BREACH DETECTION SYSTEMS TEST REPORT

Trend Micro Deep Discovery Inspector Model 4000 v3.8SP2
with **OfficeScan** 11.0.5102 Service Pack 1

Authors – Dipti Ghimire, Jessica Williams, Ahmed Garhy

Overview

NSS Labs performed an independent test of the Trend Micro Deep Discovery Inspector Model 4000 v3.8SP2 (this product is also sold as TippingPoint Advanced Threat Protection) with OfficeScan 11.0.5102 Service Pack 1. The product was subjected to thorough testing at the NSS facility in Austin, Texas, based on the Breach Detection Systems (BDS) Test Methodology v3.0, available at www.nsslabs.com. This test was conducted free of charge and NSS did not receive any compensation in return for Trend Micro's participation.

While the companion Comparative Reports on security, performance, and total cost of ownership (TCO) will provide information about all tested products, this Test Report provides detailed information 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 Rate[1]	NSS-Tested Throughput	3-Year TCO (List Price)	3-Year TCO (Street Price)
Trend Micro Deep Discovery Inspector Model 4000 v3.8SP2 with **OfficeScan** 11.0.5102 Service Pack 1				99.8%	8,000 Mbps	$522,600	$299,400
False Positives	Drive-by Exploits	Social Exploits	HTTP Malware	SMTP Malware	Offline Infections	Evasions	Stability & Reliability
1.32%	100.0%	95.7%	100.0%	100.0%	100.0%	100.0%	PASS

Figure 1 – Overall Test Results

The Deep Discovery Inspector Model 4000 and OfficeScan received a breach detection rating of 99.8%. The Deep Discovery Inspector Model 4000 proved effective against all evasion techniques tested. The solution also passed all stability and reliability tests.

The Deep Discovery Inspector Model 4000 was tested and rated by NSS at 8,000 Mbps. *NSS-Tested Throughput* is calculated as an average of the "real-world" protocol mixes (Enterprise Perimeter and Education), and the 21 KB HTTP response-based tests.

[1] The breach detection rate is calculated as the percentage of all malware and exploits that were detected under test (drive-by exploits, social exploits, HTTP malware, SMTP malware, offline infections, and SSL encryption).

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Security Effectiveness

This section aims to verify that the product can detect and log breaches and attempted breaches accurately. All tests in this section are completed with no background network load.

This test utilizes threats and attack methods that exist in the wild and that are currently being used by cybercriminals and other threat actors. For live testing, NSS employs a unique live test harness, the Cyber Advanced Warning System™ (CAWS), to measure how well security products protect against "drive-by" exploits that target client applications.

The CAWS test harness captures thousands of suspicious URLs per day from threat data generated from NSS and its customers, as well as data from open-source and commercial threat feeds. This list of URLs is optimized and assigned to victim machines, each of which has a unique combination of operating system (including service pack/patch level), browser, and client application. For details on live testing, please refer to the latest Security Stack (Network) Test Methodology, which can be found at www.nsslabs.com.

The ability of the product to detect and report successful infections in a timely manner is critical to maintaining the security and functionality of the monitored network. Infection and transmission of malware should be reported quickly and accurately, giving administrators the opportunity to contain the infection and minimize impact on the network.

As response time is critical in halting the damage caused by malware infections, the system under test (SUT) should be able to detect known samples, or analyze unknown samples, and report on them within 24 hours of initial infection and command and control (C&C) callback. Any SUT that does not alert on an attack, infection, or C&C callback within the detection window will not receive credit for the detection.

The following use cases may be examined to determine if the SUT can identify a security risk 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," these occur when the user is infected merely by visiting a web page that hosts malicious code.
- **Socially engineered malware delivered via non-HTTP traffic** – Malware is delivered by other common means such as email, a cloaked executable (.jpeg, .exe, .zip), FTP, or an infected USB drive.
- **Blended exploits** – Also known as "doc-jacking," these are typically delivered via common documents, such as Microsoft Word documents or Excel spreadsheets, containing exploits. These exploits are typically delivered via network protocols.
- **Offline 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.

False Positives

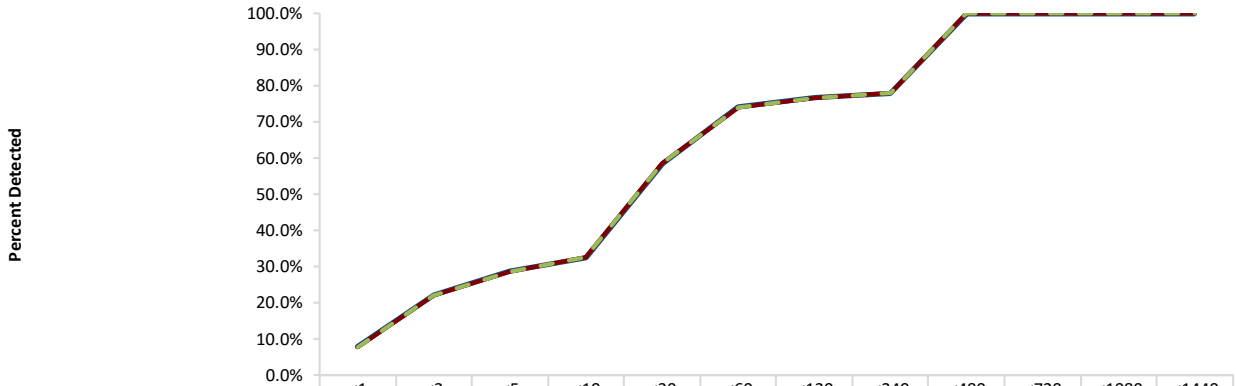
The ability of the BDS to identify legitimate traffic while at the same time detecting threats and breaches is as important as its ability to detect malicious content. This test includes a varied sample of legitimate application traffic that may be falsely identified as malicious (also known as false positives).

Figure 2 depicts the percentage of non-malicious traffic mistakenly identified as malicious. A lower score is better. The Deep Discovery Inspector Model 4000 with OfficeScan had a false positive rate of 1.32%.

Figure 2 – False Positive Rate

Malware Delivered by Drive-by Exploits

Figure 3 depicts malware delivered using drive-by exploits. Drive-by exploits are defined as malicious software designed to take advantage of existing deficiencies in hardware or software systems, such as vulnerabilities or bugs. Over the course of the test, the Deep Discovery Inspector Model 4000 with OfficeScan detected 100.0% of drive-by exploits on initial compromise and 100.0% on callback, resulting in an overall detection rate of 100.0%. Figure 3 provides a histogram of detection over time. Earlier detection is better.

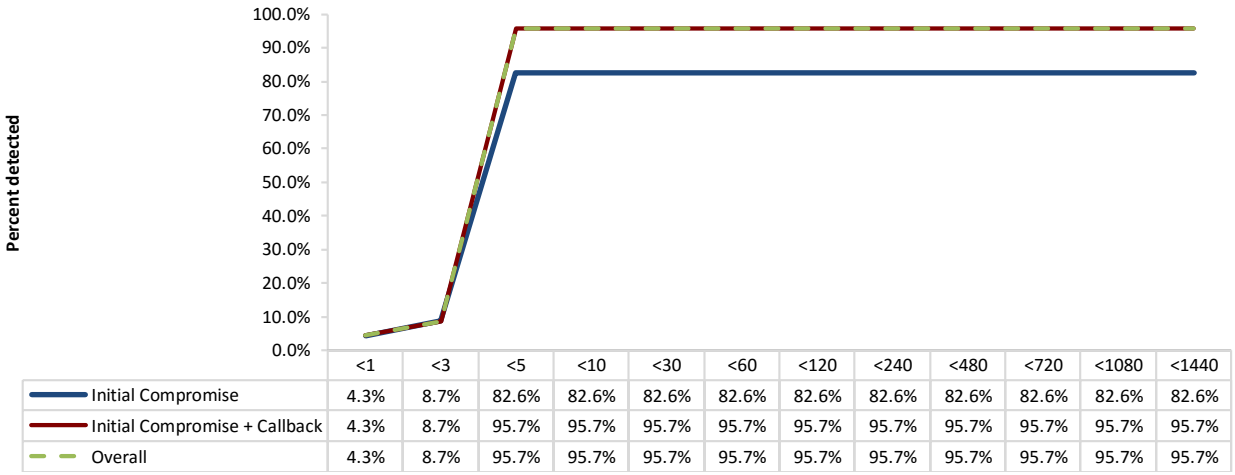


	<1	<3	<5	<10	<30	<60	<120	<240	<480	<720	<1080	<1440
Initial Compromise	7.8%	22.1%	28.6%	32.5%	58.4%	74.0%	76.6%	77.9%	100.0%	100.0%	100.0%	100.0%
Initial Compromise + Callback	7.8%	22.1%	28.6%	32.5%	58.4%	74.0%	76.6%	77.9%	100.0%	100.0%	100.0%	100.0%
Overall	7.8%	22.1%	28.6%	32.5%	58.4%	74.0%	76.6%	77.9%	100.0%	100.0%	100.0%	100.0%

Figure 3 – Malware Delivered by Drive-by Exploits: Detection over Time (Minutes)

Malware Delivered by Social Exploits

Figure 4 depicts malware delivered using social exploits. Social exploits are defined as malicious software designed to take advantage of user behavior through existing deficiencies in hardware or software systems, such as vulnerabilities or bugs. Over the course of the test, the Deep Discovery Inspector Model 4000 with OfficeScan detected 82.6% of exploits on initial compromise and 95.7% on callback, resulting in an overall detection rate of 95.7%. Figure 4 provides a histogram of detection over time. Earlier detection is better.

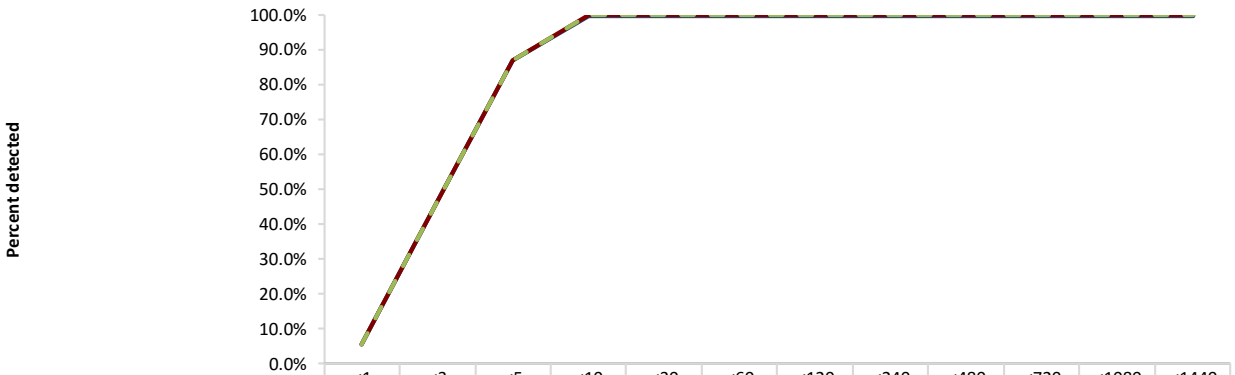


	<1	<3	<5	<10	<30	<60	<120	<240	<480	<720	<1080	<1440
Initial Compromise	4.3%	8.7%	82.6%	82.6%	82.6%	82.6%	82.6%	82.6%	82.6%	82.6%	82.6%	82.6%
Initial Compromise + Callback	4.3%	8.7%	95.7%	95.7%	95.7%	95.7%	95.7%	95.7%	95.7%	95.7%	95.7%	95.7%
Overall	4.3%	8.7%	95.7%	95.7%	95.7%	95.7%	95.7%	95.7%	95.7%	95.7%	95.7%	95.7%

Figure 4 – Malware Delivered by Social Exploits: Detection over Time (Minutes)

Malware Delivered over HTTP

Figure 5 depicts malware using the HTTP protocol as its transport mechanism; that is, the malware is downloaded through a web browser. Over the course of the test, the Deep Discovery Inspector Model 4000 with OfficeScan detected 99.6% of malware on download and 100.0% on callback, resulting in an overall detection rate of 100.0%. Figure 5 provides a histogram of detection over time. Earlier detection is better.

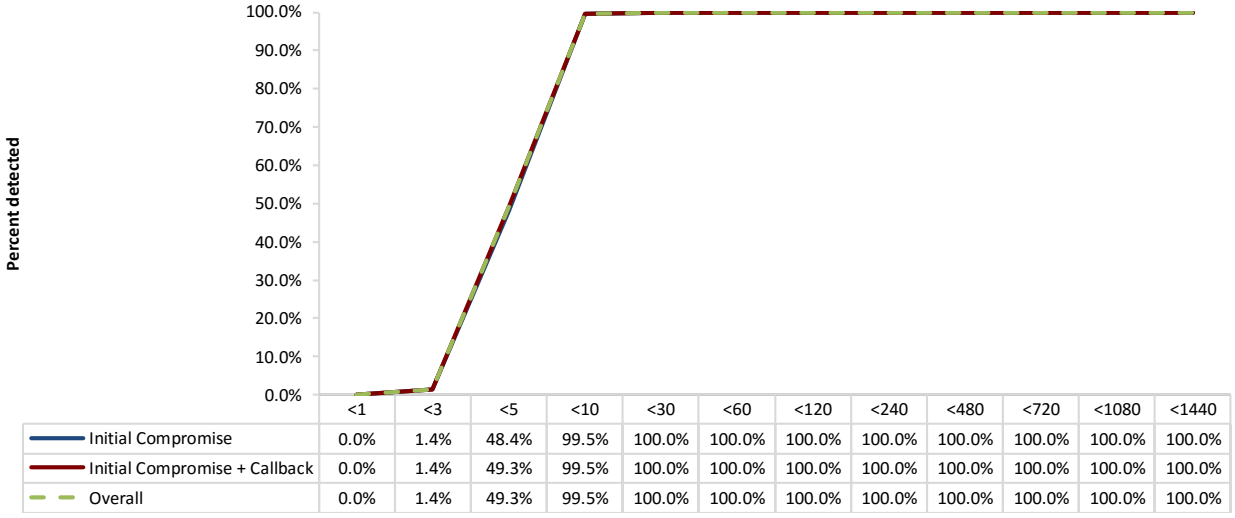


	<1	<3	<5	<10	<30	<60	<120	<240	<480	<720	<1080	<1440
Initial Compromise	5.4%	46.7%	87.0%	99.6%	99.6%	99.6%	99.6%	99.6%	99.6%	99.6%	99.6%	99.6%
Initial Compromise + Callback	5.4%	46.7%	87.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Overall	5.4%	46.7%	87.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Figure 5 – Malware Delivered over HTTP: Detection over Time (Minutes)

Malware Delivered over Email

Figure 6 depicts malware that uses email (SMTP) as its transport mechanism; for example, a malicious email attachment. Over the course of the test, the Deep Discovery Inspector Model 4000 with OfficeScan detected 100.0% of malware on download and 100.0% on callback, resulting in an overall detection rate of 100.0%. Figure 6 provides a histogram of detection over time. Earlier detection is better.

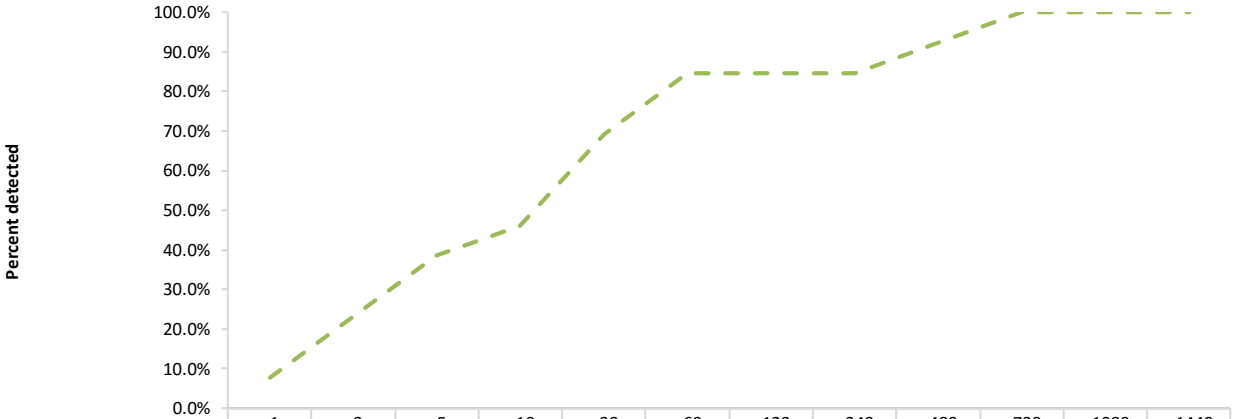


	<1	<3	<5	<10	<30	<60	<120	<240	<480	<720	<1080	<1440
Initial Compromise	0.0%	1.4%	48.4%	99.5%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Initial Compromise + Callback	0.0%	1.4%	49.3%	99.5%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Overall	0.0%	1.4%	49.3%	99.5%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Figure 6 – Malware Delivered over Email: Detection over Time (Minutes)

Offline Infections

Offline infections are defined as hosts infected with malware outside the corporate network and subsequently attached to the network. Over the course of the test, the Deep Discovery Inspector Model 4000 with OfficeScan detected 100.0% of offline infections. Figure 7 provides a histogram of detection over time. Earlier detection is better.



	<1	<3	<5	<10	<30	<60	<120	<240	<480	<720	<1080	<1440
Offline Infections	7.7%	23.1%	38.5%	46.2%	69.2%	84.6%	84.6%	84.6%	92.3%	100.0%	100.0%	100.0%

Figure 7 – Offline Infections (Minutes)

Resistance to Evasion Techniques

Evasion techniques are a means of disguising and modifying attacks at the point of delivery in order to avoid detection by security products. If a security device fails to correctly identify a specific type of evasion, an attacker could potentially deliver malware that the device normally would detect. Figure 8 depicts the results of the evasion tests for the Deep Discovery Inspector Model 4000 with OfficeScan.

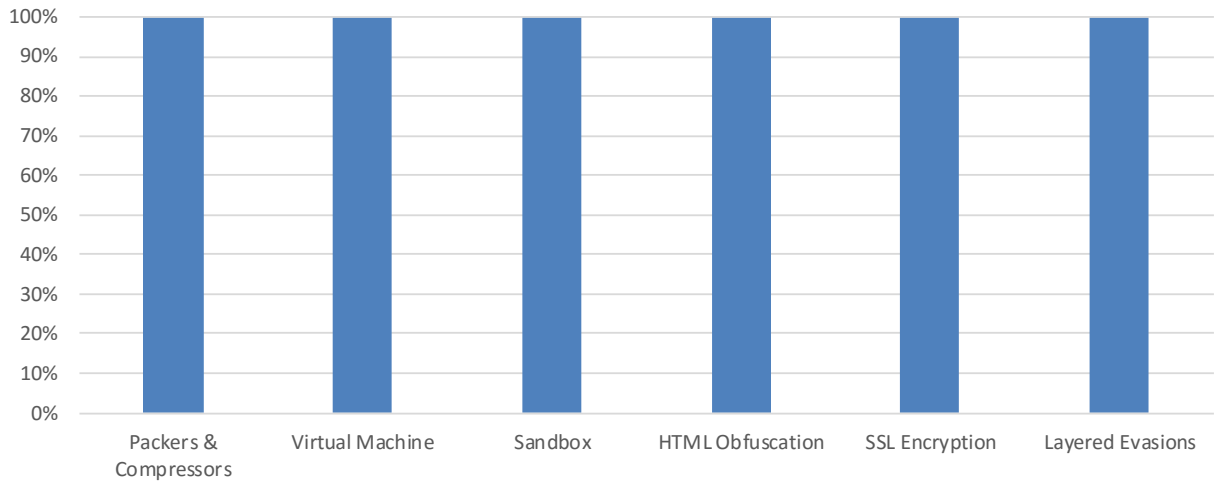


Figure 8 – Resistance to Evasion Results

SSL Encryption

Threat actors are known to compromise high-profile websites or websites with specific clientele in order to serve exploits from a trusted source. Such websites are known as "watering holes" and frequently encrypt content in order to evade detection. Over the course of the test, the Deep Discovery Inspector Model 4000 with OfficeScan detected 100.0% of SSL malware. Figure 9 provides a histogram of detection over time. Earlier detection is better.

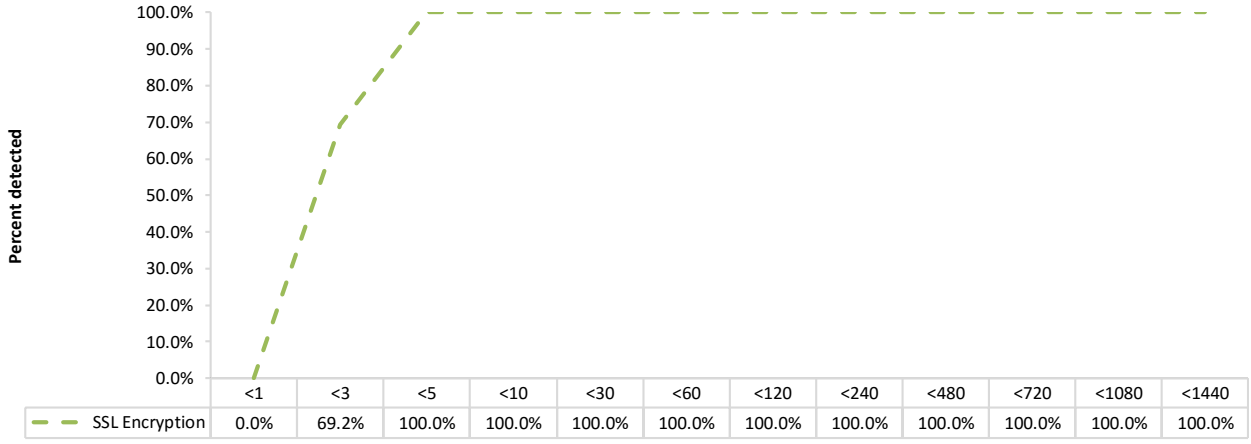


Figure 9 – Detection of SSL Encryption (Minutes)

Packers and Compressor Evasions

Figure 10 and Figure 11 depict the packing and compressing techniques used as part of the evasion testing. The Deep Discovery Inspector Model 4000 with OfficeScan detected all packing and compressing techniques.

Packing Technique	Identified by Device	Packing Technique	Identified by Device
GioPacker	YES	Packman	YES
HidePX	YES	PeLock	YES
Petite	YES	ASPack	YES
Morphine	YES	WinPack	YES
mPack	YES	RoguePack	YES
AckerPack	YES	Excalibur	YES
GHFProtector	YES	SecuPack	YES
SimplePack	YES	mPress	YES
VMProtect	YES	nsPack	YES
AnskyaPolymorphic	YES	WinCrypt	YES

Figure 10 – Packing Techniques

Compressing Technique	Identified by Device
Brazip	YES
makeZip	YES
QuickZip	YES
SmartSFX	YES
NEWZIP	YES
IZArc	YES
Bandizip	YES

Figure 11 – Compressing Techniques

Network Device 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 no security shortcuts are taken to maintain or improve performance. The NSS performance tests are designed to validate that a network device inspection engine can maintain its detection rate as background traffic increases. All tests in this section are repeated at 25%, 50%, 75%, and 100% of the maximum rated throughput of the SUT (note that the 100% load will actually be less than 100% to allow headroom for malicious traffic). At each stage, multiple instances of malicious traffic are passed and the number detected is logged. The first stage at which one or more attacks is not detected is recorded as the maximum capacity for that test.

Maximum Capacity

The use of automated testing and traffic generation appliances allows NSS engineers to create "real-world," high-speed traffic as the background load for the tests.

These tests aim to stress the network device inspection engine and determine how it handles increasing TCP connections per second, application layer transactions per second, and concurrent open connections.

- **Maximum TCP connections per second** – This test is designed to determine the maximum TCP connection rate of the SUT with 1 byte of data passing across the connections. This type of traffic would not typically be found on a normal network, but it provides the means to determine the maximum possible TCP connection rate. The first stage at which one or more attacks is not detected is recorded as the maximum TCP connections.
- **Maximum HTTP connections per second** – This test is designed to determine the maximum TCP connection rate of the SUT with a 1-byte HTTP response size. The response size defines the number of bytes contained in the body, excluding any bytes associated with the HTTP header. A 1-byte response size is designed to provide the theoretical maximum HTTP connections per second (CPS) rate. The first stage at which one or more attacks is not detected is recorded as the maximum HTTP connections.

Results for the maximum TCP connections per second and maximum HTTP connections per second tests are provided in Figure 12.

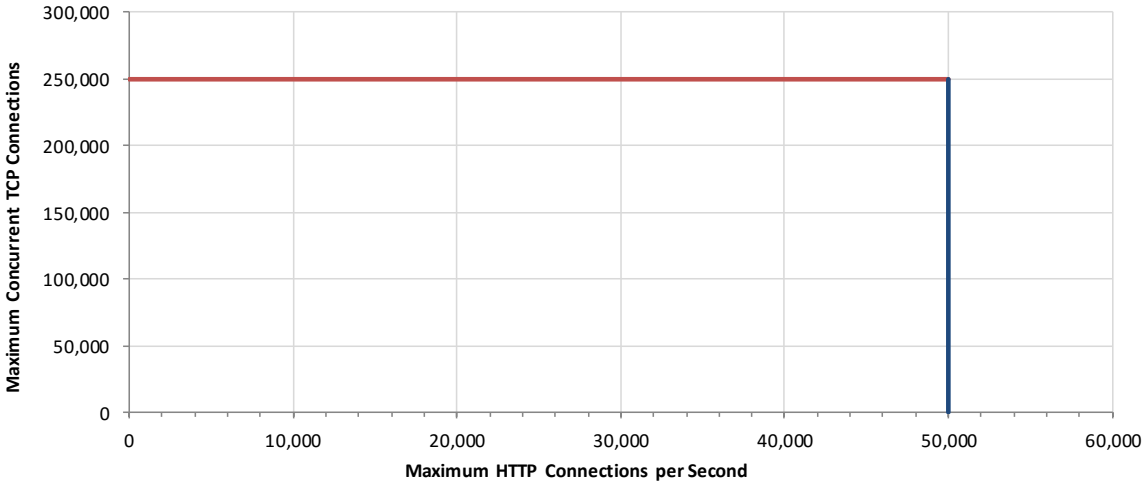


Figure 12 – Maximum TCP Connections per Second and Maximum HTTP Connections per Second

HTTP Capacity with No Transaction Delays

These tests stress the HTTP detection engine and determine how the SUT copes with network loads of varying average packet size and varying connections per second. By creating genuine session-based traffic with varying session lengths, the SUT 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 conditions as can be achieved in a lab environment, while also ensuring absolute accuracy and repeatability.

Each transaction consists of a single HTTP GET request with no transaction delays (that is, the web server responds immediately to all requests). All packets contain valid payload (a mix of binary and ASCII objects) and address data. This test provides an excellent representation of a live network (albeit one biased toward HTTP traffic) at various network loads.

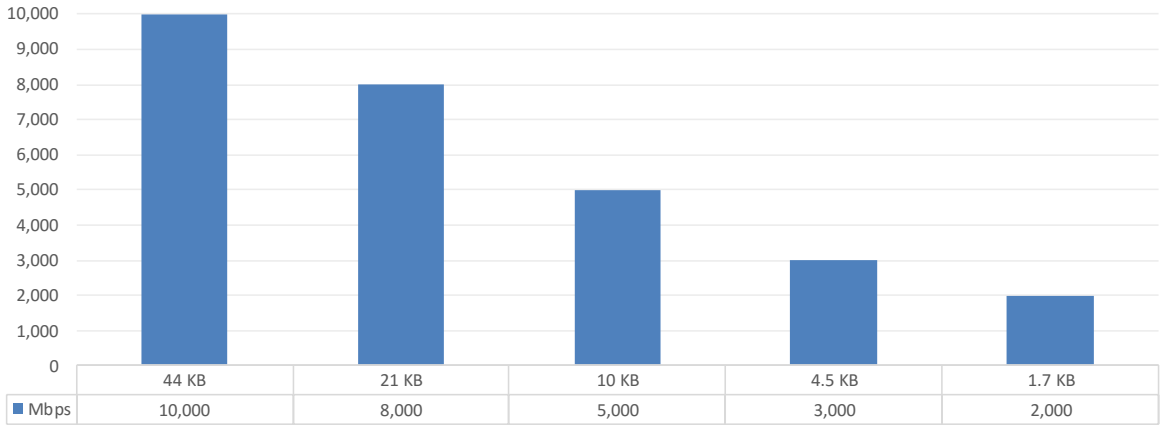


Figure 13 – Detection under Load (HTTP Capacity with No Transaction Delay)

HTTP Capacity with Transaction Delays

Typical user behavior introduces delays between requests and reponses; for example, "think time," as users read web pages and decide which links to click next. This group of tests is identical to the previous group except that these tests include a five-second delay in the server response for each transaction. This delay 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. Figure 14 presents the results for HTTP capacity both with and without transaction delays.

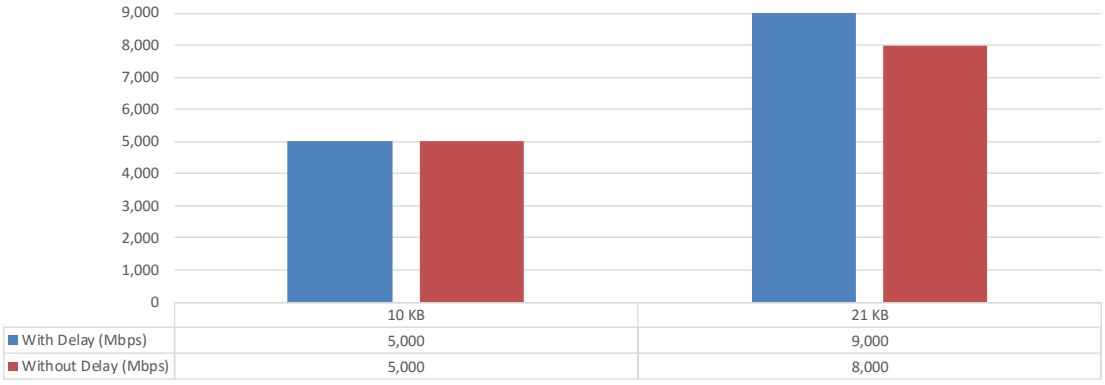


Figure 14 – Detection under Load (HTTP Capacity with and without Transaction Delay)

Real-World Traffic Mixes

This test measures the performance of the network device under test in 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. Results are presented in Figure 15.

The Deep Discovery Inspector Model 4000 performed above the throughput claimed by the vendor.

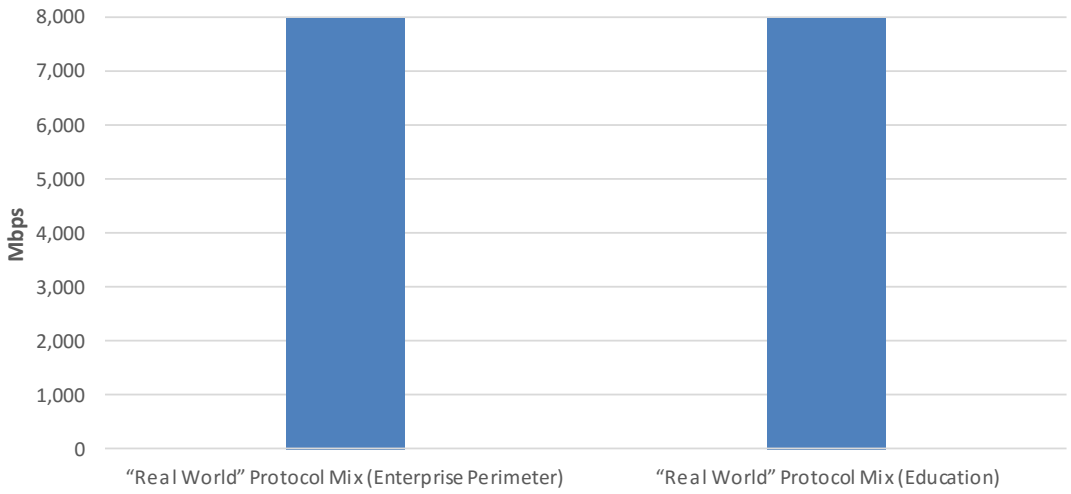


Figure 15 – Detection under Load ("Real-World" Traffic)

Stability and Reliability

Long-term stability is important, since a failure can result in serious breaches remaining undetected and thus not being remediated. These tests verify the stability of the SUT along with its ability to maintain security effectiveness while under normal load and while detecting malicious traffic. Products that cannot sustain logging of legitimate traffic or that crash while under hostile attack will not pass.

The SUT is required to remain operational and stable throughout these tests and to detect 100% of previously detected traffic, raising an alert for each. If any malicious traffic passes undetected—caused by either the volume of traffic or by the SUT failing for any reason—this will result in a fail.

Figure 16 presents the results of the stability and reliability tests for the Deep Discovery Inspector Model 4000.

Stability and Reliability	Result
Detection under extended attack	PASS
Power failure and persistence of data	PASS

Figure 16 – Stability and Reliability Results

Management and Configuration

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

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

Enterprises should include management and configuration during their evaluations, focusing on the following at a minimum:

- **General Management and Configuration** – How easy is it to install and configure devices, and how easy is it to deploy multiple devices throughout a large enterprise network?
- **Policy Handling** – How easy is it to create, edit, and deploy complicated security policies across an enterprise?
- **Alert Handling** – How accurate and timely is the alerting, and how easy is it to drill down to locate critical information needed to remediate a security problem?
- **Reporting** – How effective is the reporting capability, and how readily can it be customized?

Total Cost of Ownership (TCO)

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

- **Product Purchase** – The cost of acquisition
- **Product Maintenance** – The fees paid to the vendor, including software and hardware support, maintenance, and other updates
- **Installation** – 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).

Calculating the Total Cost of Ownership (TCO)

In procuring a BDS solution for the enterprise, it is essential to factor in both bandwidth and the number of users. NSS has found that the malware detection rates of some BDS network devices drop when they operate at maximum capacity. NSS research has shown that, in general, enterprise network administrators architect their networks for up to 2 Mbps of sustained throughput per employee. Consequently, an enterprise must deploy 500 agents and/or one network device of 1,000 Mbps capacity to support 500 users.

Users	Mbps per User	Network Device Throughput	Centralized Management
500	2 Mbps	1,000 Mbps	1

Figure 17 – Number of Users

Installation Time

This table depicts the number of hours of labor required to install each device using only local device management options. The table accurately reflects the amount of time that NSS engineers, with the help of vendor engineers, needed to install and configure the SUT to the point where it operated successfully in the test harness, passed legitimate traffic, and blocked and detected prohibited or malicious traffic. This closely mimics a typical enterprise deployment scenario for a single device.

The installation cost is based on the time that an experienced security engineer would require to perform the installation tasks described above. This approach allows NSS to hold constant the talent cost and measure only the difference in time required for installation. Readers should substitute their own costs to obtain accurate TCO figures.

Product	Installation
Trend Micro Deep Discovery Inspector Model 4000 v3.8SP2 with **OfficeScan** 11.0.5102 Service Pack 1	8 hours

Figure 18 – Installation Time (Hours)

List Price and Total Cost of Ownership

Calculations are based on vendor-provided pricing information. 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. Prices are for a 4,000 Mbps single-network BDS and/or 2,000 software agents and maintenance only; costs for central management solutions (CMS) may be extra.

Product	Purchase	Maintenance /Year	Year 1 Cost	Year 2 Cost	Year 3 Cost	3-Year TCO
Trend Micro Deep Discovery Inspector Model 4000 v3.8SP2 with **OfficeScan** 11.0.5102 Service Pack 1	$290,000	$116,000	$290,600	$116,000	$116,000	$522,600

Figure 19 – List Price 3-Year TCO

- **Year 1 Cost** is calculated by adding installation costs (US$75 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.

Street Price and Total Cost of Ownership

Calculations are based on vendor-provided pricing information. 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. Prices are for a 4,000 Mbps single network BDS and/or 2,000 software agents, and maintenance only; costs for CMS may be extra.

Product	Purchase	Maintenance /Year	Year 1 Cost	Year 2 Cost	Year 3 Cost	3-Year TCO
Trend Micro Deep Discovery Inspector Model 4000 v3.8SP2 with **OfficeScan** 11.0.5102 Service Pack 1	$166,000	$66,400	$166,600	$66,400	$66,400	$299,400

Figure 20 – Street Price 3-Year TCO

- **Year 1 Cost** is calculated by adding installation costs (US$75 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.

For additional TCO analysis, including for the CMS, refer to the TCO Comparative Report.

Appendix: Product Scorecard

Security Effectiveness			
False Positives (Detection Accuracy)	1.32%		
Detection Rate	**Download/Drop**	**Download/Callback**	**Overall**
Exploits			
Drive-by Exploits	100.0%	100.0%	100.0%
Social Exploits	82.6%	95.7%	95.7%
Malware (various delivery mechanisms)			
HTTP	99.6%	100.0%	100.0%
SMTP	100.0%	100.0%	100.0%
Offline Infections	100.0%		
Evasions			
Packers & Compressors	100.0%		
Virtual Machine	100.0%		
Sandbox	100.0%		
HTML Obfuscation	100.0%		
SSL Encryption	100.0%		
Layered Evasions	100.0%		
Performance			
Maximum Capacity	**Max Capacity**		
Maximum TCP Connections per Second	250,000		
Maximum HTTP Connections per Second	50,000		
HTTP Capacity with No Transaction Delays	Max Capacity (Mbps)		
44 KB HTTP Response Size – 2,500 Connections per Second	10,000		
21 KB HTTP Response Size – 5,000 Connections per Second	8,000		
10 KB HTTP Response Size – 10,000 Connections per Second	5,000		
4.5 KB HTTP Response Size – 20,000 Connections per Second	3,000		
1.7 KB HTTP Response Size – 40,000 Connections per Second	2,000		
HTTP Capacity with Transaction Delays	Max Capacity (Mbps)		
21 KB HTTP Response Size with Delay	9,000		
10 KB HTTP Response Size with Delay	5,000		
"Real-World" Traffic	Max Capacity (Mbps)		
"Real-World" Protocol Mix (Enterprise Perimeter)	8,000		
"Real-World" Protocol Mix (Education)	8,000		
Stability & Reliability			
Detection Under Extended Attack	PASS		
Power Failure and Persistence of Data	PASS		
Total Cost of Ownership (List Price)			
Ease of Use			
Initial Setup (Hours)	8		
Expected Costs			
Initial Purchase (hardware as tested)	$290,000		
Installation Labor Cost (@$75/hr)	$600		
Annual Cost of Maintenance & Support (hardware/software)	$116,000		
Annual Cost of Updates (IPS/AV/etc.)	$0		
Initial Purchase (centralized management system)	See Comparative		
Annual Cost of Maintenance & Support (centralized management system)	See Comparative		

Total Cost of Ownership	
Year 1	$290,600
Year 2	$116,000
Year 3	$116,000
3-Year Total Cost of Ownership	$522,600
Total Cost of Ownership (Street Price)	
Ease of Use	
Initial Setup (Hours)	8
Expected Costs	
Initial Purchase (hardware as tested)	$166,000
Installation Labor Cost (@$75/hr)	$600
Annual Cost of Maintenance & Support (hardware/software)	$66,400
Annual Cost of Updates (IPS/AV/etc.)	$0
Initial Purchase (enterprise management system)	See Comparative
Annual Cost of Maintenance & Support (enterprise management system)	See Comparative
Total Cost of Ownership	
Year 1	$166,600
Year 2	$66,400
Year 3	$66,400
3-Year Total Cost of Ownership	$299,400

Figure 21 – Scorecard

Test Methodology

Breach Detection Systems (BDS) Test Methodology v3.0

A copy of the test methodology is available on the NSS Labs website at www.nsslabs.com.

Contact Information

NSS Labs, Inc.
206 Wild Basin Road
Building A, Suite 200
Austin, TX 78746 USA
info@nsslabs.com
www.nsslabs.com