Intel® PRO/100 S Network Adapters
IPSec Offload Performance and Comparison

TESTING LABS

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Origin of report

eTesting Labs prepared this report under contract from Intel Corporation.

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1.0 Executive Summary

The Intel Corporation commissioned eTesting Labs to conduct performance testing comparing different models of the Intel® PRO/100 S Network Adapter family (Server, Desktop and Mobile) with similar offerings from 3Com. Specifically, we compared the throughput performance and CPU utilization of the following products:

Intel	3Com
Intel® PRO /100 S Server Adapter	3Com 3XP Server Adapter
Intel® PRO/100 S Desktop Adapter	3Com 3XP Desktop Adapter
Intel® PRO/100 SR Combo Mobile Adapter	3Com 10/100 LAN+56 Global Adapter

The tests we conducted were aimed at comparing the benefit of IPSec hardware offloading capabilities with the Intel and 3Com adapters on server, desktop and mobile computing platforms. By offloading this IPSec processing from software to hardware, throughput is significantly increased and CPU utilization is significantly decreased. All the adapters tested were capable of offloading IPSec processing from the CPU to the adapter with the exception of the 3Com 10/100 LAN+56 Mobile adapter. 3Com, nor any other vendor, does not have a Mobile adapter that supports IPSec hardware offload.

We used the Performance Efficiency index to compare the results from each test case. The Performance Efficiency index, originally developed by *PC Week* in 1995 (now eWeek), is determined by dividing network throughput in Mbps by processor utilization as a percentage. This metric shows the overall benefit of a NIC (Network Interface Card). In addition to using the throughput of a NIC as a metric, this method also accounts for a NIC's ability to offload work from the host CPU. Since processor performance is often a bottleneck, any work that can be offloaded from the processor is a benefit to the overall performance of a server. The Performance Efficiency index accounts for the added benefit that NICs like Intel's PRO/100 S family of Network Adapters has to offer.

Our testing showed the Intel® PRO/100 S adapters provide better hardware accelerated IPSec performance when compared to the 3Com offerings on all platforms tested. Please refer to the test results section for details.
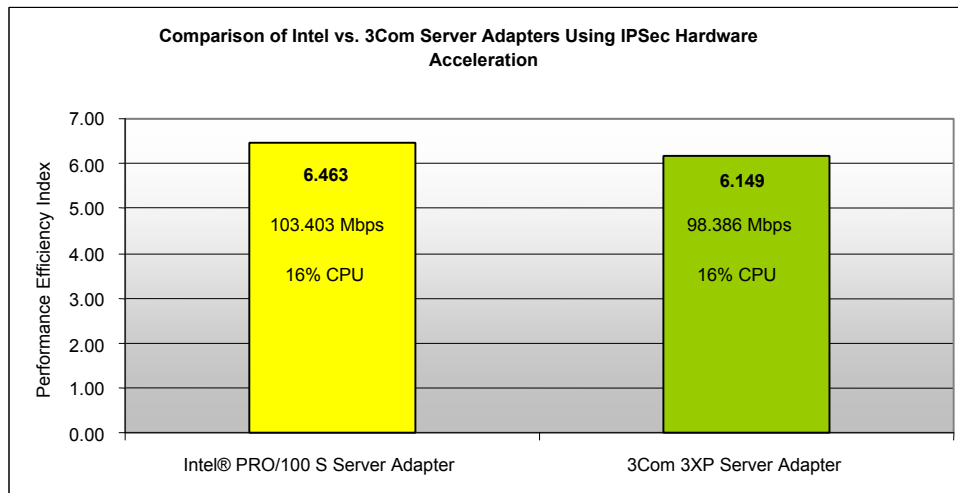
2.0 Test Results

Figure 1. Server Adapter Performance

The results listed in Figure 1 show the difference in server adapter performance. The Performance Efficiency Index of the Intel® PRO 100 S Server Adapter is 5.5% greater than that of the 3Com 3XP Server Adapter. The server adapter tests showed no difference in server CPU utilization between the Intel and 3Com adapters. However, the Intel® PRO 100 S Server adapter generated throughput results approximately 5.5% better than the 3Com 3XP Server adapter.

Comparison of Intel vs. 3Com Desktop Adapters Using IPSec Hardware Acceleration

Intel® PRO/100 S Desktop Adapter: 1.33, 97.981 Mbps, 73.5% CPU
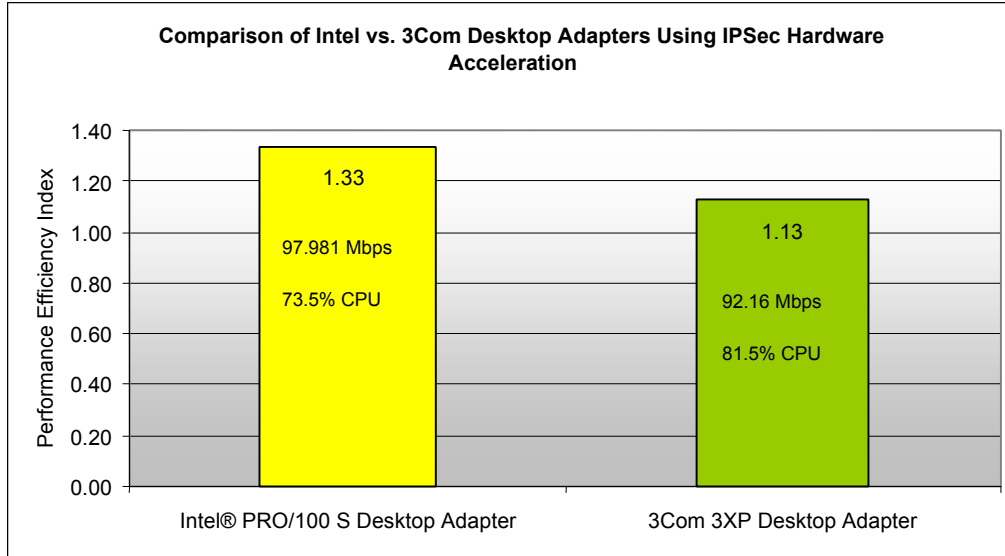3Com 3XP Desktop Adapter: 1.13, 92.16 Mbps, 81.5% CPU

Figure 2. Peer to Peer Desktop Adapter Performance

The results listed in Figure 2 show the difference in desktop adapter performance. The Performance Efficiency Index of the Intel® PRO 100 S Desktop Adapter is approximately 17% greater than that of the 3Com 3XP Desktop Adapter. The overall throughput generated using the Intel desktop adapters is approximately 6 percent greater than that of the 3Com desktop adapters. Additionally, the tests showed an 11 percent improvement in CPU utilization with the Intel adapter when compared to the same test clients using the 3Com desktop adapters.

Comparison of IPSec Hardware Acceleration vs. IPSec Software Processing using Intel and 3Com Mobile Adapters

Intel® PRO/100 S Mobile Adapter: 1.64, 73.974 Mbps, 45% CPU
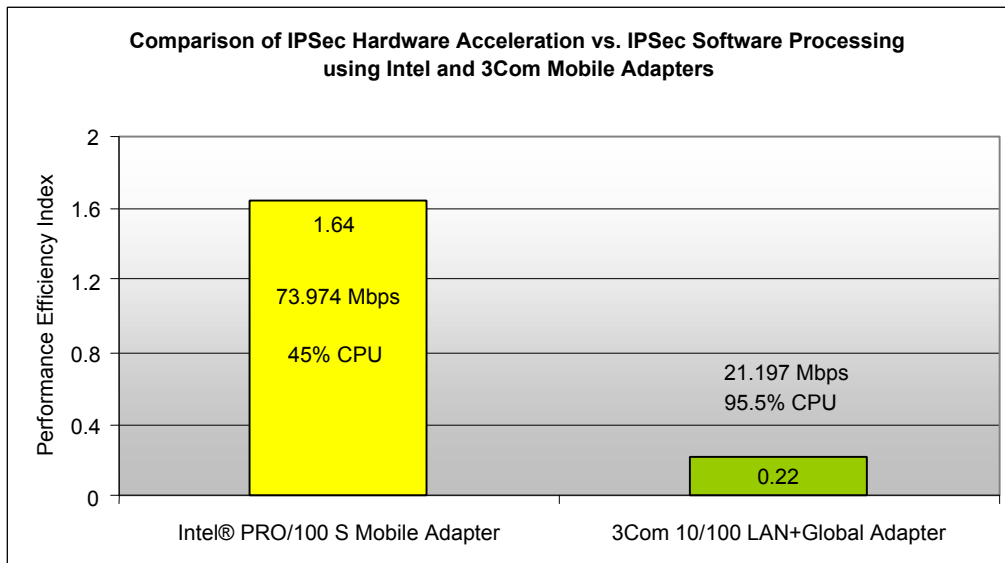3Com 10/100 LAN+Global Adapter: 0.22, 21.197 Mbps, 95.5% CPU

Figure 3. Peer to Peer Mobile Adapter Performance

The results listed in Figure 3 show the difference in mobile adapter performance. The Performance Efficiency Index of the Intel® PRO 100 S Mobile Adapter is approximately 7.5 times greater than that of the 3Com 3XP Mobile Adapter. The overall throughput generated using the Intel mobile adapters is more than 3 times greater than that of the 3Com mobile adapters. Additionally, the tests showed more than a 100 percent improvement in CPU utilization with the Intel adapter when compared to the same test clients using the 3Com mobile adapters.

The primary reason for the differences between the throughput and CPU utilization results using the mobile adapters is due to the fact that the 3Com does not have a mobile adapter product offering that offloads the IPSec traffic. This means that all the IPSec operations are performed in software by the CPU when using the 3Com adapter.

With IPSec now a standard feature of Windows 2000 and the increasing need for secure communications in the e-commerce environment, it's becoming more important to have the power to handle this type of traffic. By providing the capability to off-load IPSec traffic on server, desktop and mobile platforms, the Intel® PRO 100 S family of network adapters allows a wide variety of users the ability to make the most of their computing resources.

3.0 Test Methodology

Because the family of Intel® PRO/ 100 S Adapters is available for server, desktop and mobile computing platforms, we configured separate test environments for each. To compare the server adapters we configured a testbed of six identical network clients running Windows 2000 Professional and a server running Windows 2000 Advanced Server. To test the desktop adapters, we employed a peer to peer configuration using two of the six testbed clients. To test the mobile adapters, we employed a peer to peer configuration using a notebook computer and one of the six testbed clients. Please refer to Appendix A for detailed configuration information.

All clients and server systems were connected using an Intel Express 520T 10/100 Network Switch. All switch ports and network adapters were configured to auto-negotiate line speed and duplex mode to 100 Mbps and full duplex. These settings were verified using the switch configuration software.

To generate network traffic between test systems, we used Chariot from Ganymede Software. The Chariot software contains both console and endpoint programs. The console program controls the test and is installed on a separate client. The endpoint software is installed on the test clients and server and is used to send data between different network clients. For these tests, we used Chariot Console version 3.1 and downloaded version 3.5.785 of the Chariot endpoint software from the Ganymede web site.

Based on specifications from Intel, we created separate Chariot test suites for the server and peer to peer testing. Figures 2 and 3 below show the Chariot endpoint configuration for the server adapter and peer to peer testing.

Pair	Network Protocol	From	To	Script Name
1	TCP	192.168.1.250	192.168.1.1	filesndl.scr
2	TCP	192.168.1.250	192.168.1.2	filesndl.scr
3	TCP	192.168.1.250	192.168.1.3	filesndl.scr
4	TCP	192.168.1.250	192.168.1.4	filercvl.scr
5	TCP	192.168.1.250	192.168.1.5	filercvl.scr
6	TCP	192.168.1.250	192.168.1.6	filercvl.scr

Figure 4. Chariot Test Configuration for Server Adapters

Pair	Network Protocol	From	To	Script Name
1	TCP	192.168.1.1	192.168.1.3	filesndl.scr
2	TCP	192.168.1.1	192.168.1.3	filercvl.scr

Figure 5. Chariot Test Configuration for Peer to Peer Testing

For the server adapter testing, we designated six endpoint pairs. The server was always designated as the first endpoint and then each of the six identical network clients was specified as the second endpoint. Three of the endpoint pairs ran the standard File Send Long Chariot test suite and the remaining three endpoint pairs ran the standard File Receive Long Chariot test suite.

For the peer to peer testing, we used two network clients and created a test suite using two endpoint pairs. The first endpoint pair ran the standard File Send Long Chariot test suite and the second endpoint pair ran the standard File Receive Long Chariot test suite.

For the peer to peer desktop adapter testing, the two clients employed were chosen from the six identical network clients used during the server adapter testing. For the peer to peer Mobile adapter testing, we employed one machine from the six identical network clients and a separate Dell Latitude CPX H500GT notebook machine configured with either an Intel or 3Com Mobile adapter, a 500 MHz Celeron processor and 64MB of RAM.

Each Chariot test suite was configured to run in batch mode using a duration of one minute. Additionally, we selected the Chariot option to gather CPU utilization data for all endpoints. For each platform, we executed two iterations of the required set of tests using an Intel adapter. We then installed and configured the corresponding 3Com adapter and performed two iterations of the required tests. We then averaged the throughput and CPU utilization results reported by Chariot for the two test runs to generate the overall test results.

Intel provided the drivers for their adapters as well as for the server and desktop offerings from 3Com. We downloaded the latest drivers for the 3Com 10/100 LAN+56 Global Adapter from the 3Com web site. Refer to Appendix A for details of Intel and 3Com adapter drivers.

We configured IPSec policy on all the test machines as follows:

- Transport Mode
- ESP 3DES/SHA1
- Preshared Key

IPSec encryption is built directly into Windows 2000. However, because of export restrictions, Windows 2000 only ships with support for DES. To enable support for 3DES, we installed Microsoft's High Encryption Pack included with the Windows 2000 software release.

We used the IP Security Monitor that ships with Windows 2000 to verify that the correct IPSec security policies were being enforced on all client and server systems during the tests.

Appendix

A. Disclosure

Client Configuration - Desktop Adapters	
Operating System	Microsoft Windows 2000 Professional
Vendor	Dell Optiplex GX100
CPU	500 MHz Celeron
RAM	128 MB
Intel Network Interface Card/Driver Ver.	Intel® PRO/100 S Desktop Adapter/5.0.67
3Com Network Interface Card/Driver Ver.	3Com Etherlink 10/100 Mbps with 3XP Processor(3CR990-TX-97)/1.01.21.0000

Figure 6 : Desktop Adapter Client Configuration

Client Configuration - Mobile Adapters	
Operating System	Microsoft Windows 2000 Professional
Vendor	Dell Latitude CPX H500GT
CPU	500 MHz Celeron
RAM	64 MB
Intel Network Interface Card/Driver Ver.	Intel® PRO/100 S Mobile Adapter/5.0.67
3Com Network Interface Card/Driver Ver.	3Com Global 10-100+56K CardBus PC/3.0.5000.4

Figure 7 : Mobile Adapter Client Configuration

Server Configuration - Server Adapters	
Operating System	Microsoft Windows 2000 Advanced Server
Vendor	Dell PowerEdge 6300
CPU	550 MHz 4 Way Pentium III Xeon
RAM	2048 MB
Intel Network Interface Card/Driver Ver.	Intel® PRO/100 S Server Adapter/5.0.67
3Com Network Interface Card/Driver Ver.	3Com Etherlink Server 10/100 Mbps PCI NIC with 3XP Processor(3CR99OSVR97)/1.0.21.0000

Figure 8 : Server Adapter Configuration

Chariot Console Configuration	
Operating System	Microsoft Windows NT 4.0 Server with SP5
Vendor	Dell OptiPlex GXPro
CPU	200Mhz Pentium
RAM	64MB
Network Interface Card	3Com Fast Etherlink XL (3C905)
Network Interface Card Driver	N/A

Figure 9 : Chariot Console Configuration

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