



## **BREACH DETECTION SYSTEM PRODUCT ANALYSIS**

**Fortinet FortiSandbox 3000D** v1.2

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## Overview

NSS Labs performed an independent test of the Fortinet FortiSandbox 3000D v1.2 breach detection system (BDS). The product was subjected to thorough testing at the NSS facility in Austin, Texas, based on the BDS methodology v1.5 available at [www.nsslabs.com](http://www.nsslabs.com). This test was conducted free of charge and NSS did not receive any compensation in return for participation.

While the companion “Comparative Analysis Reports” (CARs) on “Security,” “Performance,” “Management,” and “Total Cost Of Ownership” (TCO) will provide comparative information about all tested products, this individual “Product Analysis Report” (PAR) provides detailed information that is not available elsewhere.

As part of the initial BDS test setup, devices are tuned as deemed necessary by the vendor. Every effort is made to ensure the optimal combination of security effectiveness and performance, as would be the aim of a typical customer deploying the device in a live network environment. Figure 1 presents the overall results of the tests.

Product				Breach Detection	NSS Tested Throughput
<b>Fortinet FortiSandbox 3000D</b> v1.2				99.0%	1,000 Mbps
HTTP Malware	Email Malware	Exploits	Stability and Reliability	Evasions	False Positive Rate
99%	98%	100%	PASS	83%	0%

Figure 1 – Overall Test Results

The Fortinet FortiSandbox 3000D was tested and rated by NSS at 1,000 Mbps, which is in line with the vendor’s claim (Fortinet rates this device at 1,000 Mbps). NSS rated throughput is calculated as an average of the “Real-World” Protocol Mixes (Enterprise Perimeter, Education), and the 21 KB HTTP response-based tests.

The Fortinet FortiSandbox 3000D detected 99% of HTTP malware, 98% of email malware, and 100% of exploits, giving an overall breach detection rating of 99.0%. The device passed all stability and reliability tests and detected 83% of evasions. The FortiSandbox 3000D also had a 0% false positive rate.

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## Security Effectiveness

NSS testing verifies that the BDS is able to detect and log breaches and attempted breaches accurately, while remaining resistant to false positives. All tests in this section are completed with no background network load.

The BDS must be able to identify known and unknown malware, and command and control (C&C) channels. The ability to manage policies and generate reports while under load is a required function. Alerts must be triggered at the sensor device and transmitted to the management station continually and under all test conditions. All malicious traffic is transmitted in a single burst at the start of each test, and alerts must be received within 48 hours from that point to count towards as successful breach detection.

The following use cases may be examined to determine if the BDS can identify the breach within each scenario.

- **Web-based malware attacks that rely on social engineering** – The user is deceived into clicking a malicious link to download and execute malware.
- **Web-based exploits** – Also known as “drive-by downloads,” the user merely needs to visit a web page that hosts malicious code in order to be infected.
- **Socially engineered malware coming via non-HTTP traffic** – Malware is delivered by other common means such as email, a cloaked executable (.jpeg, .jpg, .exe, .zip), FTP, or an infected USB drive.
- **Blended exploits** – Also known as “doc-jacking,” these are typically delivered via common documents (for example, Microsoft Word documents and, Excel spreadsheets) containing exploits. These exploits are typically delivered via network protocols.
- **Off-line infections** – Remote users with mobile devices can become infected while outside the protection of the corporate network security. When infected devices are subsequently reattached to the corporate network, the infection can spread.

### HTTP Malware

HTTP malware is socially engineered malware using the HTTP protocol as its transport mechanism, i.e., it is downloaded through a web browser. Over the duration of the test, Fortinet FortiSandbox 3000D detected 95% on download and 99% on callback, resulting in an overall detection rate of 99%. Figure 2 provides a histogram of detection over time (earlier detection is better).

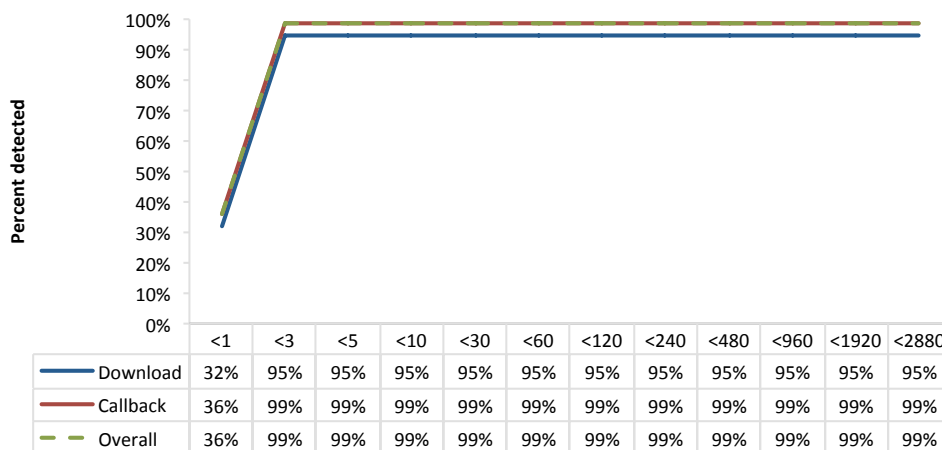


Figure 2 – HTTP Malware Detection Over Time (Minutes)

## Email Malware

Email malware is socially engineered malware that uses email as its transport mechanism; for example, a malicious email attachment. Over the duration of the test, Fortinet FortiSandbox 3000D detected 98% on download and 98% on callback, resulting in an overall detection rate of 98%. Figure 3 provides a histogram of detection over time (earlier detection is better).

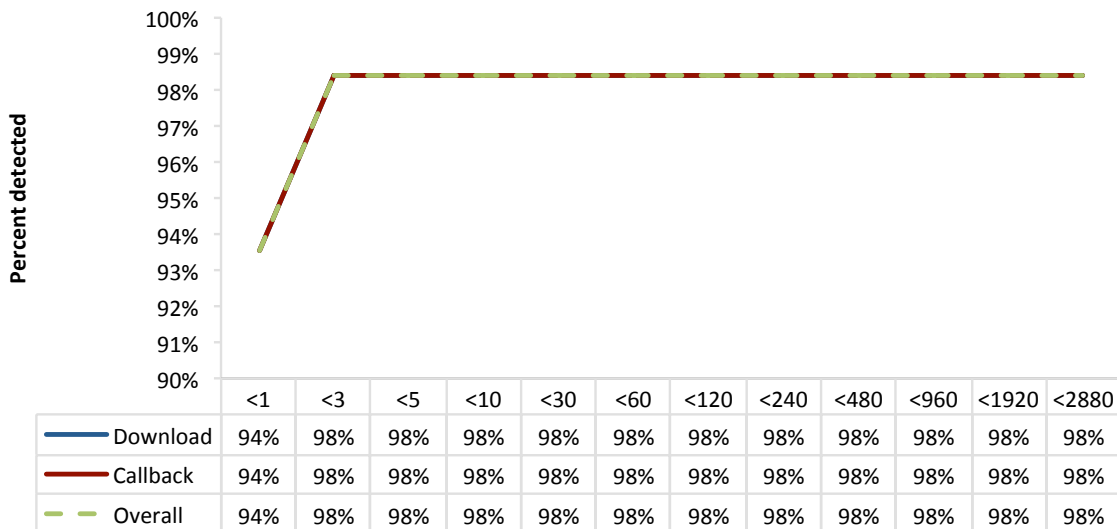


Figure 3 – Email Malware Detection Over Time (Minutes)

## Exploits

Exploits are defined as malicious software that is designed to take advantage of an existing deficiency in a hardware or software system, be it a vulnerability or a bug. Over the duration of the test, Fortinet FortiSandbox 3000D detected 100% of exploits on drop and 100% on callback, resulting in an overall detection rate of 100%. Figure 4 provides a histogram of detection over time (earlier detection is better).

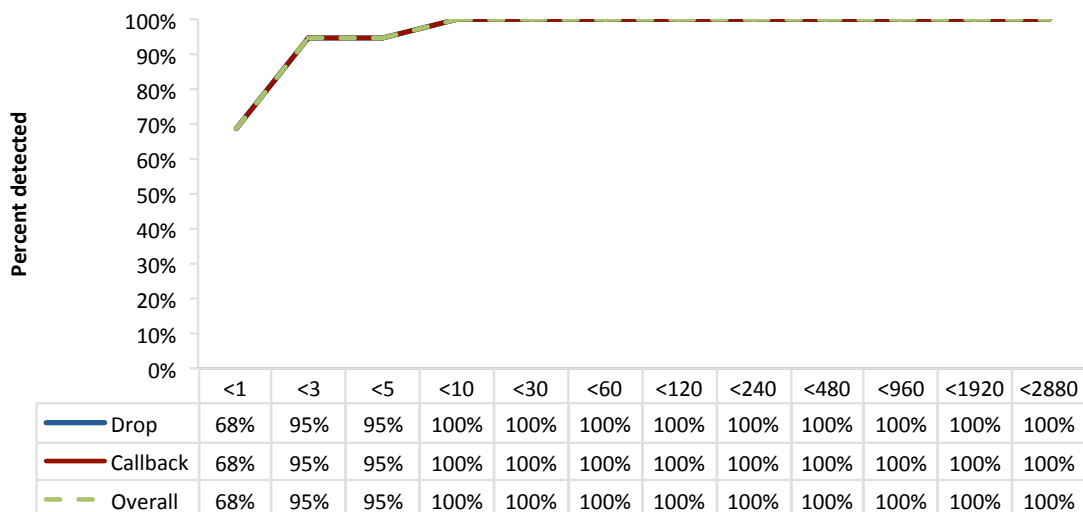


Figure 4 – Exploit Detection Over Time (Minutes)

## Resistance to Evasion

Evasion techniques are a means of disguising and modifying attacks in order to avoid detection by security products. Failure to handle properly any of the evasion techniques tested can have a significant detrimental effect on the overall security effectiveness of a BDS device.

Figure 5 provides the results of the evasion tests for Fortinet FortiSandbox 3000D. Overall resistance to evasion techniques was 83% Fortinet FortiSandbox 3000D failed to properly handle certain packer evasion techniques.

Evasions	Result
Packers	0%
Compressors	100%
Metamorphism	100%
Polymorphism	100%
Virtual machine	100%
Sandbox	100%
<b>Overall Resistance to Evasion</b>	<b>83%</b>

Figure 5 – Resistance To Evasion Results

For more details on evasion techniques used in this test, see the “*Breach Detection Systems Test Methodology*” at [www.nsslabs.com](http://www.nsslabs.com).

## False Positives

The ability of the BDS to identify legitimate traffic while maintaining detection of threats and breaches is as important as its detection of malicious content. This test includes a varied sample of legitimate application traffic, some of which is not malicious, but which may be falsely identified as such (also known as false positives).

Figure 6 shows the percentage of non-malicious traffic mistakenly identified as malicious (lower score is better). Fortinet FortiSandbox 3000D had a false positive rate of 0%

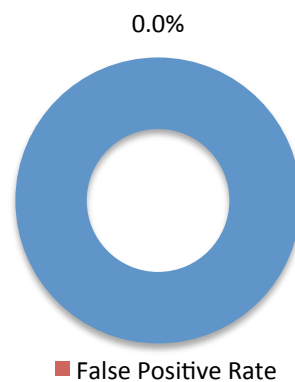


Figure 6 – False Positive Rate

## Performance

There is frequently a trade-off between security effectiveness and performance; a product's security effectiveness should be evaluated within the context of its performance and vice versa. This ensures that detection does not adversely impact performance and that security shortcuts are not taken to maintain or improve performance. The NSS performance tests are designed to validate that the inspection engine can maintain its detection rate as background traffic increases.

### Maximum Capacity

The use of automated testing and traffic generation appliances allows NSS engineers to create true “real-world,” high-speed traffic as background load for the tests. The aim of these tests is to stress the inspection engine and to determine how it copes with high volumes of concurrent transmission control protocol (TCP) open connections and TCP connections per second.

- **Maximum Concurrent TCP Connections** - This test is designed to determine the maximum concurrent TCP connections of the BDS with no data passing across the connections. This type of traffic is not typically found on a normal network, but it provides the means to determine the maximum possible concurrent connections figure.
- **Maximum TCP Connections Per Second** - This test is designed to determine the maximum TCP connection rate of the BDS with one byte of data passing across the connections. This type of traffic is not typically found on a normal network, but it provides the means to determine the maximum possible TCP connection rate.

Results for the Fortinet FortiSandbox 3000D are provided in Figure 7.

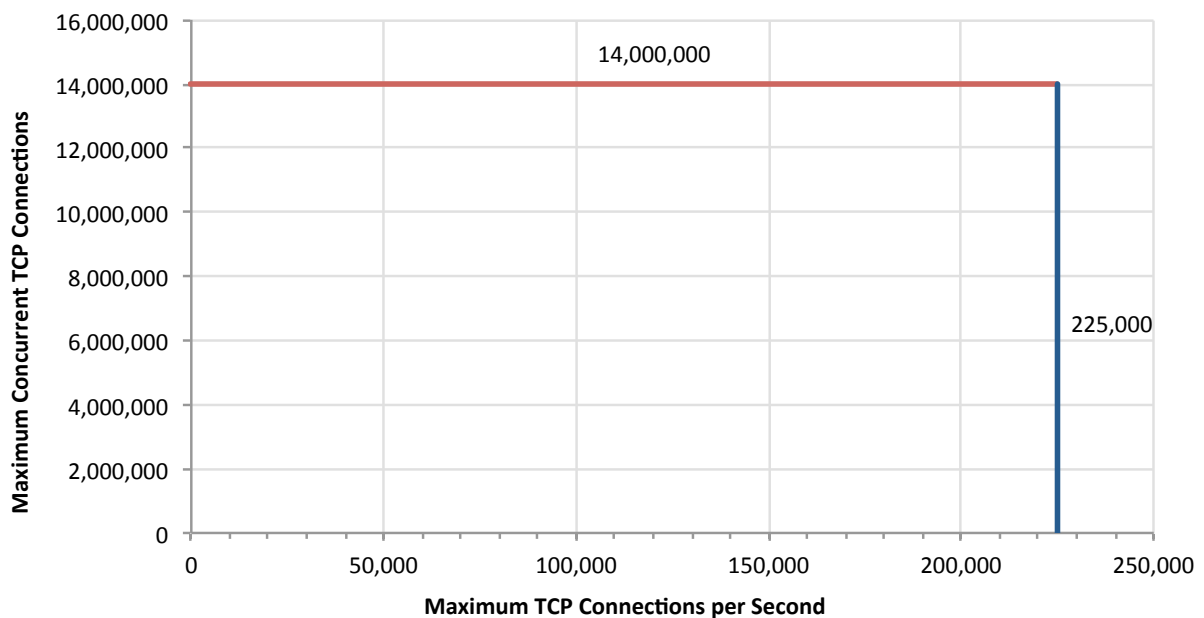


Figure 7 – Maximum Concurrent TCP Connections And Maximum TCP Connections Per Second



## HTTP Capacity With No Transaction Delays

The aim of these tests is to stress the HTTP detection engine and to determine how the BDS copes with network loads of varying average packet size and with varying connections per second. By creating genuine, session-based traffic of varying session lengths, the BDS is forced to track valid TCP sessions, thus ensuring a higher workload than for simple, packet-based background traffic. This provides a test environment that is as close to “real world” as it is possible to achieve in a lab environment, while ensuring absolute accuracy and repeatability.

The tests are repeated at 25 percent, 50 percent, 75 percent, and 100 percent of maximum rated throughput of the BDS (note that the 100 percent load will actually be less than 100 percent to allow headroom for malicious traffic). At each stage, multiple malware files are passed through the network and the number detected is logged. The first stage at which one or more attacks are not detected is recorded as the maximum HTTP capacity for that response size/traffic mix. Figure 8 depicts these results.

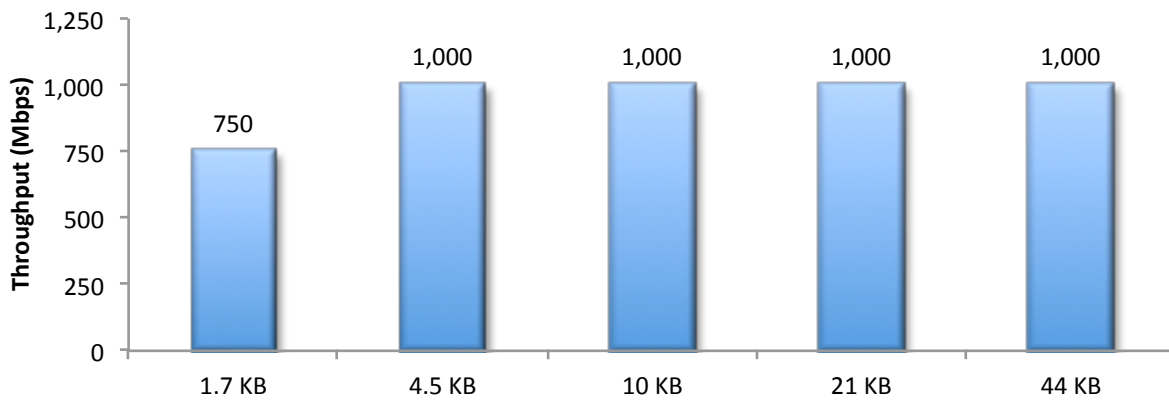


Figure 8 – Detection Under Load (HTTP Capacity With No Transaction Delay)

## HTTP Capacity with Transaction Delays

Typical user behavior introduces delays between requests and responses, for example, as users read web pages and decide which links to click next. This next set of tests is identical to the previous set except that these include a 5 second delay in the server response for each transaction. This has the effect of maintaining a high number of open connections throughout the test, thus forcing the sensor to utilize additional resources to track those connections.

All tests are repeated at 25 percent, 50 percent, 75 percent, and 100 percent of maximum rated throughput of the BDS. In order to highlight any difference in performance, Figure 9 presents the results for HTTP capacity both with and without transaction delays.



Figure 9 – Detection Under Load (HTTP Capacity With Transaction Delay)

## “Real-World” Traffic Mixes

Where previous tests provide a pure HTTP environment with varying connection rates and average packet sizes, the aim of this test is to simulate a “real-world” environment by introducing additional protocols and real content, while still maintaining a precisely repeatable and consistent background traffic load.

The average result is a background traffic load that is closer to what may be found on a heavily utilized “normal” production network. All tests are repeated at 25 percent, 50 percent, 75 percent, and 100 percent of maximum rated throughput of the BDS (note that the 100 percent load will actually be less than 100 percent to allow headroom for malicious traffic). Results are presented in Figure 10.

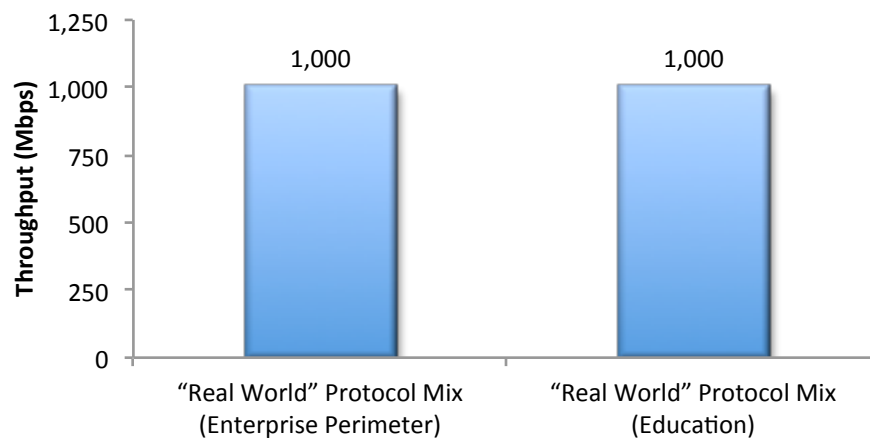


Figure 10 – Detection Under Load (“Real World Traffic”)

For more details about “real-world” traffic protocol types, see the “*Breach Detection Systems Test Methodology*,” available at [www.nsslabs.com](http://www.nsslabs.com).

## Stability And Reliability

Long-term stability is important, since a failure can result in serious breaches remaining undetected and thus not remediated. These tests verify the stability of the BDS, along with its ability to maintain a minimum level of detection while under normal load and while identifying malicious traffic. Products that are not able to sustain logging of legitimate traffic, or that crash while under hostile attack, will not pass.

The BDS is required to remain operational and stable throughout these tests, and it is required to operate at 100 percent scanning capability, raising an alert for each detection. If any malicious traffic passes undetected, caused by either the volume of traffic or by the BDS failing *for any reason*, this will result in a FAIL.

Figure 11 presents the results of the stability and reliability tests for the Fortinet FortiSandbox 3000D.

Stability and Reliability	Result
Detection under extended attack	PASS
Attack detection – normal load	PASS
Protocol fuzzing and mutation – detection ports	PASS
Protocol fuzzing and mutation – management port	PASS
Power fail	PASS
Redundancy	PASS
Persistence of data	PASS
<b>Overall Stability and Reliability</b>	<b>PASS</b>

Figure 11 – Stability And Reliability Results

For more information on stability and reliability results, see the “*Breach Detection Systems CAR*,” available at [www.nsslabs.com](http://www.nsslabs.com).

## Management And Configuration

Security devices are complicated to deploy, and essential systems such as centralized management console options, log aggregation, and event correlation/management systems further complicate the purchasing decision.

Understanding key comparison points allows customers to model the overall impact on network service level agreements (SLAs); estimate operational resource requirements to maintain and manage the systems; and better evaluate the required skill/competencies of staff.

As part of this test, NSS performed in-depth technical evaluations of the main features and capabilities of the enterprise management systems offered by each vendor, covering the following key areas:

- **General Management And Configuration** – How easily can devices be installed and configured, and how easily can multiple devices be deployed throughout a large enterprise network?
- **Product Customization** – How easily can customized configurations be created, edited, and deployed across an enterprise? Configurations may be policies, alert settings, and so on, depending on the product.
- **Alert Handling** – How accurate and timely is the alerting, and how easily accessible is the critical information that would be needed to remediate a security problem?
- **Reporting** – How effective and how easily customized is the reporting capability?

For a complete analysis of enterprise management capabilities and total cost of ownership (TCO), refer to the *“Total Cost Of Ownership”* and *“Management”* CARs available at [www.nsslabs.com](http://www.nsslabs.com).

## Total Cost of Ownership (TCO)

Implementation of security solutions can be complex, with several factors affecting the overall cost of deployment, maintenance fees, and upkeep. All of these factors should be considered over the course of the useful life of the solution.

- **Product Purchase** – The cost of acquisition.
- **Product Maintenance Fees** – The recurring fees paid to the vendor (including software and hardware support, maintenance and other updates).
- **Installation Time** – The time required to take the device out of the box, configure it, put it into the network, apply updates and patches, and set up desired logging and reporting.
- **Upkeep** – The time required to apply periodic updates and patches from vendors, including hardware, software, and other updates.
- **Management** – Day-to-day management tasks including device configuration, policy updates, policy deployment, alert handling, and so on.

For the purposes of this report, capital expenditure (CAPEX) items are included for a single device only (the cost of acquisition and installation). Operational expenditure (OPEX) items (ongoing management and labor costs) for multiple devices plus centralized management systems are modeled in the separate “*Management*” and “*Total Cost Of Ownership*” CARs, available at [www.nsslabs.com](http://www.nsslabs.com).

### Installation Time

Figure 12 depicts the number of hours of labor required to install each device, using only local device management options. This is the amount of time taken by NSS engineers and vendor engineers to install and configure the BDS to the point where it operates successfully in the test harness, ignores legitimate traffic, and detects prohibited/malicious traffic. This closely mimics a typical enterprise deployment scenario for a single device. Centralized management options are covered in the “*Management*” CAR.

Product	Installation
Fortinet FortiSandbox 3000D v1.2	6 hours

Figure 12 – Installation Time

## Total Cost of Ownership (TCO)

Figure 13 presents the TCO and vendor-provided purchase price along with maintenance for the device. Prices are for single device management and maintenance only; costs for central device management (CDM) solutions may be extra. Where possible, the 24/7 maintenance and support option with 24-hour replacement is utilized, since this is the option typically selected by enterprise customers.

Note that the maintenance cost for years 2 and 3 are bundled in the year 1 cost.

Product	Purchase	Maintenance/ Year	Year 1 Cost	Year 2 Cost	Year 3 Cost	3-Year TCO
Fortinet FortiSandbox 3000D v1.2	\$99,995	\$102,373	\$202,818	\$0	\$0	\$202,818

Figure 13 – Total Cost Of Ownership (TCO)

- **Year 1 Cost** is calculated by adding installation costs (\$75 USD per hour fully loaded labor x installation time) + purchase price + first-year maintenance/support fees.
- **Year 2 Cost** consists only of maintenance/support fees.
- **Year 3 Cost** consists only of maintenance/support fees.

This provides a TCO figure consisting of hardware, installation and maintenance costs only. Additional management and labor costs are excluded, since they are modeled extensively in the *Management* and *TCO CARs*.

## Value: Total Cost of Ownership Per Detected-Mbps

There is a clear difference between price and value. The least expensive product does not necessarily offer the greatest value if it offers significantly lower performance than only slightly more expensive competitors. The best value is a product with a low TCO and a high level of secure throughput (malware detection x performance).

Figure 14 depicts the relative cost per unit of work performed, described as Detected-Mbps.

Product	Breach Detection	NSS Tested Throughput	3-Year TCO	TCO/Detected-Mbps
Fortinet FortiSandbox 3000D v1.2	99.0%	1,000 Mbps	\$202,818	\$205

Figure 14 – Total Cost Of Ownership Per Detected-Mbps

TCO per Detected Mbps was calculated by taking the three-year TCO and dividing it by the product of Detection x NSS-measured throughput. Therefore, 3-Year TCO/(Detection x Throughput) = TCO/Detected Mbps.

TCO is for single device maintenance only; costs for CDM solutions may be extra. For additional TCO analysis, including CDM, refer to the *“Total Cost Of Ownership”* and *“Management” CARs*.

## Detailed Product Scorecard

Description	Result		
	Download/Drop	Callback	Overall
<b>Security Effectiveness</b>			
<b>Malware</b>	<b>97%</b>	<b>99%</b>	<b>99%</b>
HTTP	95%	99%	99%
Email (SMTP/IMAP)	98%	98%	98%
Drive-by Exploits	100%	100%	100%
False Positive Rate	0%		
<b>Evasions</b>	<b>83%</b>		
Packers	0%		
Compressors	100%		
Metamorphism	100%		
Polymorphism	100%		
Virtual Machine	100%		
Sandbox	100%		
<b>Performance</b>			
<b>Maximum Capacity</b>	<b>Max Capacity</b>		
Maximum TCP Connections Per Second	225,000		
Maximum Concurrent TCP Connections	14,000,000		
<b>HTTP Capacity</b>	<b>Max Capacity (Mbps)*</b>		
44 KB	1,000		
21 KB	1,000		
10 KB	1,000		
4.5 KB	1,000		
1.7 KB	750		
<b>HTTP Capacity With Transaction Delays</b>	<b>Max Capacity (Mbps)*</b>		
21 KB	1,000		
10 KB	1,000		
<b>“Real World” Traffic</b>	<b>Max Capacity (Mbps)*</b>		
“Real World” Protocol Mix (Enterprise Perimeter)	1,000		
“Real World” Protocol Mix (Education)	1,000		
<b>Stability &amp; Reliability</b>			
Detection Under Extended Attack (Leakage)	PASS		
Attack Detection - Normal Load	PASS		
Protocol Fuzzing and Mutation – Detection Ports	PASS		
Protocol Fuzzing and Mutation – Management Port	PASS		
Power Fail	PASS		
Redundancy	PASS		
Persistence of Data	PASS		
<b>Total Cost of Ownership</b>			
<b>Ease of Use</b>			
Initial Setup (Hours)	6		
Time Required for Upkeep (Hours per Year)	<b>See CAR</b>		
<b>Expected Costs</b>			
Initial Purchase (hardware as tested)	\$99,995		
Initial Purchase (enterprise management system)	<b>See CAR</b>		
Annual Cost of Maintenance & Support (hardware/software)	\$34,124		
Annual Cost of Maintenance & Support (enterprise management system)	<b>See CAR</b>		
Installation Labor Cost (@\$75/hr)	\$450		
Management Labor Cost (per Year @\$75/hr)	<b>See CAR</b>		
<b>Total Cost of Ownership (TCO)</b>			
Year 1	\$134,569		
Year 2	\$34,124		
Year 3	\$34,124		
3-Year TCO	\$202,818		

\* Maximum capacity is approximately 950 Mbps to allow for normal traffic fluctuations.



More detailed scorecards that include enterprise management capabilities and TCO calculations are available in the appropriate “*Comparative Analysis Reports*” (CARs), available at [www.nsslabs.com](http://www.nsslabs.com).

## Test Methodology

### Breach Detection Systems: Test Methodology 1.5

A copy of the test methodology is available at [www.nsslabs.com](http://www.nsslabs.com)

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