THE TOLLY GROUP

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WildPackets, Inc.

OmniPeek 2.0, Omnipliance, and Omni DNX Engine

Performance Analysis of Omni Network Fault Analysis Platform

Test Summary

Premise: *Enterprise network managers are faced with the challenge of locating and troubleshooting network faults in order to minimize network downtime. Monitoring multiple segments of a network in real time simultaneously and independently is not a trivial issue. While monitoring multiple network segments independently and simultaneously in real time is extremely helpful to the network managers, the monitoring device should be able to capture the traffic at a rate that would provide meaningful and valuable data on the network traffic.*

WildPackets, Inc. commissioned The Tolly Group to evaluate the performance of its Omni network analysis platform. Tolly Group engineers examined the real-time performance of several key products: OmniPeek Version 2.0 real-time analysis software console; Omnipliance, a distributed agent platform hosting an Omni DNX Engine that captures data on a network segment to which it is attached and can perform real-time expert analysis.

Tolly Group engineers recorded the packet capture performance of the Omni solution in several key operational modes, examined the impact that OmniPeek management traffic has on network utilization, demonstrated the expert system capabilities of the solution, and identified the scalability capabilities of Omni DNX Engine in Expert Analysis mode.

Tests largely focused around two performance options in the Omni DNX Engine: Save-to-Disk and Expert Analysis. In the

Test Highlights

- Captures and saves to disk over 683 Mbps of data in a one-minute run over full-duplex Gigabit Ethernet link
- Consumes just 8 Kbps of a network connection when transmitting traffic between an Omni DNX Engine and an OmniPeek Console in Save-to-Disk mode
- Uses 2.6% of Omnipliance processor cycles when Omni DNX Engine is handling 100,000 conversations
- Scales to support over 1,000 connections per second when capturing data in Statistics-only mode, and 200 connections per second when in Expert Analysis mode

Packet Capture Performance of WildPackets Omni DNX Engine

Performance Options Enabled[1]	Packet capture rate (packets/sec)[2]		Total traffic rate (Mbps)	
	1 minute	10 minutes	1 minute	10 minutes
Save-to-Disk Only (data captured locally and stored, summary data to upstream console)	155,602	133,928	683.0	587.8
Expert Analysis Only (data captured/analyzed locally, summary data to upstream console)	81,976	72,978	359.8	320.3

[1]Traffic flows consisted of 2/3 64-byte and 1/3 1,518-byte UDP packets.
[2]Test configuration consisted of a single XL1 Gigabit Ethernet analyzer card supporting two half-duplex GbE ports.

Source: The Tolly Group, April 2005 *Figure 1*

Network Utilization of WildPackets Omni Analysis Software

Performance Options Enabled	UDP traffic load on monitored segment[1]	Upstream management traffic between the Omni DNX Engine and the OmniPeek Console
	Maximum traffic captured by Omni DNX Engine (Mbps)	Average Kbps
Save-to-Disk Only (data captured locally and stored, summary data to upstream console)	587.4	8
Expert Analysis Only (data captured/analyzed locally, summary data to upstream console)	320.3	10

[1]Test traffic consisted of 2/3 packets of 64-byte size and 1/3 packets of 1,518-byte size.

Source: The Tolly Group, April 2005 *Figure 2*

Save-to-Disk scenario, Omni DNX Engine software, running on a distributed Omnipliance data gathering device, captured data and stored it to the local disk on the Omnipliance without performing any data analysis. Summary data was communicated upstream across the network to an OmniPeek management console. In the Expert Analysis configuration, the Omni DNX Engine captured data, performed extensive analysis and communicated results upstream to the OmniPeek management console. Tests were conducted in April 2005 at The Tolly Group's facilities in Boca Raton, Fl.

Tests show that the Omni products deliver high packet capture performance, introduce negligible traffic onto network links, and deliver a distributed expert analysis capability that helps reduce the amount of data that must be channeled upstream since analysis can be handled locally. Finally, results show the Omni solution scales to accommodate large numbers of user sessions/streams.

Results

Packet Capture Performance

Engineers set out to test the packet capture performance of Omni DNX Engine when different performance options are enabled. Engineers tested the Save-to-Disk and the Expert Analysis capture performance options of Omni DNX Engine.

Packet capture performance was measured with a data flow consisting of two 64-byte frames followed by a single 1518-byte frame.

During a one-minute test run, engineers recorded an average traffic rate (captured across two half-duplex GbE channels on an XL1 Gigabit Analyzer Card) of 683 Mbps with the Save-to-Disk option enabled. During the test, Omni DNX Engine captured packets at a rate of 155,602 packets per second (pps). In the same scenario, when Omni DNX Engine's Expert Analysis option was

Expert System Performance of WildPackets Omni DNX Engine
Expert System Load when Handling 100,000 Conversations at a Traffic Rate of 10 pps

% Processor time[1]			Working set (Mbytes)[1]			Capture buffer memory consumed
Min	Max	Avg	Min	Max	Avg	
0	9	3	317	383	378	20%

[1] **1% Processor Time** is the percentage of elapsed time that all of process threads used the processor to execute instructions.
Working Set is the set of memory pages touched recently by the threads in the process.
The total **Capture Buffer** per capture was set at 256 Mbytes.

Source: The Tolly Group, April 2005 *Figure 3*

enabled, Omni DNX Engine handled 360 Mbps of traffic, and processed an average of 81,976 pps.

Engineers also conducted a 10-minute test run to illustrate the ability of the device to capture traffic over long periods of time. Here, with Omni DNX Engine's Save-to-Disk option enabled, engineers recorded an average traffic rate of 588 Mbps and a packet capture rate of 133,928 pps. In the same scenario, with Omni DNX Engine's Expert Analysis option enabled, Omni DNX Engine handled 320 Mbps of total traffic, and processed an average of 72,978 pps.

Network Utilization

An important consideration for choosing a distributed network fault analysis system is that the solution should consume a small amount of network resources so that the actual network traffic is not hampered by the traffic generated by the network fault analysis system.

In this test, engineers measured the amount of network resources consumed by the communication between Omni DNX Engine and OmniPeek console. With a load of 587 Mbps of UDP test traffic introduced locally, engineers recorded an average traffic rate of 8 Kbps between the Omni DNX Engine and OmniPeek console with the Save-to-Disk option enabled. An average of 1,953 packets was transmitted from the Omnipliance to the OmniPeek console at an average packet size of 351 bytes.

With the Expert Analysis option enabled, engineers recorded an average traffic rate of 10 Kbps between the Omni DNX Engine and OmniPeek console when 320 Mbps of UDP test traffic was introduced locally. An average of 2,730 packets was transmitted from the Omnipliance to the OmniPeek console at an average packet size of 427 bytes.

Expert System Impact on Omnipliance

Using the Perfmon.exe utility built into Microsoft Windows, engineers measured the percentage of processor time consumed by the Omni DNX Engine on the Omnipliance performing expert analysis while it was processing 100,000 conversations. Engineers also recorded the working set value (in bytes). The working set is the collection of memory pages touched by threads in the process and provides an indication of how much host memory is affected by the operating process.

Engineers noted that while handling 100,000 conversations, the Omni DNX Engine consumed 2.6% of the Omnipliance processor time and consumed just 20% of the available 256-Mbyte capture memory buffer, leaving the Omnipliance with ample CPU cycles to manage other network segments.

Scalability Performance

In this test, the scalability performance of Omni DNX Engine Expert System was tested by simultaneously capturing the traffic on all eight ports of two XL1 Gigabit Analyzer cards installed on the Omnipliance.

Engineers recorded the maximum TCP connections attempted and maximum TCP connections established, as well as measuring the maximum bidirectional throughput.

With only the Expert Analysis option active, engineers ran the test for 10 minutes and 30 seconds and determined that Omni DNX Engine can scale to 200 connections per second and handle maximum sustained traffic of 15.5 Mbps per port.

The same test was run with Omni DNX Engine active in Statistics Only mode, where just summary data is pushed upstream from the

WildPackets, Inc.

Omni Platform

Functionality and Performance

WildPackets, Inc.
Omni
Product Specifications*

WildPackets' Omni platform is a distributed fault analysis platform for optimizing network services and maximizing uptime on enterprise networks. The Omni distributed platform gives network engineers real-time visibility into every part of the network – including Gigabit Ethernet, 10/100 Ethernet/Fast Ethernet, 802.11 wireless, and WAN links to remote offices. Using Omni's centralized console, distributed engines, and expert analysis, engineers can rapidly troubleshoot faults and fix problems, restoring essential services and maximizing network uptime.

Omni enables network engineers to:

- Accelerate troubleshooting and maximize network uptime across the entire enterprise, including remote offices
- Gain real-time visibility into any part of the network from a central location
- Respond more rapidly and effectively to end-user requests
- Eliminate travel to other buildings and campuses
- Ensure that mission-critical applications get the network bandwidth and availability they need
- Increase network performance while decreasing time and expenses for analysis and troubleshooting
- Integrate network troubleshooting with other NOC applications and procedures
- Adapt global troubleshooting capabilities to new processes and applications as the network evolves

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* *Vendor-supplied information not verified by The Tolly Group*

Per-Port Scalability Performance of WildPackets Omni DNX Engine						
Performance options enabled	Test duration	Test load (connections per sec)	Maximum TCP connections (attempted)	Maximum TCP connections (established)	Maximum traffic handled (Mbps)	Maximum packets handled (Packets/sec)
Expert Analysis Only	10 min 30 sec	200	238	238	15.5	4,607
Statistics Only (Except Wireless Statistics)	10 min 30 sec	1,000	1,110	1,049	63.2	22,102

Source: The Tolly Group, April 2005

Figure 4

Omnipliance. In that scenario, Omni DNX Engine scaled to support 1,000 connections per second and handled over 63 Mbps of traffic.

Analysis

The Omni analysis software proved that it can operate efficiently and with minimal impact on resident host systems while handling traffic in real time.

During packet capture performance tests, Omni DNX Engine captured data in a Save-to-Disk mode at a rate of 683 Mbps for the first minute, easing back to 588 Mbps during a 10-minute run. When Omni DNX Engine's Expert Analysis option was turned on, Omni DNX Engine handled data at a rate of 360 Mbps over the first minute and 320 Mbps over a 10-minute span. The delta between the Save-to-Disk and Expert Analysis options highlights the fact that Omni DNX Engine processes and analyzes the data in Expert Analysis mode, yet packet capture still remains relatively high despite the local processing load.

Next, when engineers examined the impact that Omni DNX Engine has on network utilization, results indicate that the analysis tool has negligible impact on network connections, considering the fact that it consumes between 8 and 10 Kbps. This means that, even as important data analysis is sent upstream to an OmniPeek Console, there is still more than ample bandwidth available over WAN connections for other data traffic.

One of the benefits that separate WildPackets from other analysis tools is its Expert Analysis option. Tests show that, even as it processes data on an Omnipliance, the Omni DNX Engine Expert Analysis option consumed fewer than 3% of the host's processor cycles and 20% of the device's capture buffer memory. This means even with Expert Analysis active, Omnipliance still has ample processing cycles for normal duties.

Finally, scalability tests show that Omni DNX Engine can scale to handle over 1,000 connections per second when processing statistics only, and over 200 connections per second when Expert Analysis is active. This demonstrates that Omni DNX Engine can scale to accommodate large numbers of users.

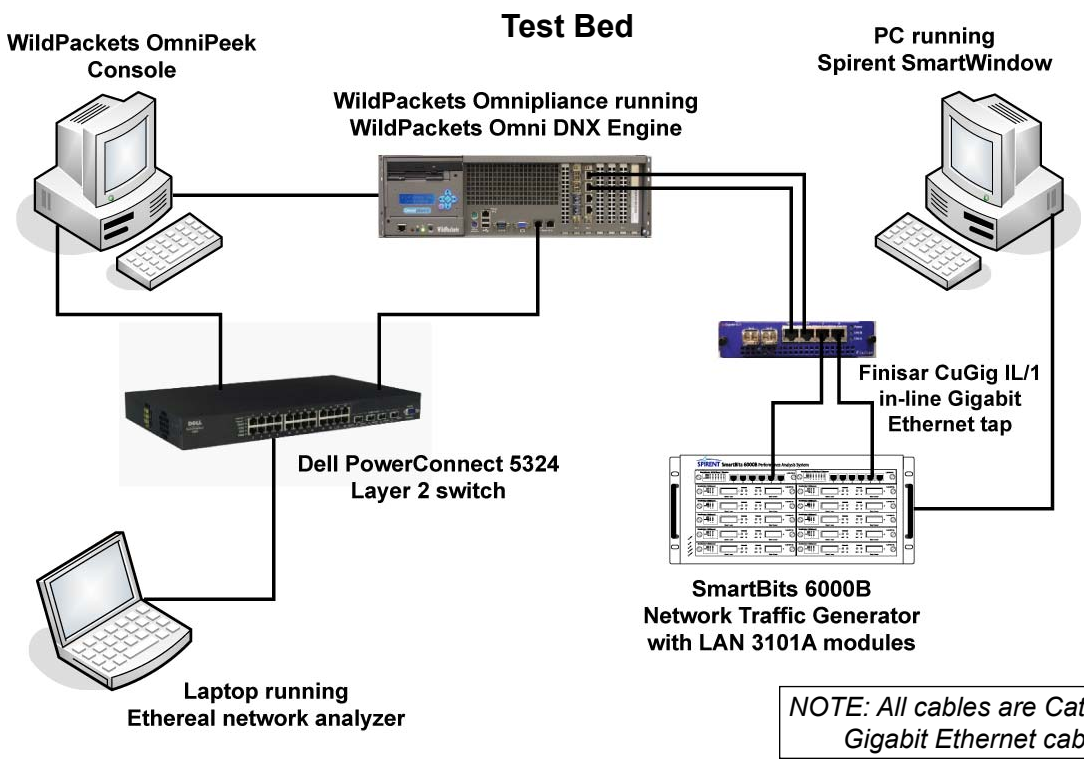
Test Configuration and Methodology

For performance tests, The Tolly Group tested the Omni DNX Engine running on an Omnipliance. The Omnipliance device uses Microsoft Windows 2003 Server Standard Edition. It was configured with dual 2.4-GHz Intel Xeon Processors, 1 GB of RAM, and two 70-GB SATA hard disk drives. The following network adapters were configured on the Omnipliance:

- One Intel PRO/100 Server S adapter
- Two Intel PRO/1000 MT dual-port server adapters
- One WildPackets XL1 Gigabit Analyzer Card with four copper ports
- One WildPackets XL1 Gigabit Analyzer Card with four fiber-optic ports

The Omni DNX Engine was managed by OmniPeek Version 2.0, which was hosted on a PC running Microsoft Windows XP. The OmniPeek console communicated with the Omni DNX Engine using one of two built-in Gigabit Ethernet NICs on the Omnipliance.

For the Packet Capture performance test, the test traffic was generated using the Spirent SmartWindow test tool and the SmartBits 6000B network traffic generator. Two Gigabit Ethernet ports were used on the SmartBits 6000B, and those ports were connected to two Finisar CuGig IL/1 In-Line Gigabit Ethernet taps whose outputs were connected to channels 1 and 2 of a XL-1 Gigabit Analyzer Card (copper based) loaded in the slot-2 of the Omnipliance.



Source: The Tolly Group, April 2005

Figure 6

The test traffic was initially set at 2 million packets transmitted for one minute. If the Omnipliance captured all the packets transmitted, the test traffic was doubled; otherwise a lower test load was attempted. This process was repeated until the approximate maximum packets per second that the Omnipliance could capture without dropping any packets was determined. At this load the test was run three times to ensure repeatability of results. A 10-minute run was also tested in the same manner. The test was performed with the 'Expert Analysis Only' and the 'Save-to-Disk only' options.

For the Network Utilization test, engineers used the public domain Ethereal analyzer tool to monitor the bandwidth consumed and network traffic generated by the communication between Omni DNX Engine and OmniPeek console. The management port on the Omnipliance was connected to a Layer 2 switch. The traffic on this switch port was mirrored onto another switch port which was connected to the PC running Ethereal network analyzer software. Another switch port was connected to OmniPeek console using a Category 5 Gigabit Ethernet cable. Network traffic was captured using Ethereal, and packet filters were created to limit network traffic capture to only those packets between OmniPeek console and the Omni DNX Engine.

For the Expert Analysis test, the network trace file containing 100,000 conversations was played back into the Omni DNX Engine using WildPackets Peek Player software. The test traffic was transmitted with a delay value of 0.1 seconds.

Using the Perfmon.exe utility built into Microsoft Windows, engineers measured the % Processor Time, and Working set value (in bytes) for Omni DNX Engine processes running on the Omnipliance, and OmniPeek processes running on the PC hosting OmniPeek 2.0.

For the Scalability test, six pairs of Avalanche/Reflector ports were used to generate eight channels of simulated real-world traffic for capture on the eight ports across the two XL-1 Gigabit Analyzer Cards installed on the Omnipliance. Two pairs of Avalanche/Reflector ports were connected to the two in-line Gigabit Ethernet taps whose fiber-optic output ports were connected to the four channels of the XL-1 Gigabit Analyzer Card on the Omnipliance.

Each of the remaining four pairs of Avalanche/Reflector ports were connected to a Dell PowerConnect 5324 Layer 2 switch. On each Layer 2 switch, the traffic on the switch ports connected to Avalanche/Reflector ports was mirrored onto a monitoring switch port. The monitoring switch port on each Layer 2 switch was connected to a channel on the XL-1 Gigabit Analyzer Card installed on the Omnipliance.

The two Avalanche/Reflector pairs were controlled from a common console running the Spirent Avalanche Commander, running on a PC. Omni DNX Engine was running on the

Omnipliance, and OmniPeek console was running on a PC connected to the Omnipliance through a Category 5 Gigabit Ethernet cable.

The Avalanche/Reflector pair was configured to generate simulated real-world test traffic consisting of HTTP, FTP, POP3, SMTP, RTSP and DNS protocols at the appropriate load. On the Avalanche Commander, the Client load profile is chosen to be connections per second. The chosen load in connections/second was distributed equally among all six Avalanche ports. Engineers started the test with a load of 1000 connections/sec. They set up individual captures on each of the eight channels across the two GbE analyzer cards, and captured the traffic. While capturing the traffic, engineers attempted to interact with the capture windows by switching between the individual capture windows; scrolling the capture window at random to list the captured packets at different stages of the test run, etc. During the entire duration of the test, the OmniPeek application remained responsive to the user interaction.

The Tolly Group gratefully acknowledges the providers of test equipment used in this project.

Vendor	Product	Web address
Microsoft Corp.	PerfMon 5.1	http://www.microsoft.com
Public domain	Ethereal 0.10.9	http://www.ethereal.org
Spirent Communications	Avalanche Commander 6.51	http://www.spirentcom.com
Spirent Communications	Avalanche/Reflector 6.51	http://www.spirentcom.com
Spirent Communications	SmartBits 6000B	http://www.spirentcom.com
Spirent Communications	SmartWindow 8.0.162	http://www.spirentcom.com
WildPackets, Inc.	PeekPlayer 1.2.0.5	http://www.wildpackets.com

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Project Profile

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Product class: Network fault analysis

Products under test:

- OmniPeek Version 2.0
- Omni DNX Engine
- Omnipliance

Software status: Generally available

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