# SD-WAN COMPARATIVE REPORT

## Total Cost of Ownership (TCO)

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## Tested Products

Barracuda Networks NextGen Firewall F-Series F80 v7.1.1

Citrix Systems NetScaler SD-WAN v10.0.0.207

Cradlepoint AER2200-600M v6.5.0

FatPipe Networks MPVPN/SD-WAN v9.1.2

Forcepoint NGFW 1101 vSMC 6.3.6, engine 6.3.6.19302

Fortinet FortiGate 61E v6.0.1 GA Build 5068

Talari Networks Adaptive Private Networking (APN) Software APN 7.1

Versa Networks FlexVNF v120

VMware NSX SD-WAN by VeloCloud Edge v3.2

## Environment

Software-Defined Wide Area Network (SD-WAN) Test Methodology v1.2

# Overview

Implementation of software-defined wide area network (SD-WAN) products can be a complex process, with multiple factors affecting the overall cost of deployment, maintenance, and upkeep. Enterprises should include the total cost of ownership (TCO) as part of their evaluations, focusing on the following at a minimum:

- Acquisition costs for SD-WAN and a central management system (CMS)
- Fees paid to the vendor for annual maintenance, support, and where applicable, signature updates
- Labor costs for installation, maintenance, and upkeep

No two network security systems deliver the same performance, making precise comparisons extremely difficult. To enable value-based comparisons of SD-WANs on the market, NSS has developed a unique formula: *TCO per Mbps*. Using this formula, NSS can normalize data and account for wide-ranging differences in TCO and performance among products. See Figure 1 for details.

Within a given performance range (*NSS-Tested VPN Throughput*), the *TCO per Mbps* metric provides clear guidance as to whether a product's price is higher or lower than the majority of its competitors. A high price could indicate a premium based on performance, brand recognition, or level of customer service. Conversely, a high price could also be a penalty for purchasing an underperforming product.

> **TCO per Mbps = TCO / NSS-Tested VPN Throughput [1]**

**Figure 1 –TCO per Mbps Formula**

For the purposes of this analysis, NSS developed an enterprise use case with one headquarters site and two branch offices.

| Vendor | 3-Year TCO | NSS-Tested VPN Throughput | TCO per Mbps |
|---|---|---|---|
| Barracuda Networks | $10,534 | 124 | $85 |
| Citrix Systems | $89,137 | 751 | $119 |
| Cradlepoint | $8,427 | 17 | $496 |
| FatPipe Networks | $37,335 | 447 | $84 |
| Forcepoint | $31,124 | 713 | $44 |
| Fortinet | $3,522 | 749 | $5 |
| Talari Networks | $146,569 | 745 | $197 |
| Versa Networks | $42,426 | 552 | $77 |
| VMware | $85,800 | 880 | $97 |

**Figure 2 – TCO per Mbps Results for Tested Products (US$)**

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[1] TCP-based performance testing was conducted between Branch A and the headquarters site over two established tunnels and was limited to a maximum of 1,092 Mbps, as described in the NSS Labs Software-Defined Wide Area Network (SD-WAN) Test Methodology.

# Table of Contents

# Table of Figures

# Total Cost of Ownership

## SD-WAN Test Architecture

The SD-WAN test architecture simulates an enterprise infrastructure with two branches connected to a data center. Each branch location has two links; one is an MPLS link, and the other is a standard broadband connection. The WAN environment is provisioned with behavioral characteristics similar to those typically encountered over normal WAN link states, and the test harness baseline is recorded to ensure consistent behavior. The SD-WAN is deployed and each test case is measured against the baseline. All tests are performed across the VPN links established according to the use case topology. The traffic flows used in this test were a mix of real-time, interactive, and bulk traffic. The MPLS Link is set to 100 Mbps and the ISP Link is set to 1 Gbps (maximum achievable: 1,092 Mbps). The metrics used to measure the health of the network are VoIP (real-time protocol [RTP]) MOS (mean opinion score) and video (relative) MOS.

The MOS is used to calculate the Quality of Experience (QoE) enterprises can expect when deploying SD-WAN products. Relative (video) MOS is an estimated perceptual quality score that considers the effects of codec, the impact of IP impairments (such as packet loss) on the GoP (group of pictures) structure and video content, and the effectiveness of loss concealment methods. Unlike speech codecs, video codecs have no limits on a maximum possible MOS value. The encoding specifications for video codec are used as guidelines and conformance, and vendors are free to design encoders to improve video quality and reduce the number of transmission bits. Simply put, MOS for video (relative MOS) can vary based on different advancements in the video estimation or encoding techniques. In the video used for the test, the maximum achievable QoE was 4.53. RTP (voice) MOS on the other hand measures the MOS score for VoIP call based on the speech codec being used. The setup used a G711 codec, which produces a maximum QoE score of 4.41 for an excellent VoIP call. Any score below 3.5 represents a significantly degraded voice call/video stream. NSS considers a score below 3.4 as failing to meet the use case. Figure 3 depicts how the SD-WAN products under test were configured and priced.
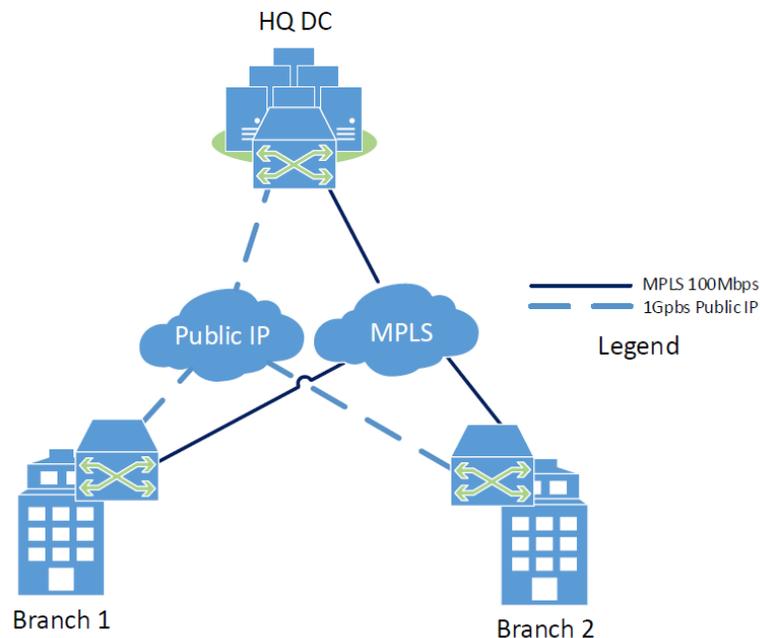


**Figure 3 – Testing Architecture**

## Tuning

The SD-WAN products were configured with the vendor's pre-defined or recommended (i.e., "out-of-the-box") settings in order to provide readers with relevant quality of experience (QoE) and performance based on their expected usage.

Figure 4 depicts the labor required to take the products out of their boxes, configure them, deploy them in the network, apply updates and patches, perform initial tuning, and set up desired logging and reporting. Several solutions utilized zero-touch provisioning with great success, and this significantly reduces overall operational costs in large-scale deployments.

## Labor for SD-WAN Setup

Costs are based on the time that would be required by an experienced security engineer to perform the setup tasks listed above. The calculations assume a rate of US$75 per hour.

| Vendor | Installation (Hours) |
|---|---|
| Barracuda Networks | 8 |
| Citrix Systems | 8 |
| Cradlepoint | 8 |
| FatPipe Networks | 8 |
| Forcepoint | 8 |
| Fortinet | 8 |
| Talari Networks | 4 |
| Versa Networks | 8 |
| VMware | 4 |

**Figure 4 – Labor for SD-WAN Setup (Hours)**

## Labor for Central Management

Enterprises should include labor costs for operational expenditures (opex) when evaluating SD-WAN products. These costs would include day-to-day management tasks such as administration, policy and configuration handling, log handling, alert handling, monitoring, reporting, analysis, auditing and compliance, maintenance, software updates, and troubleshooting.

NSS does not include opex in this analysis and does not take into account either the additional operational overhead of maintaining threat protections or the operational savings and risk reductions that can be realized by integrating them into the WAN.

## Equipment and Software Costs

All capital expenditure (capex) costs are based on list prices provided by vendors at the time of the test. The actual cost to end users may be lower depending on the negotiated discount. However, it is fair to assume that all vendors will provide a similar discount, resulting in a relatively constant cost ratio. It is important to note that not all SD-WANs are priced equally on the same capabilities; overprovisioning for the test architecture, perpetual licenses, and additional functionality such as integrated LTE, next generation firewall (NGFW), threat protections, etc. all contribute to differences in TCO. Costs are depicted in Figure 5. Where bundles are offered and/or a perpetual license is used, the total cost is listed under Maintenance and Support (Hardware/Software).

| Vendor | Products as Tested | Maintenance and Support (Hardware/Software) |
|---|---|---|
| Barracuda Networks | $0 | $3,311 |
| Citrix Systems | $20,500 | $22,679 |
| Cradlepoint | $0 | $2,609 |
| FatPipe Networks | $20,985 | $5,250 |
| Forcepoint | $18,900 | $3,875 |
| Fortinet | $1,914 | $336 |
| Talari Networks | $55,619 | $45,325 |
| Versa Networks | $4,020 | $12,522 |
| VMware | $0 | $28,500 |

**Figure 5 – Equipment and Software Costs (US$)**

## TCO Calculations

The TCO incorporates capex over a three-year period, including initial acquisition and deployment costs and annual maintenance, support, and update costs (software and hardware updates). Calculations are as follows:

| Value | Description of Calculation |
|---|---|
| Year 1 Cost | Initial Purchase Price + Maintenance Cost + (Installation x Labor rate $/hr) |
| Year 2 Cost | Maintenance Cost |
| Year 3 Cost | Maintenance Cost |
| 3-Year TCO | Year 1 Cost + Year 2 Cost + Year 3 Cost |

**Figure 6 – TCO Calculations**

Calculations are based on a labor rate of US$75 per hour and vendor-provided pricing information. Where possible, the 24/7 maintenance and support option with 24-hour replacement is used, since enterprise customers typically select that option. Pricing includes three SD-WAN devices as described in the SD-WAN Test Architecture section.

| Vendor | Purchase Price | Maintenance per Year | Year 1 Product Cost | Year 1 Labor Cost | 1-Year TCO |
|---|---|---|---|---|---|
| Barracuda Networks | $0 | $3,311 | $3,311 | $600 | $3,911 |
| Citrix Systems | $20,500 | $22,679 | $43,179 | $600 | $43,779 |
| Cradlepoint | $0 | $2,609 | $2,609 | $600 | $3,209 |
| FatPipe Networks | $20,985 | $5,250 | $26,235 | $600 | $26,835 |
| Forcepoint | $18,900 | $3,875 | $22,775 | $600 | $23,375 |
| Fortinet | $1,914 | $336 | $2,250 | $600 | $2,850 |
| Talari Networks | $55,619 | $45,325 | $55,619 | $300 | $55,919 |
| Versa Networks | $4,020 | $12,522 | $16,542 | $600 | $17,142 |
| VMware | $0 | $28,500 | $28,500 | $300 | $28,800 |

**Figure 7 – 1-Year TCO (US$)**

## Normalizing TCO Data

The benefit of normalization is that, within a given performance range (*NSS-Tested VPN Throughput*), the *TCO per Mbps* metric provides clear guidance as to whether a product's price is higher or lower than the majority of its competitors at a normalized performance level and assessed equally across tested products. A high price could indicate a premium based on performance, brand recognition, or level of customer service. Conversely, a high price could also be a penalty for purchasing an underperforming product.

There are multiple methods by which *Value* can be determined:

### Purchase Price Based on Vendor-Claimed Throughput

The simplest means of determining *Value*, but also often the most misleading, is to determine the purchase price per Mbps based on the vendor-claimed throughput and the initial purchase price of the product.

### TCO Based on Vendor-Claimed Throughput

A more accurate calculation would be to determine the TCO per vendor-claimed throughput (in the case of this SD-WAN assessment, this would be Mbps). This calculation is performed in many purchasing departments. Unfortunately, this is as flawed as the first approach, since it relies on vendor-claimed throughput without performing independent tests to determine the *actual* throughput of the product under real-world conditions.

### TCO Based on NSS-Tested VPN Throughput

Vendor throughput claims are frequently exaggerated in marketing materials, or they simply fail to take into account real-world deployment conditions.[2] Knowing this, many enterprise IT professionals will over-purchase based on throughput to ensure adequate performance headroom.

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[2] See SD-WAN Test Architecture section for information on throughput and limitations as well as individual test reports for more detail on each vendor's submitted SD-WAN products.

*NSS-Tested VPN Throughput* is a real-world representation of a product's performance. *NSS-Tested VPN Throughput* is often significantly different from vendor-claimed throughput (see Figure 8). For more information on *NSS-Tested VPN Throughput,* see the Comparative Report on Performance at www.nsslabs.com.

| Vendor | Vendor-Claimed Throughput (Mbps) | NSS -Tested VPN Throughput (Mbps) | % Delta |
|---|---|---|---|
| Barracuda Networks | 240 | 124 | -48% |
| Citrix Systems | 1,500 | 751 | -50% |
| Cradlepoint | 30 | 17 | -43% |
| FatPipe Networks | 1,000 | 447 | -55% |
| Forcepoint | 1,500 | 713 | -52% |
| Fortinet | 1,000 | 749 | -25% |
| Talari Networks | 1,000 | 745 | -25% |
| Versa Networks | 1,000 | 552 | -45% |
| VMware | 1,000 | 880 | -12% |

**Figure 8 – Vendor-Claimed Throughput vs. NSS-Tested VPN Throughput**

Figure 9 depicts the calculation for *TCO per Mbps,* which is based on the product's three-year TCO and the *NSS-Tested VPN Throughput (Mbps).*

| Vendor | 3-Year TCO | NSS -Tested VPN Throughput (Mbps) | TCO per Mbps |
|---|---|---|---|
| Barracuda Networks | $10,534 | 124 | $85 |
| Citrix Systems | $89,137 | 751 | $119 |
| Cradlepoint | $8,427 | 17 | $496 |
| FatPipe Networks | $37,335 | 447 | $84 |
| Forcepoint | $31,124 | 713 | $44 |
| Fortinet | $3,522 | 749 | $5 |
| Talari Networks | $146,569 | 745 | $197 |
| Versa Networks | $42,426 | 552 | $77 |
| VMware | $85,800 | 880 | $97 |

**Figure 9 – TCO per Mbps (US$)**

## Value

*Value* is a metric that is distinct from both purchase price and TCO. Figure 10 and Figure 11 demonstrate the ways in which a product's actual value can change as *NSS-Tested VPN Throughput* is factored in.

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8

In Figure 10, reading from left to right, the value changes as test metrics are introduced. The value in the final column incorporates the three-year TCO and *NSS-Tested VPN Throughput* as determined by NSS testing.

SD-WAN deployments have varying requirements for performance and value that can extend beyond throughput. NSS clients can schedule an inquiry call with NSS analysts to discuss other value metrics and normalized values for these deployment use cases.

| Vendor | Vendor-Claimed Throughput (Mbps) | NSS -Tested VPN Throughput (Mbps) |
|---|---|---|
| Barracuda Networks | $44 | $85 |
| Citrix Systems | $59 | $119 |
| Cradlepoint | $281 | $496 |
| FatPipe Networks | $37 | $84 |
| Forcepoint | $21 | $44 |
| Fortinet | $4 | $5 |
| Talari Networks | $147 | $197 |
| Versa Networks | $42 | $77 |
| VMware | $86 | $97 |

**Figure 10 – Value Based on TCO per Mbps (US$)**

Figure 11 compares the vendor-claimed *Value* metric with the metric generated from NSS test results. The *Value* indicates whether a product is underpriced, overpriced, or priced accurately depending on the *NSS-Tested VPN Throughput*. A product with a *Value* that is higher than its purchase price can be considered to have a good value. A product with a purchase price that is higher than its *Value* can be considered overpriced.

| Product | Purchase Price | Value | $ Delta | % Delta |
|---|---|---|---|---|
| Barracuda Networks | $3,911 | $4,066 | $155 | 4% |
| Citrix Systems | $43,779 | $24,607 | ($19,172) | -44% |
| Cradlepoint | $3,209 | $557 | ($2,652) | -83% |
| FatPipe Networks | $26,835 | $14,654 | ($12,181) | -45% |
| Forcepoint | $23,375 | $23,375 | $0 | 0% |
| Fortinet | $2,850 | $24,554 | $21,704 | 762% |
| Talari Networks | $55,919 | $24,431 | ($31,488) | -56% |
| Versa Networks | $17,142 | $18,108 | $966 | 6% |
| VMware | $28,800 | $28,857 | $57 | 0% |

**Figure 11 – Purchase Price vs. Value**

# Test Methodology

Software-Defined Wide Area Network (SD-WAN) Test Methodology v1.2

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