



Cisco Software Defined WAN Solution Validation and Performance Assessment for Small Branches



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1.0 Executive Summary

Software Defined Wide Area Networks (SD-WAN) are the advancement of the WAN infrastructure seen in branch, campus, data center and cloud networks. Traditional networks use Virtual Private Network (VPN) management architecture over Multiprotocol Label Switching (MPLS), T1/T3, broadband or cellular (4G/LTE) links across WAN. But as networks expand, across locations and with the increase in client devices, administrators begin to see more performance, scalability and security problems arise.

Without the capacity to handle such issues, the end user suffers – lowering productivity and leaving businesses at risk for costly downtime. Cisco SD-WAN promises a consolidated, powerful, scalable, and highly visible approach to upholding such demanding scenarios by using contextual analysis, automation, and intelligent routing abilities.

By subjecting the Cisco solution to a real-world deployment, Miercom engineers validated throughput, scalability, and management.

Key Findings of the Cisco SD-WAN Solution

- **Outperformed throughput specification.** Cisco SD-WAN achieved 316 Mbps, over its 300 Mbps specification, for all security features enabled with IMIX traffic without any bottlenecking incidents on the ISR 1100-6G router. For large frame 1400-byte traffic, throughput was observed to be as high as 1.16 Gbps. The Cisco ISR 1100-4G router also achieved its claimed throughput of 120 Mbps with IMIX and 434Mbps with 1400 bytes traffic in the same all security enabled feature profile.
- **Impressive scalability during streaming tests.** Cisco SD-WAN saw up to 14,000 flows for deep packet inspection across the SD-WAN Fabric; 65,000 flows for CFlows; and 128,000 flows for OMP Route, NAT, and Firewall features. All streaming was verified as Cisco's advertised scalability claims.
- **Comprehensive, automated, optimized management.** Cisco SD-WAN's vManage dashboard, Cloud OnRamp cloud application optimization, and vAnalytics visibility and insight engine, ensures a streamlined, reliable, and flexible control of the SD-WAN Fabric across all environment types.

Based on our findings, the Cisco SD-WAN solution achieved or exceeded all advertised throughput, scalability and management specifications without incident, instability, or errors. We proudly certify the Cisco SD-WAN solution as **Miercom Performance Verified**.

Robert Smithers

CEO, Miercom

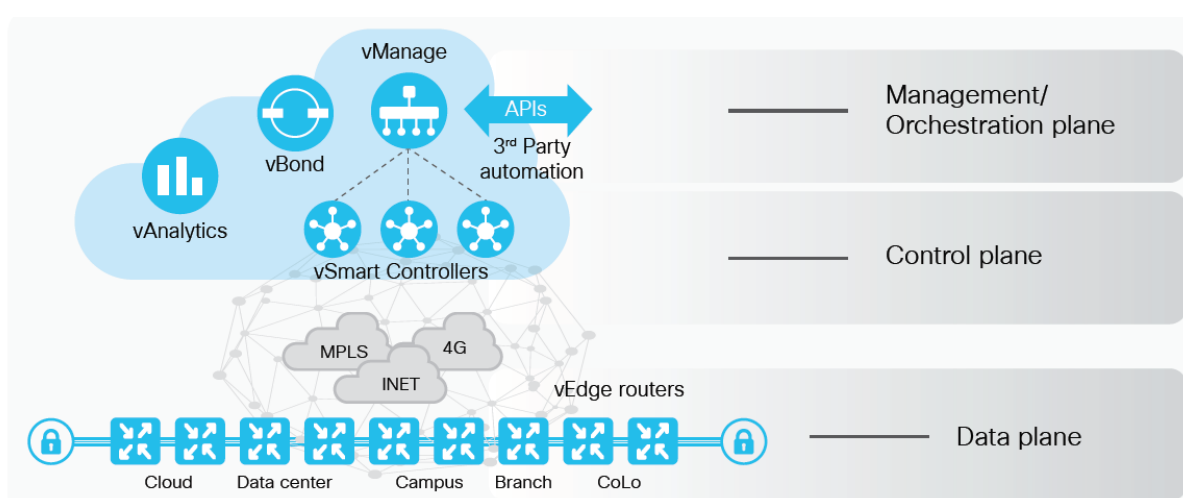


2.0 Introduction

The demands that Internet of Things (IoT) are growing as more endpoints join networks, creating a burden on available bandwidth and an attack surface for hackers. Cloud applications are necessary in the expanding world of mobile users, but companies are struggling to maintain optimal performance along the way.

2.1 Cisco SD-WAN

Cisco SD-WAN is a platform solution for resolving performance, scalability and management of networks facing the transition into a cloud-based, mobile world. Cisco helps users remain visible across WAN while experiencing fast and secure connectivity.



Source: Cisco

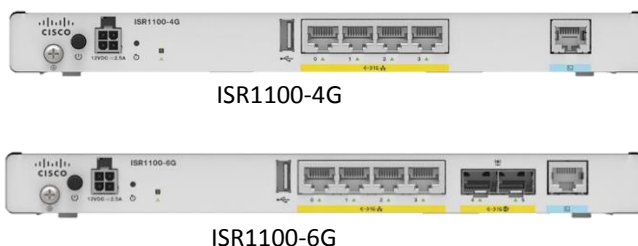
The Cisco SD-WAN vManage console connects the overlay fabric to data center, branch, campus, cloud and other networks with improved performance and security using templates and custom policies. Optimal paths are chosen based on contextual activity unique to the business intent and current connectivity issues.

Additionally, the support of API integration provides a customizable, yet simple and automated, set of daily operations. Critical enterprise deployment protocols are also available – including Border Gateway Protocol (BGP), Open Shortest Path First (OSPF), Virtual Router Redundancy Protocol (VRRP) and IPv6.

Cisco Digital Network Architecture (Cisco DNA) for WAN support the SD-WAN solution on both cloud and on-premise with greater flexibility and simplicity. Read more about Cisco DNA in this previous Miercom report: <https://miercom.com/cisco-digital-network-architecture-performance-verified/>.

2.2 Cisco ISR 1100-4G and ISR 1100-6G Routers

Cisco SD-WAN was tested by using Cisco ISR 1100 router series, which are powered by a Viptela operating system. These routers combine WAN and comprehensive security in a high-performance branch platform, as well as an enterprise-grade platform with best-in-class SD-WAN.



They are the next generation vEdge – which has Day 1 full feature parity with vEdge platform, and it is ready for existing vEdge100 and vEdge1000 customers migration.

The ISR 1100-4G, ISR 1100-4GLTE, and ISR 1100-6G routers are delivered as platforms that sit at the perimeter of a site (e.g. remote office, branch office, small campus). Their fanless design allows them to sit quietly in your small branch office, without distraction, while providing you high-speed connection to the cloud for increased productivity.

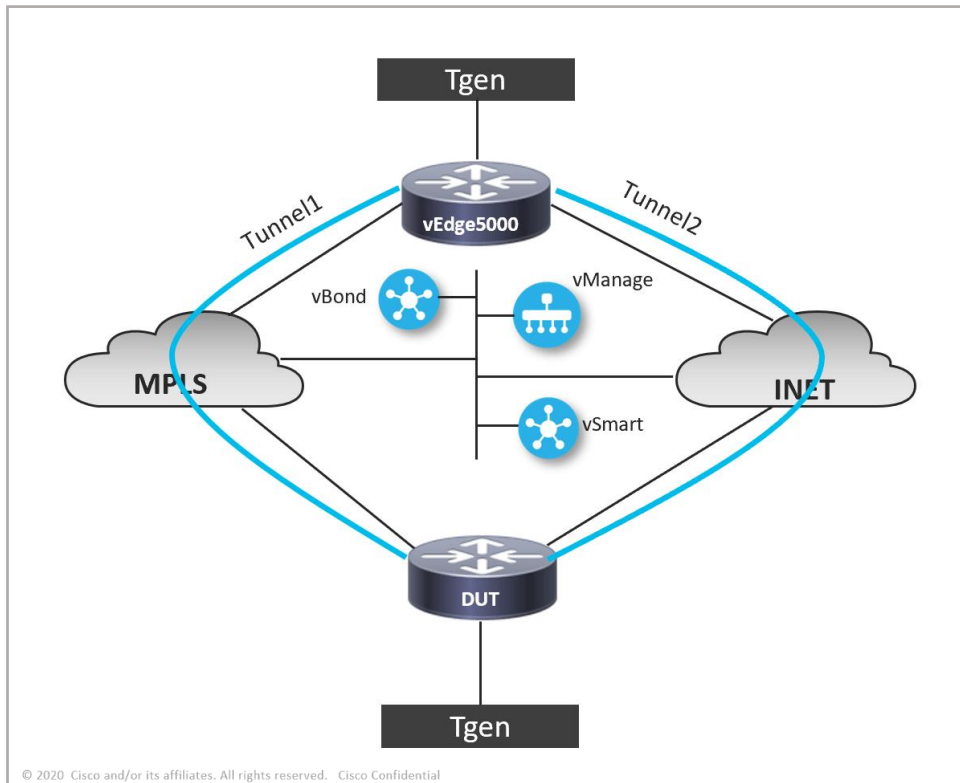
Both routers have Cisco built-in hardware of Trustworthy Solution (TWS), bringing product assurance functionality as well as foundational security capabilities into small branches.

The ISR 1100-4G provides 4x10/100/1000 Ethernet connectivity for WAN and LAN, and the ISR 1100-4GLTE provides additional LTE capability to connect the small branch. The ISR 1100-6G has 2x1 Gigabit Ethernet (GbE) SFP ports in addition to the 4x10/100/1000 Ethernet to enable multiple high-speed ethernet connections to the SD-WAN network.

3.0 How We Did It

Our hands-on testing used a real-world network environment to challenge the SD-WAN solution with a realistic assessment of performance features and capabilities. The following topology was used for all performed tests.

Test Topology



The test topology includes the Cisco ISR 1100-6G and ISR 1100-4G SD-WAN routers, which are fully integrated with all the benefits expected from Cisco routers with scalability and functionality for SD-WAN built in.

Device under Test (DUT)

Cisco SD-WAN Solution	Cisco ISR1100-4G
Viptela OS (version 19.2.2)	Cisco ISR1100-6G

Test Tool Descriptions

Ixia IxNetwork

Version 8.40.1124.8 EA

A scalable performance test solution used to simulate devices and large networks to evaluate routing, switching and software defined networking capabilities. Generated traffic flows emulate real-world applications and scenarios used on today's networks.

Spirent Test Center

Version 4.77.1796.0000

A high-speed test tool to generate products and services for testing high-density network scenarios. Traffic flow emulation allows for validation of scalability scenarios for small, medium and large network sizes.

4.0 Throughput

Network performance is dependent on the amount of processing required. Security requires many high-quality services that typically require a sacrifice in performance. While SD-WAN solutions aim to provide enhanced network security, another goal is minimizing processing loads to maintain competitive performance. The SD-WAN product is expected to optimally balance security and performance with superior security engineering.

Our testing intended to validate the minimal network performance degradation incurred while protected by security features of the Cisco SD-WAN.

Ixia IxNetwork generated 100 servers and 1,000 clients to simulate 1,000 one-to-many flows of bi-directional traffic with randomized IP addresses. The test duration was 120 seconds, measuring aggregate throughput and No Drop Rate (NDR), zero packet drop.

We used two different IPv4 Unicast packet profiles, measure in bytes (B):

- IMIX (64B/72B, 594B, 1400B; 7:4:1 ratio) – average packet size 352B
- Large packets (1400B)

Packet sizes are defined as Ethernet frame size: Ethernet Header (DMAC/SMAC/EtherType) + Ethernet FCS + IP Header.

The SD-WAN solution was tested using three throughput profiles of different feature combinations of Internet Protocol Security (IPsec), Quality of Service (QoS), Deep Packet Inspection (DPI), cFlow, Network Address Translation (NAT), and Firewall:

1. IPsec
2. IPsec + QoS + DPI + cFlow
3. IPsec + QoS + DPI + cFlow + NAT + Firewall

What We Expect

The ISR 1100-6G platform should provide aggregated throughput of more than 300 Mbps and ISR 1100-4G platform should provide aggregated throughput of more than 100 Mbps while ensuring no bottlenecking occurs on supporting devices.

Results

Performance (Mbps) for Bi-directional Aggregate Throughput

Platform	Profile 1	Profile 2	Profile 3
ISR 1100-6G			
1400 byte	1.85 Gbps	1.28 Gbps	1.16 Gbps
IMIX	530 Mbps	354 Mbps	316 Mbps
ISR 1100-4G			
1400 byte	730 Mbps	476 Mbps	434 Mbps
IMIX	210 Mbps	136 Mbps	120 Mbps

5.0 Scalability

Networks are designed based on the demands placed by the products and services – for both the current intent and the future. SD-WAN solutions are expected to be flexible in terms of scale, so the performance is not compromised.

The Cisco ISR 1100-6G and ISR 1100-4G routers were tested for SD-WAN scalability by sending traffic streams through the router and SD-WAN Fabric. The number of flow entries were observed and recorded. These results were intended to verify design specification as advertised by Cisco scalability claims.

The following features were enabled for this series of tests:

- DPI (Deep Packet Inspection)
- CFlow
- OMP Routes
- NAT (Network Address Translation)
- FW (Firewall)

Results

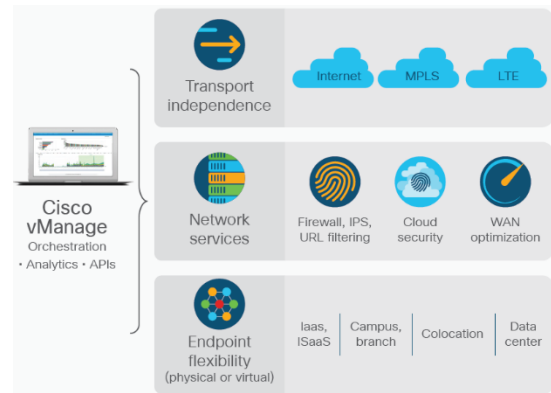
Scalability Testing Summary

	DPI Flows	CFlows	OMP Route	NAT	FW
ISR 1100-6G	14K	65K	128K	128K	128K
ISR 1100-4G	14K	8K	30K	16K	16K

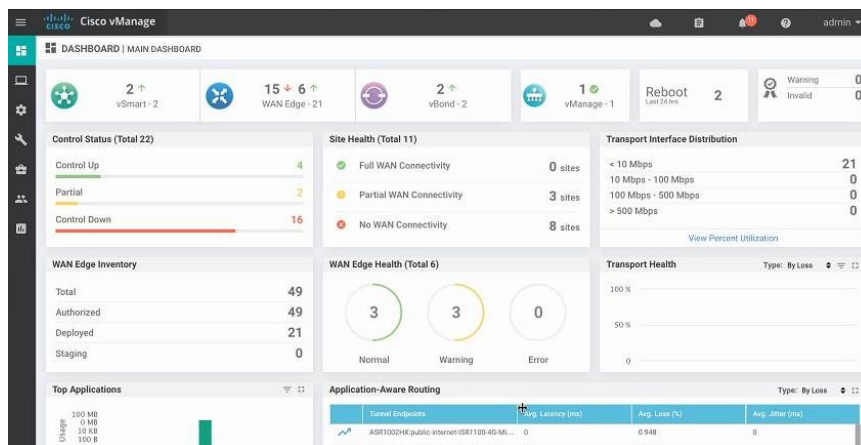
6.0 Management

6.1 vManage

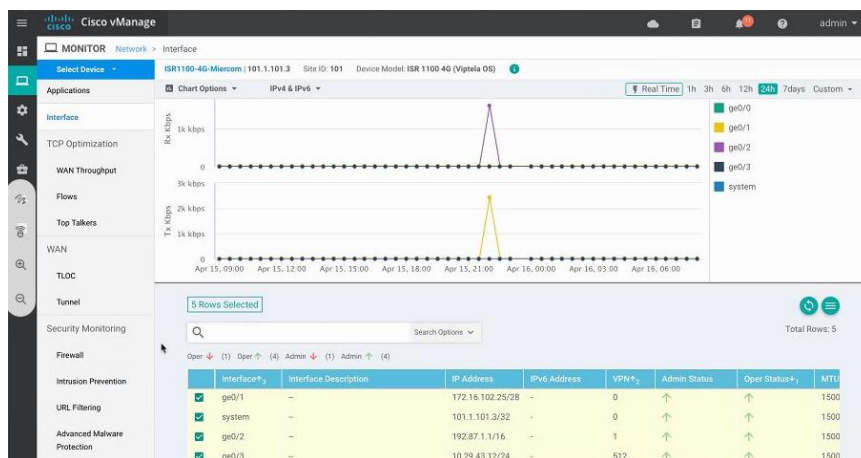
Cisco SD-WAN provided a single dashboard – vManage. Through vManage, Cisco SD-WAN supports zero network downtime, automated application flexibility over multiple connection types (Internet, MPLS and wireless 4G LTE). It easily enriches services such as WAN optimization, cloud security, firewalling, intrusion prevention, URL filtering at any point across the SD-WAN Fabric – all from a single, comprehensive console. Endpoints are given equal flexibility via simplified, extended physical or virtual connectivity via SD-WAN Fabric across branch, campus, data center and cloud environments to suit the business intent.



Source: Cisco



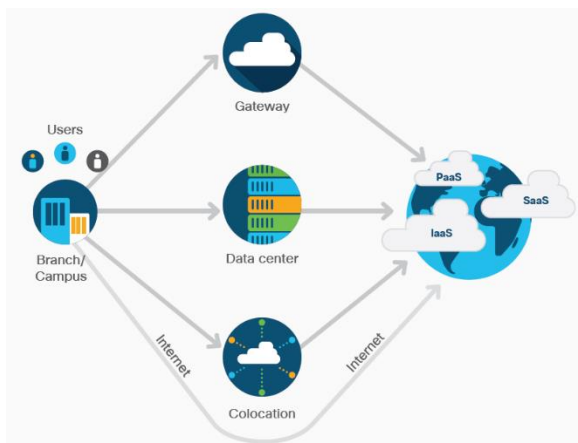
Source: Miercom



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6.2 Cloud OnRamp

Managing WAN is made simple with the vManage dashboard, but Cisco SD-WAN takes it a step further with reliable and efficient high-speed connections to cloud platforms. Virtual private gateways can be automatically deployed in Infrastructure-as-a-Service (IaaS) and Platform-as-a-Service (PaaS) environments using Cloud OnRamp – a way to securely ensure application delivery and performance. Cloud OnRamp monitors and adjusts routes for enhanced connectivity with forcing manual processing of multi-tenant gateways.



Source: Cisco

The real-time visibility and control of Cloud OnRamp helps optimize applications for daily operations – by finding the fastest, most reliable paths, as well as adjusting for Layer 3 interruptions – to provide a continuous, high-quality user experience from any location.

6.3 vAnalytics

In the vManage console, the advanced vAnalytics engine provides insight into WAN issues, end-to-end visibility of applications and infrastructure across the SD-WAN Fabric, real-time failure details, benchmarking, and performance scores. Customers can use potential scenarios for forecasting events affecting performance, as well as be assisted with recommendations for intelligent application provisioning, bandwidth restrictions, branch expansions, policy making, templates and preferences. Predictable performance is made possible by using the available Application Quality-of-Service (QoS) categorization and policy changes.

vAnalytics parses through raw even data to ensure contextual analysis that reduces false positives and overly stringent security, as well as the IT labor involved, for a more focused approach to optimization. Users benefit from a high-speed, high-performance application experience that boosts productivity.

About Miercom

Miercom has published hundreds of network product analyses in leading trade periodicals and other publications. Miercom's reputation as the leading, independent product test center is undisputed.

Private test services available from Miercom include competitive product analyses, as well as individual product evaluations. Miercom features comprehensive certification and test programs including: Certified Interoperable™, Certified Reliable™, Certified Secure™ and Certified Green™. Products may also be evaluated under the Performance Verified™ program, the industry's most thorough and trusted assessment for product usability and performance.

Use of This Report

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