SD-WAN 101: Ensuring Peak Network Performance and Service QoE

Executive Summary

Want to save money? Just switch to SD-WAN! A lot of vendors will tell you it is that easy. But software-defined wide area network (SD-WAN) migrations are rarely simple, and poor network performance can quickly negate any return on investment (ROI) achieved through cost savings alone. Downtime costs you precious time and money—and you can’t afford outages bringing down your most business-critical applications. A successful transition to SD-WAN hinges on reliability, and that means ensuring peak performance across all your network infrastructure.

In this whitepaper, you’ll discover essential strategies for monitoring SD-WAN performance, including how to:

- Set yourself up for success by validating network infrastructure before you migrate
- Ensure a quick ROI by monitoring service-level agreements (SLAs) and network performance after you deploy

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Using Internet For Low-Cost Bandwidth

SD-WAN has become one of the most-widely adopted applications of software-defined networking (SDN) in enterprise networks. The high cost and complexity of traditional WAN deployments has plagued enterprise IT for years. In fact, the WAN expenditure for a multi-site enterprise consumed as much as 70% of the total IT budget. Moreover, a big portion of this high-cost WAN infrastructure was for redundant, unused bandwidth necessary as a failover option.

As the cost of bandwidth became cheaper and reliability of shared networks increased, the Internet became an alternative to dedicated multiprotocol label switching (MPLS) circuits. In fact, Internet bandwidth costs only 2% of comparable MPLS bandwidth. This concept of using Internet for low-cost bandwidth, the popularity of SDN provisioning, and the proliferation of cloud-based applications made SD-WAN the magic wand for every enterprise.

But, as with any new technology, SD-WAN does not come without challenges. The network infrastructure needs to be well-tested to be able to provide the five-nines reliability required for business-critical applications. Testing robustness and ensuring security of the network is extremely critical since the cost of downtime for an enterprise network is very high.

According to a report by Gartner, a network outage lasting only a single hour can cost a business more than $300,000. This can be more, depending on the size of the firm. Every enterprise evaluating SD-WAN will have one question in mind – by moving from private MPLS circuits to public Internet links, are we compromising performance for cost?

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Validation pre- and post-deployment is the key to ensuring the success of an SD-WAN implementation. The top SD-WAN vendors, carriers, and system integrators use Ixia solutions to validate their WAN network infrastructure pre-deployment, in the lab. On the other hand, enterprises and carriers use Ixia tools to monitor network and service level agreement (SLA) performance in the post-deployment phase.

From the experience of working with these customers, Ixia has identified the right solutions for critical testing use cases as you architect, build, deploy, and run SD-WAN networks and services.

**Pre-Deployment Validation**

SD-WAN network design goes through lab testing before the actual deployment. In this pre-deployment stage, it is important to have test solutions that can emulate a fully-scaled network, generate real-life workloads, and measure traffic characteristics. Before rolling out the solution, you’ll need to perform device performance benchmarks, SD-WAN policy calibration, and measurements of the quality of experience (QoE).

**Testing workload characteristics**

IxLoad is Ixia’s application-layer test solution that delivers comprehensive performance validation for user QoE in real-world conditions. IxLoad works by emulating web, video, voice, storage, VPN, wireless, infrastructure, and encapsulation/security protocols to create realistic scenarios. Based on physical or, with IxLoad Virtual Edition, virtual test ports, a modular system design allows distributed deployment that scales with your infrastructure. The real-time QoE metrics allow you to quickly identify network degradations and isolate breaking points.

Figure 2. IxLoad’s real-time QoE metrics allow you to quickly identify network degradations and isolate breaking points.
Testing the routing infrastructure

The routing capability in the SD-WAN gateway allows SD-WAN to operate in overlay mode. There can be a router on the edge, and the SD-WAN appliance is on the LAN side of that router. Or in some cases this can be an integrated device with routing intelligence. The WAN gateway needs to incorporate routing intelligence in the overlay network for site-to-site communication to happen over MPLS tunnels.

The customer site end-point information also needs to pass through the overlay network for the hosts to communicate. Ensuring routing functionality in this type of environment requires validation from multiple dimensions:

1. OSPF or BGP session establishment over the WAN
2. Real-time route learning from the network through OSPF or BGP
3. Advertise routes over the WAN for any changes in the LAN side
4. Selective route filtering

IxNetwork, Ixia’s flagship product for testing Layer 2/3 infrastructure, emulates protocols and generates traffic at high scale to validate the routing capability of SD-WAN networks. It can work both in a hardware-based platform or, with IxNetwork Virtual Edition, as a virtual machine inside a hypervisor, making it easy for network engineers to create the right kind of test bed for their SD-WAN.

Figure 3. Emulating Layer 2/3 protocols and generating traffic at high scale, IxNetwork validates the routing capability of SD-WAN networks.
**Realistic WAN emulation**

The final part of a robust test system is the addition of realistic and worst-case network conditions in the lab. Using network impairment emulation, users can validate and test performance of new hardware, protocols, and applications to prevent failures in production networks. Ixia’s Network Emulator II offers a rich feature-set to allow testing in a controlled lab environment with repeatable and predictable impairments. Network Emulator II enables users to test delay and real-world network impairments such as drop, duplication, reorder, and modification. In combination with IxLoad and IxNetwork, this proactive real-world testing allows customers to find problems in the lab, rather than during deployment.

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**Post-Deployment Validation**

**Monitoring SLA and optimizing QoS**

In a hybrid network infrastructure, the SD-WAN solution needs to dynamically steer application traffic over MPLS or Internet links. SLAs for network availability, latency, packet loss, and jitter are highly critical in a hybrid network as the performance guarantees are not the same as an MPLS-based WAN. Moreover, the different types of application traffic profiles, like real-time traffic, interactive traffic, or bulk traffic, require different QoS guarantees. A typical SD-WAN will create QoS classes and assign application traffic dynamically to these classes using source/destination IP or TCP/UDP ports.

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The above diagram shows the different kind of traffic that a WAN will encounter in a real deployment scenario, which includes:

1. Traffic between branch office and cloud/Internet
2. Traffic between branch office and private data center
3. Traffic between two branch offices

Both during service turn-up and post-deployment, the traffic rules and expected SLA require verifications so that the proper traffic routing and prioritization and minimum performance are met. Key metrics include throughput, loss, and latency to guarantee good IP packet transfers, as well as bandwidth availability and class-of-service repartition and management to validate the full integration.

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Ixia’s Hawkeye solution makes the service turn up and post-deployment validation easy for network engineers and operations team. Hawkeye instantly assesses and troubleshoots networks and applications before and after deployment.

This powerful assessment tool uses software agents called Performance Endpoints to simulate application traffic and deliver key performance metrics to a central console for easy management. Emulating user traffic and placed within the different delivery points of an SD-WAN architecture to validate end-to-end performance and SLA, the Performance Endpoints are:

- Delivered as a virtual network function (VNF) on the virtual CPE
- Dynamically activated/deactivated for each test
- Used in public or private cloud locations
- Used in specific data center servers
- Also available as hardware appliances

The result is a fully instrumented system for confidently assessing the performance and reliability of networks and applications running on a wide variety of transport interfaces that include wired, wireless, and virtual data centers. Hawkeye is also used with scheduled tests to continue validating network performance in production at regular intervals and provide alerts on performance degradations or outages.
Testing needs to span from Layer 2 data transmission to Layer 7 application protocols, and throughout the network lifecycle.

Figure 7. Monitor and troubleshoot SD-WAN infrastructures with Hawkeye’s intuitive dashboards and hop-by-hop analysis.

Conclusion

Moving from MPLS circuits to SD-WAN links is a cost-saving move, but adds risk of disrupting network and application performance. The success of any SD-WAN implementation depends on the validation of the network design and post-deployment use. Testing needs to span from Layer 2 data transmission to Layer 7 application protocols, and throughout the network lifecycle.

Ixia offers the industry-leading solutions for these critical SD-WAN test use cases as you architect, build, deploy, and run SD-WAN networks and services. This is the reason Ixia is the test partner of choice for the top SD-WAN vendors, service providers, and enterprises globally.

Learn more at: www.keysight.com

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