PaaS and IaaS (see "Forecast: Public Cloud Services, Worldwide, 2011-2018, 4Q14 Update").

Note 2
ONUG

Moving forward, the Open Networking User Group (ONUG) is attempting to define some aspects of SD WANs, which will influence possible future standards including northbound APIs, which allow the network to be controlled by external systems.