



Cisco Intelligent WAN Is the Foundation for the Software- Defined WAN

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A Division of Kerravala Consulting

Introduction: Digital Transformation Drives WAN Evolution

Digital transformation is reshaping the business landscape faster than at any time in history. It used to take decades to disrupt a market, but natively digital companies such as Uber and Airbnb have disrupted their industries in just half a decade. Digitization is creating new winners and losers at an unprecedented rate. Organizations that adopt a digital strategy will leapfrog the competition, while those that do not will risk becoming irrelevant within five years.

One important step in becoming a digital enterprise is becoming an agile organization—that is, having the ability to take advantage of market opportunities faster than the competition. This shift to being an agile business has now become a top initiative for IT and business leaders. However, business agility cannot be achieved without having an agile IT infrastructure to enable it. This is why businesses spent more than \$12 billion on technology to make IT more agile in 2014, according to ZK Research.

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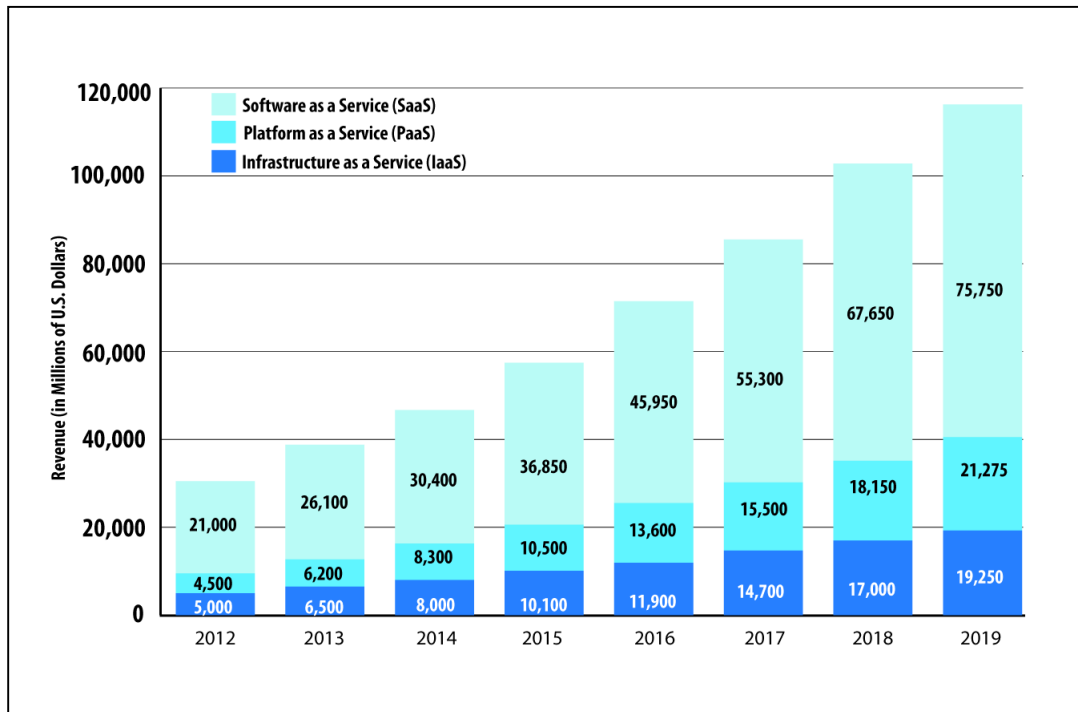
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However, one part of IT that has yet to evolve and lacks flexibility is the enterprise wide area network (WAN). Evolving the WAN must be a top priority for every IT and business leader because organizations are only as agile as their least agile IT component—which, today, is the WAN. In addition to digitization, several other factors are driving the evolution of the WAN, including the following:

- **Cloud computing continues to skyrocket.** More applications and workloads are heading to the cloud. Today, the cloud is the fastest growing segment of enterprise software, and ZK Research predicts that cloud services will grow from \$46 billion globally in 2014 to more than \$116 billion in 2019 (Exhibit 1). The surge in cloud traffic is driving significantly different traffic patterns over enterprise WANs.
- **Collaboration becomes business critical.** For the digital enterprise, competitive advantage is based on an organization’s ability to make the right decision while involving the best people in as short a time as possible, regardless of where they are located. The rise in mobile workers and virtual employees has made collaboration technologies such as unified communications (UC) and video conferencing mission critical. The ZK Research 2015 Unified Communications and Collaboration Study indicates that 89% of organizations have at least partially deployed UC. Multimedia applications, such as voice and video, are putting a strain on today’s WANs.
- **Computing shifts to a network-centric model.** Mobile computing, the cloud, the Internet of Things (IoT) and big data are at the top of almost every organization’s priority list. These new compute models are all network centric, meaning the network plays a significant role in the success or failure of these initiatives. This is particularly true in the WAN where, historically, bandwidth has been at a premium.

Influence and insight through social media

Exhibit 1: Cloud Computing Growth Poses Challenges for Legacy WANs



Source: ZK Research 2015 Global Cloud Forecast

If businesses are to achieve the necessary levels of agility required to compete in the digital era, the WAN must now evolve to a software-defined model. However, the path to a software-defined WAN (SD-WAN) involves many components, and organizations should take an architectural approach. This paper discusses the challenges with today's WAN, introduces the software-defined WAN and highlights how Cisco's Intelligent WAN (IWAN) can enable a rapid, risk-free migration to this new network model.

Section II: Challenges with the Traditional WAN

The current architecture used to design business WANs has been in place for more than 30 years. The existing model was designed for predictable traffic flows from client/server computing and best-effort Internet traffic. The centralized architecture is optimized for manageability but lacks any kind of dynamism or granular access control required for today's diverse and varied traffic types driven from mobile users, extranets and telecommuters.

Mobile applications and multimedia traffic are among the fastest growing application types. Based on

ongoing research, ZK Research estimates that video traffic consumes up to 90% of business traffic today, a major shift from even a decade ago when video constituted less than 10% of network traffic.

The evolving business climate is putting new demands on the WAN that cannot be met with legacy deployment models because of the following challenges:

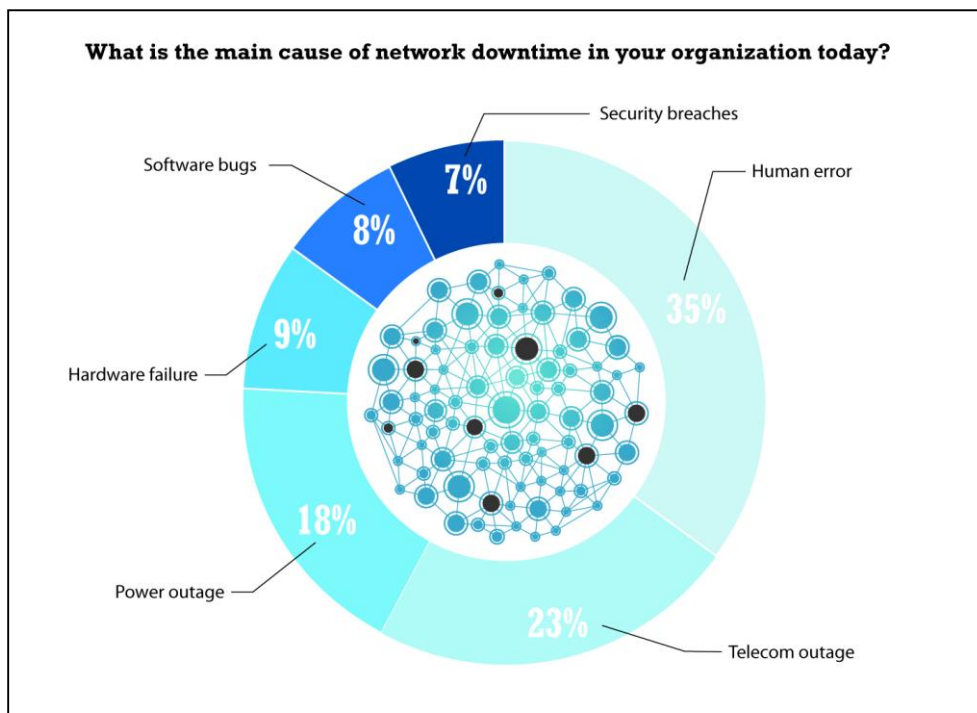
- Inefficient use of network bandwidth:** Because the WAN is so critical to business operations, almost all organizations provision backup network connections. In most cases, the dual network connections are put in "active/passive" mode, where all traffic is sent down the primary connection and the backup link only becomes active when the primary fails. This is done to avoid routing loops and other problems that can create network issues. An active/passive configuration means both network connections must be provisioned with enough bandwidth to pass all of a company's WAN traffic, causing organizations to pay for up to twice the amount of bandwidth they are actually using.

- **High cost of bandwidth:** With traditional WANs, the only way to ensure the availability of bandwidth for applications is to use expensive private IP network services such as Multiprotocol Label Switching (MPLS). Lower-cost Internet connections do not offer any kind of service-level agreements (SLAs) or the assurances necessary to use them as business-class circuits.
- **Security and performance are overlay technologies:** Securing a legacy WAN is typically accomplished by layering on additional physical appliances to add the new functionality required. The overlay approach, which is built on multiple appliances, can further increase the complexity of the network.
- **Little to no automation capabilities:** Traditional WANs have almost no ability to automate network operations tasks. The provisioning of new services and the implementation of configuration changes are typically done manually on a box-by-box basis, creating long lead times for any kind of change to be made. In this era of network-centric IT, a network engineer's time is extremely valuable and should be spent working on strategic initiatives.
- **Difficulty optimizing the user experience:** Despite the high cost of private networking

services, it is still difficult for most network managers to optimize the user experience of WAN-based applications. Consequently, network managers are often tuning quality-of-service (QoS) settings, creating alternative paths or changing other network parameters. This tweaking of the network is often done "ad hoc" when users are complaining about problems, which is one reason why the largest cause of network outages today is human error, according to the ZK Research 2015 Network Purchase Intention Study (Exhibit 2). Improving the quality of experience for applications requires having deep visibility into application behavior, identifying optimal paths and then automating constant changes to QoS settings and other factors.

Network agility can no longer be an aspirational goal because it is business critical today. Business leaders must shed their legacy thinking regarding network design and deploy a network that offers the same level of agility that exists at the compute and application tiers. To accomplish this, a new, agile WAN architecture is required. It's time for the software-defined WAN.

Exhibit 2: Human Error Causes Unnecessary Network Outages



Source: ZK Research 2015 Network Purchase Intention Study

Section III: Introducing the Software-Defined WAN

A software-defined WAN can be thought of as the next generation of WAN architecture that is optimized for network-centric compute models such as cloud, mobile computing and IoT.

An SD-WAN is built on the concepts of openness, agility, orchestration, analytics and security while continuously optimizing application performance. It enables application policies to be used to automate configuration changes, move traffic flows or enact other changes to ensure the network continually meets the needs of the organization.

In an SD-WAN, application policies can automate network configuration changes. For example, network path selection can be automated based on the characteristics of certain applications. One approach to accomplishing this is to abstract the control functions into an external controller. This provides the benefit of centralized policy expressions with distributed enforcement for scalability. Other benefits include zero-touch deployment as well as simplified configuration and troubleshooting. However, it can pose challenges with enforcing security at the branch and with performance and resiliency depending on where the controller is located.

Another approach is to have the controller distributed as part of the network infrastructure. This provides the benefits of centralization but also enables stronger security in the branch, greater availability and more resiliency along with faster adaptation to network conditions.

In 2014, the Open Networking User Group (ONUG) defined the following 10 criteria for an SD-WAN:

1. Ability for branch offices to leverage both public and private WAN connections in an **active/active configuration**
2. Ability to deploy customer-premises equipment (CPE) in either a physical or a virtual form factor on **any hardware**, including commodity infrastructure
3. **Secure hybrid WAN architecture** that allows for dynamic traffic engineering capabilities across private and public WAN paths as specified by application policies, network WAN availability and/or degradation at the transport or application layer
4. **Visibility, prioritization and steering of business-critical and real-time applications** as per security and corporate governance and compliance policies
5. A **highly available and resilient hybrid WAN** for an optimized application experience.
6. **Layer 2 and layer 3 interoperability** with a directly connected switch and/or router
7. **Management dashboard** that provides site-, application- and VPN-level performance reporting
8. **Open, northbound (NB) APIs** for controller access and management and the ability to forward specific log events to network event correlation managers and security event managers
9. **Zero-touch deployment** capabilities at branch sites with minimal to no configuration changes directly on the infrastructure to ensure the highest level of agility
10. **FIPS 140-2 validation certification** with automated certificate life-cycle management and reporting

The definition of an SD-WAN is continually evolving, and there is no “de facto standard” when it comes to what is and what is not an SD-WAN.

Section IV: Cisco’s IWAN Enables a Scalable SD-WAN Strategy and More

Cisco’s Intelligent WAN can be thought of as a platform for WAN transformation. Unlike many SD-WAN solutions that require organizations to do a “forklift upgrade” and migrate to an SD-WAN overnight, Cisco’s IWAN enables businesses to migrate to an SD-WAN or next-generation WAN architecture at a pace that is comfortable to the organization.

A business could start by implementing a hybrid WAN today to gain the cost benefits of the Internet, and then migrate to an SD-WAN at a later date without adding more appliances and complexity in the branch. Once the SD-WAN is in place, the organization can use IWAN as a foundation for branch automation and service virtualization.

IWAN enables the following WAN capabilities:

- **Application experience:** Application optimization features such as intelligent path selection and WAN acceleration to ensure the best possible user experience

- **Secure access:** Advanced threat detection to block most threats but also quickly identify any breaches that do occur and then rapidly mitigate them
- **Lower costs:** Transport-independent WANs so that any combination of broadband, 3G/4G wireless or traditional networking services (e.g., MPLS VPNs) can be used for network transport simultaneously, with a single, common network design across every transport
- **Simplicity:** Automation and orchestration of network services to ensure that the provisioning of new services and the implementation of network changes are driven by business policy and done at the speed required by a digital organization

Although Cisco's IWAN has many advanced capabilities, it also meets the 10 key requirements as defined by the ONUG. Exhibit 3 shows which Cisco IWAN features map to the specific criteria.

Exhibit 3: Cisco IWAN Meets All SD-WAN Criteria

SD-WAN CRITERIA	CISCO IWAN FEATURES
Active/active configuration	Transport-independent Dynamic Multipoint VPN (DMVPN) overlay with advanced load balancing by Cisco Performance Routing Version 3 (PfRv3)
Any hardware	Physical and virtual routers, app services, security: ISR-4000, ASR-1000, CSR 1000V Virtual Adaptive Security Appliance (vASA), Virtual Wide Area Application Services (vWAAS)/Akamai, plus third-party services/apps
Secure hybrid WAN	Secure IPsec overlay with DMVPN that is standards based and validated—FIPS 140-2, Common Criteria, AES-GCM-256
Visibility, priority and steering applications	Dynamic application path selection with PfRv3
Highly available and resilient WAN	Highly redundant and resilient Transport-Independent Design, providing fast convergence around link, node, black hole and brownout failures: with DMVPN, Border Gateway Protocol (BGP)/Enhanced Interior Gateway Routing Protocol (EIGRP) and PfRv3
Layer 2 (L2) and layer 3 (L3) interoperability	Broadest range of L2/L3 LAN wired and wireless for branch, campus and data center
Management dashboard	APIC Enterprise Module (APIC-EM)/IWAN App and Prime Infrastructure 3.0; Open Ecosystem for partners such as LiveAction and Glue Networks
Open, northbound application programming interface (API) for controller	Northbound REST API through APIC-EM and Prime Infrastructure 3.0 and partners like LiveAction
Zero-touch deployment	APIC-EM zero-touch deployment
FIPS 140-2 validation certification	FIPS 140-2, Common Criteria and Suite-B certifications

Source: ZK Research and Cisco, 2015

Cisco has all the technical capabilities to enable any customer to partially or fully migrate to an SD-WAN. However, Cisco's approach goes beyond just the technology. In addition to providing all of the technical components, Cisco also offers its customers a number of additional benefits, including:

- **Full system validation:** Deploying an SD-WAN can be a daunting task for most customers because there are several factors to consider. To help simplify deployment, Cisco has created a number of technology design guides, or Cisco Validated Designs (CVDs). With respect to SD-WANs, the CVDs can be thought of as a fully tested, validated solution to minimize the deployment complexity of IWAN solutions such as QoS, performance routing and NetFlow monitoring.
- **End-to-end solution:** The ability to “software define” the WAN provides many benefits to the customer. However, organizations should also consider bringing the benefits of software-defined networking to the campus edge (wired and wireless) and the data center. Cisco is the only network vendor that can deliver a seamless, end-to-end network from the data center to the WAN edge built on its ACI architecture.
- **Single platform for features beyond the SD-WAN:** The Cisco Integrated Services Router (ISR) is a single platform that can deliver SD-WAN capabilities but also security, voice, application optimization and caching services. This delivers a significant and obvious cost benefit over buying a dedicated platform for each but also simplifies the operational challenge of managing multiple boxes.
- **Open platform:** As a company, Cisco has been committed to developing standards-based, open platforms, and the SD-WAN is no exception. The open strategy enables a broad third-party ecosystem to interoperate with and enhance Cisco's IWAN. This includes expert-system partners such as LiveAction, Glue Networks and Akamai.
- **Ability to extend Cisco Application Centric Infrastructure (ACI) to the WAN edge:** The Cisco Application Policy Infrastructure Controller Enterprise Module (APIC-EM) extends ACI to the WAN and the access edge. ACI provides centralized administration and policy-based automation of application prioritization on the network. Through NB API programmability, network control can be automated to help IT

become more agile and rapidly respond to new business opportunities.

- **Automation capabilities:** The Cisco APIC-EM controller's IWAN Application automates the configuration and deployment of advanced IWAN features such as security, path optimization, enhanced application visibility and QoS on Cisco's 4000 series Integrated Services Router.
- **Cisco Services and large partner ecosystem:** Cisco's network of resources assist customers with IWAN design, deployment and ongoing operational needs to support and accelerate IWAN deployments.
- **Next-generation branch:** Cisco's IWAN can help customers fulfill the “any” vision—that is, the ability to connect any user to any application with an uncompromised experience—through service virtualization. Cisco IWAN enables this vision by using network functions virtualization (NFV) to deliver agility at the network service layer. NFV abstracts services such as firewall, VPN and WAN optimization from the hardware platform and enables them to run as a pure software workload. One benefit of this is that the service can be invoked when required through a centralized management console or an orchestration tool.

Additionally, the Cisco ONE software licensing model enables customers to get started immediately but still be prepared for tomorrow. With Cisco ONE, the purchase of the software is decoupled from that of the underlying hardware. Customers can buy the hardware and software required to run the business today and then upgrade the hardware platform for more processing capabilities, move to a virtual platform or upgrade the software for more features in the future.

The need for an SD-WAN is at an all-time high, and Cisco's IWAN enables customers to get started today, migrate to a full SD-WAN at a later time and then use IWAN as a foundation for future innovation.

Section V: Conclusion and Recommendations

The digital era is here and is creating new market leaders almost overnight. Business and IT leaders must focus on building an IT foundation that is dynamic, secure and agile to capitalize on digitization. Shifting the organization's WAN strategy away from legacy architectures to a software-defined WAN is a key step in building an agile IT foundation.

However, the SD-WAN market is still evolving, and there is no industry-wide accepted definition for this technology. Consequently, it's important to build a flexible foundation on which services can be deployed today but can then expand in the future as the needs of the business change and as SD-WANs continue to evolve.

Any organization looking to harness the power of digital transformation should make evolving to an SD-WAN a top priority. As next steps, ZK Research recommends the following:

- **Evaluate solution providers on their ability to enable SD-WAN services today, but ensure the needs of the business will be met in the future.** For example, Cisco's IWAN takes an architectural approach to building an SD-WAN and enables businesses to start with network automation; but then it allows them to move past this phase, evolve the branch office and transition to a virtual services model to deliver any

application or service to all users, no matter where they are located.

- **Consider real-time traffic when building an SD-WAN.** Real-time traffic applications such as voice and video are among the most difficult to run over a WAN. The requirements of these types of applications must be considered when architecting a next-generation WAN.
- **Shed conventional thinking around network design.** Many factors are involved in designing a WAN, and IT leaders must be willing to think differently today. For example, years ago, organizations would never have considered using broadband Internet or cellular services for business connectivity. Today, it's possible to use a combination of DSL, cable and 4G wireless to connect branch offices. An SD-WAN isn't a traditional WAN, and it's important that IT leaders not discount possible solutions because of historical biases.