THE TOLLY GROUP

OpenReach, Inc.
OpenReach Gateway Software
IP Routing and IPSec Gateway Performance Evaluation

Premise: Mid-sized enterprises needing to ensure an effective network security infrastructure should look toward Internet security software. Software solutions running on a general-purpose Intel-based platform can provide security and encryption of proprietary hardware-based solutions while providing throughput levels equivalent to T1 speeds to corporate sites, branch offices and telecommuters.

O penReach, Inc. commissioned The Tolly Group to evaluate version 2.2 of its OpenReach Gateway Software, an IP routing and IPSec software that runs in conjunction with Linux on Intel computing platforms. The Tolly Group conducted tests of OpenReach gateway's IP routing and its (paired) IPSec gateway throughput. Zero-loss packet throughput and application throughput tests were conducted using Red Hat Linux version 6.1 operating system running on either a 1-GHz Pentium III PC or a 500-MHz Celeron platform. For IPSec gateway tests, engineers used matched pairs. Each device was outfitted with two Fast Ethernet interfaces. Testing was performed from December 2000 through January 2001.

Test results show that when configured for IP routing, the OpenReach gateway, running on a 1-GHz Pentium III, was capable of zero-loss Fast Ethernet throughput in IP routing tests of each of the following packet sizes: 256, 512, 1,024, 1,280 and 1,518 bytes. Results also reveal that the software is capable of IP routing in tests using smaller packet sizes of 64 and 128 bytes. Results demonstrate that when the OpenReach gateway was configured for IP routing on a 500-MHz Celeron platform, wire-speed Fast Ethernet throughput was achieved in separate tests of the following packet sizes: 1,024, 1,280 and 1,518 bytes. Results reveal that even with smaller packet sizes of 64 and 128 bytes, the OpenReach software is capable of IP routing.

Test Highlights

❍ Performs IP routing close to ten times the capacity of a T1 WAN link even with small packet sizes

❍ Delivers zero-loss IPSec throughput at greater than equivalent T1 speeds in all packet sizes tested

❍ Performs IPSec encryption at nearly the speed of an equivalent T3 WAN link with packet sizes of 1,024 bytes and above

OpenReach Performance (1-GHz Pentium platform)
Zero-loss Fast Ethernet Throughput Across an IPSec (3DES, MD5) Tunnel or IP Router:
Unidirectional SmartBits Traffic (UDP Packets)*
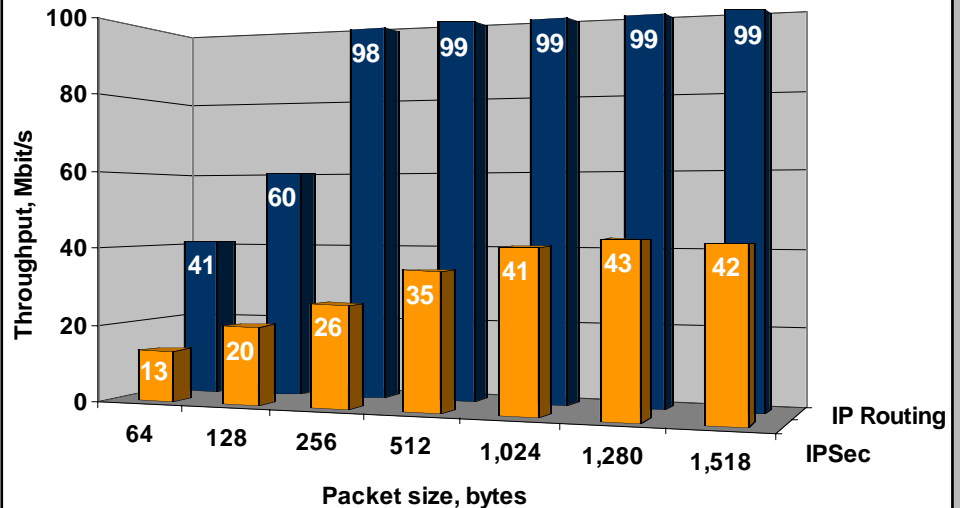
* OpenReach Gateway Software v. 2.2 (Red Hat Linux operating system v. 6.1 running on a 1-GHz Pentium III PC)

Source: The Tolly Group, March 2001   *Figure 1*

Finally, results show that when the OpenReach gateway was configured in both IP routing and IPSec gateway tests, it was successful when forwarding Fast Ethernet application throughput.

Results

Zero-loss, Unidirectional Packet Throughput: 1-GHz Pentium III Platform

The Tolly Group verified that when running on a 1-GHz Pentium III platform, the OpenReach gateway maintains wire-speed, or near wire-speed, throughput for Fast Ethernet traffic in separate tests of each of the following packet sizes: 256, 512, 1,024, 1,280 and 1,518 bytes while configured for IP routing. When the OpenReach gateway was tested in the same Fast Ethernet IP routing configuration, with 64- and 128-byte packets, throughput averaged 41 Mbit/s and 60 Mbit/s, respectively.

On the same 1-GHz Pentium platform configured as an IPSec gateway, the OpenReach gateway demonstrated the following unidirectional throughput: 13 Mbit/s with 64-byte packets; 20 Mbit/s with 128-byte packets; 26 Mbit/s with 256-byte packets; 35 Mbit/s with 512-byte packets; 41 Mbit/s with 1,024-byte packets; 43 Mbit/s with 1,280-byte packets; and 42 Mbit/s with 1,518-byte packets. *Note: Measurements were of decrypted traffic. See figure 1.*

Zero-loss Unidirectional Packet Throughput: 500-MHz Celeron Platform

The Tolly Group verified that when running on a 500-MHz Celeron platform, the OpenReach gateway maintains wire-speed, or near wire-speed, throughput for Fast Ethernet traffic in separate tests of each of the following packet sizes: 512, 1,024, 1,280 and 1,518 bytes while configured for IP routing. When the OpenReach gateway was tested in the same Fast Ethernet IP routing configuration, with 64-, 128-, and 256-byte packets, throughput averaged 28 Mbit/s, 49 Mbit/s and 89 Mbit/s, respectively.

On the same 500-MHz Celeron platform configured as an IPSec gateway, the OpenReach gateway demonstrated the following unidirectional throughput: 8 Mbit/s with 64-byte packets; 11 Mbit/s with 128-byte packets; 14 Mbit/s with 256-byte packets; 18 Mbit/s with 512-byte packets; 22 Mbit/s with 1,024-byte packets; 22 Mbit/s with 1,280-byte packets; and 21 Mbit/s with 1,518-byte packets. *Note: Measurements were of decrypted traffic. See figure 2.*
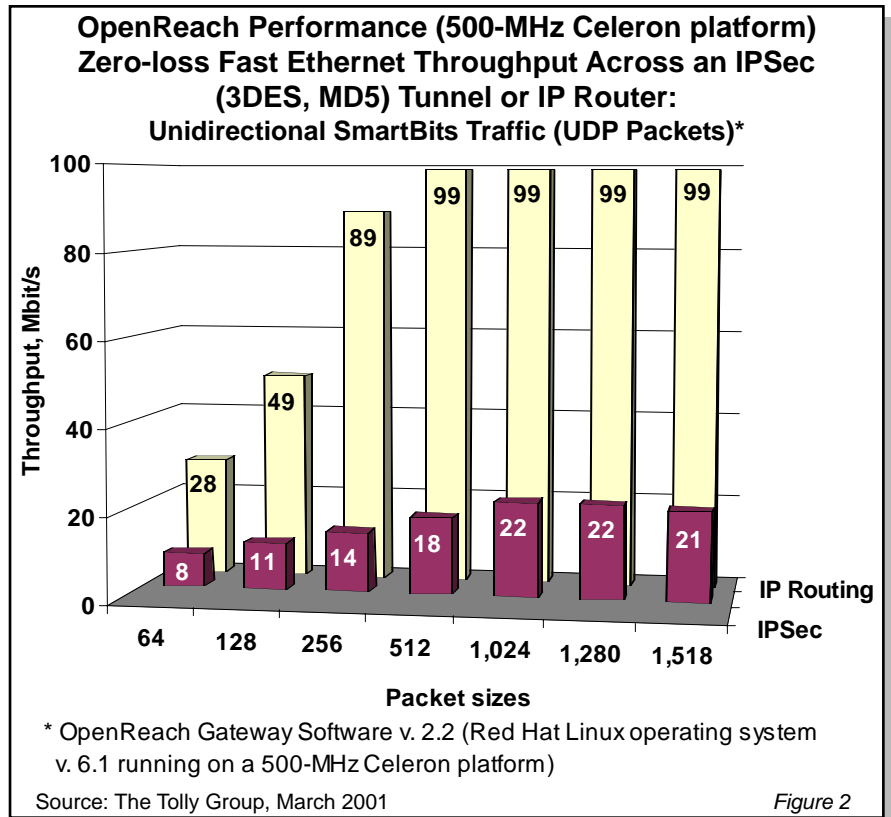

OpenReach Performance (500-MHz Celeron platform)
Zero-loss Fast Ethernet Throughput Across an IPSec (3DES, MD5) Tunnel or IP Router:
Unidirectional SmartBits Traffic (UDP Packets)*

* OpenReach Gateway Software v. 2.2 (Red Hat Linux operating system v. 6.1 running on a 500-MHz Celeron platform)

Source: The Tolly Group, March 2001

Figure 2

OpenReach Performance
Application Throughput Across an IPSec (3DES, MD5) Gateway or IP Router:
Bidirectional Chariot Traffic, Fast Ethernet
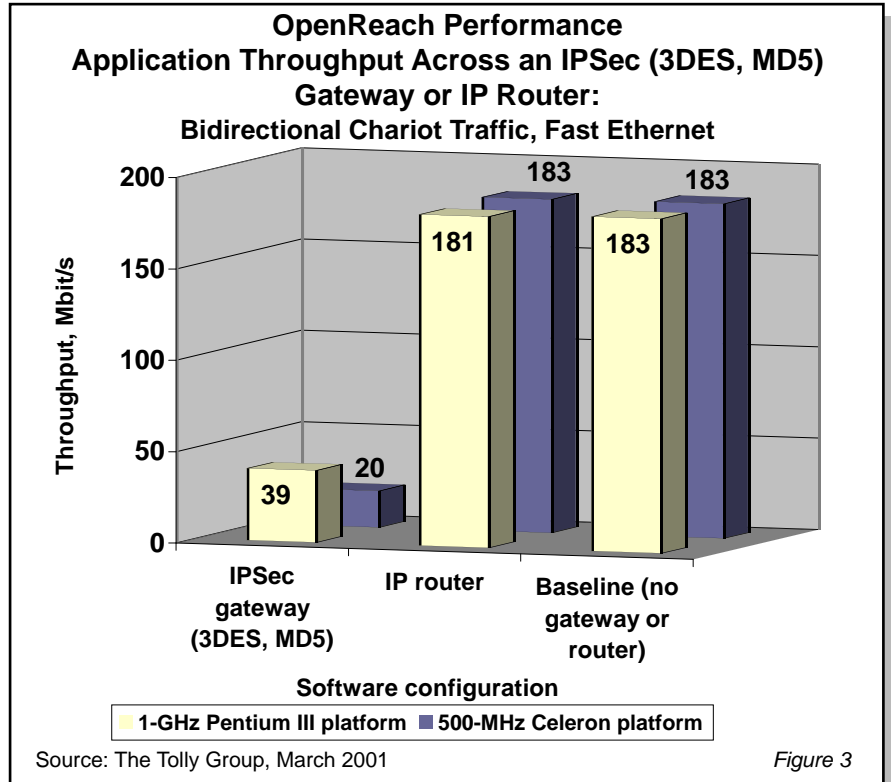
Source: The Tolly Group, March 2001

Figure 3

Application Throughput

In baseline tests of bidirectional application throughput, Tolly engineers measured average application throughput across the network at 183 Mbit/s. After putting the applications on different TCP/IP subnets that were separated by a pair of OpenReach gateways running on a 1-GHz Pentium III platform and configured as an IPSec gateway, throughput across a tunnel transporting 3DES encrypted traffic averaged 39 Mbit/s. In the same tests but with the OpenReach gateways running on a 500-MHz Celeron platform, throughput across the encrypted tunnel averaged 20 Mbit/s.

When the OpenReach gateway was tested as an IP router between two separate IP networks, results demonstrate that when running on a 1-GHz Pentium platform, the OpenReach gateway averaged 181 Mbit/s. In the same tests but with the OpenReach system running on a 500-MHz Celeron platform, the bidirectional throughput averaged 183 Mbit/s. See figure 3.

Analysis

A software-based IP router can offer a large range of adaptability and performance. Based on open source code, the Red Hat Linux operating system offers efficiency–and using a general-purpose Intel-based platform (Pentium) as a basis for a network interconnect device–brings a number of significant advantages. For example: it is inexpensive, can be configured across a range of CPU power, and has additional RAM.

An OpenReach gateway delivers IPSecurity using 3DES encryption and MD5 data integrity authentication at a performance level that exceeds legacy 10 Mbit/s Ethernet speeds even when using an inexpensive 500-MHz Celeron with 32 Mbytes of RAM and two Fast Ethernet adapters. OpenReach gateway can achieve unidirectional wire-speed Ethernet performance with packet sizes larger than 1,024 bytes, and starting at almost half-wire speed with 64-byte packets. The software, configured as a VPN gateway, also achieves more than 20 Mbit/s of throughput with bidirectional large file transfers.

By doubling the computing power to a 1-GHz Pentium III with additional memory and sending unidirectional traffic of packet sizes of 1,024 bytes and above, the OpenReach system performance improves to almost the equivalent of T3 speeds (44.736 Mbit/s).

These results indicate that OpenReach Gateway Software, residing on an Intel-based platform greater than a 500-MHz Celeron, is appropriate for mid-sized enterprises that want to securely link remote locations. These businesses can enjoy both high performance routing and secure communications between offices with WAN links at more than five times equivalent T1 speeds (1.544 Mbit/s)

Test Configuration and Methodology

For IP routing tests, Tolly engineers installed Red Hat Linux operating system 6.1, Kernel 2.2.13, on both a 1-GHz Intel Corp. Pentium III with 128 Mbytes of RAM and a 500-MHz Intel Celeron with 32 Mbytes of RAM. Both processors were also running the OpenReach Gateway Software v. 2.2.

Two Acterna Corp. DominoPLUS DA-360 Internetwork Analyzers were connected, in line, to the platform under test, each of which was connected to a Cisco Systems, Inc. Catalyst 2900XL 10/100 Mbit/s 24-port Fast Ethernet switch running IOS version 12.0(5)xu. Each switch connected to two generic PCs (Pentium IIIs 500-MHz or better), both running NetIQ Corp. Chariot Endpoint Software v. 4.0. Also connected to each switch was a Spirent Communications, Inc. SmartBits SMB-200. A generic PC was connected to the network as a console for the SMB-200 and was running Spirent SmartWindows Software version 7.0. This device also served as the NetIQ Chariot console. All network connections were via Category 5 Unshielded Twisted Pair copper cabling.

To test the OpenReach Gateway Software in the IP routing configuration, engineers configured the SmartBits SMB-200 to send unidirectional UDP packets at the maximum offered load and decreased the load in 1% increments until zero-loss occurred. For each test, engineers configured SmartBits to send either 64-, 128-, 256-, 512-, 1,024-, 1,280- or 1,518-byte packets unidirectionally for three iterations of one-minute each and averaged the results as reported by the traffic generator.

The Acterna DominoPLUS DA-360 tools were used to capture and monitor traffic. Tests were conducted with both the 1-GHz Pentium III platform and the 500-MHz Celeron platform.

The IPSec gateway test bed was configured as the same test bed as described above but used either two 1-GHz Intel Pentiums or two 500-MHz Intel Celeron processors to create a VPN gateway via 100 Mbit/s Ethernet. A third Acterna DominoPLUS was added between the two processors under test to help capture and monitor traffic. See figure 4.

For tests, engineers configured the software under test to encrypt/decrypt and authenticate traffic from each trusted network using 3DES and MD5.

OpenReach, Inc.
OpenReach Gateway Software
Product Specifications*

Tunneling
- ❍ Uses IPSec ESP (Encapsulating Security Payload) tunnels with 168-bit 3DES encryption.
- ❍ Further encapsulates IPSec in TCP to enhance interoperability with firewalls, routers and NAT devices.

Authentication
- ❍ Uses digital certificates for authentication. An MD5 Hash algorithm and 1024-bit public-private keys are used to create digital signatures.

Firewall
- ❍ A packet-filtering firewall can be enabled to dynamically control in-bound and out-bound traffic or restricted to block all traffic except VPN traffic.

Router
- ❍ Static routes deliver traffic across multiple LAN segments on the corporate network.

Access Control Lists (ACL)
- ❍ ACLs control what devices can be accessed through VPN tunnels.

Internet Connection Sharing (ICS)
- ❍ ICS allows multiple hosts on the internal network to share a single public Internet address.
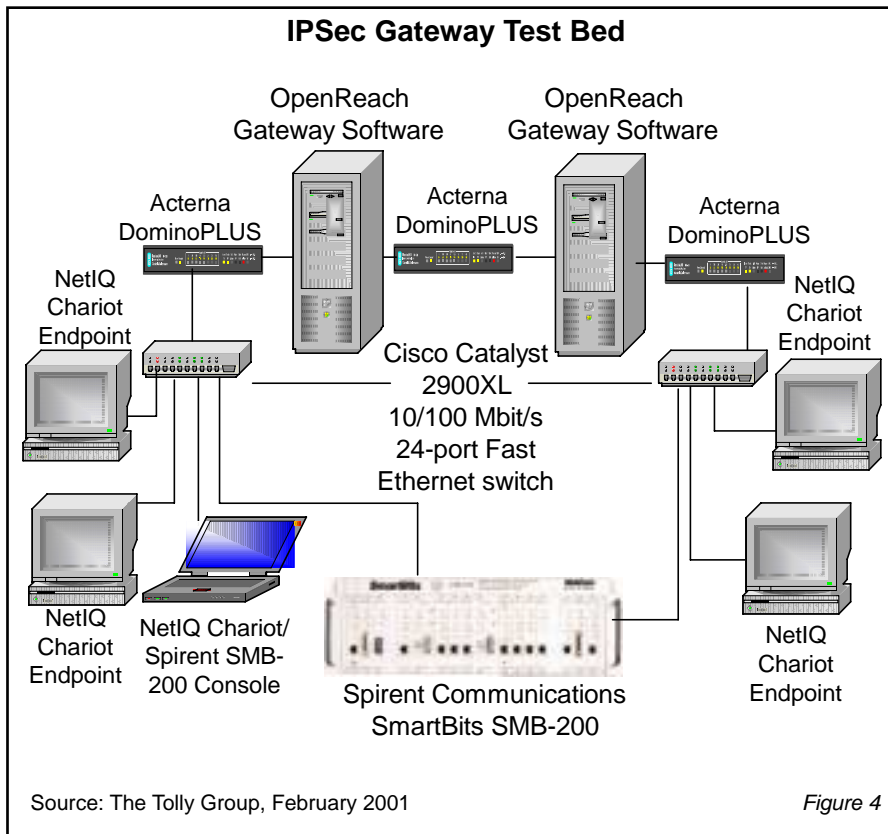
Dynamic Host Configuration Protocol (DHCP) Server
- ❍ DHCP Server can serve up IP, WINS and DNS addresses to hosts on the internal network.

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*Vendor-supplied information not verified by The Tolly Group

IPSec Gateway Test Bed

OpenReach
Gateway Software

OpenReach
Gateway Software

Acterna
DominoPLUS

Acterna
DominoPLUS

Acterna
DominoPLUS

NetIQ
Chariot
Endpoint

NetIQ
Chariot
Endpoint

Cisco Catalyst
2900XL
10/100 Mbit/s
24-port Fast
Ethernet switch

NetIQ
Chariot
Endpoint

NetIQ Chariot/
Spirent SMB-
200 Console

Spirent Communications
SmartBits SMB-200

NetIQ
Chariot
Endpoint

Source: The Tolly Group, February 2001

Figure 4

Engineers configured the SmartBits SMB-200 to send unidirectional UDP packets at the maximum offered load and decreased the load until zero-loss occurred. For each test, engineers configured SmartBits to send either 64-, 128-, 256-, 512-, 1,024-, 1,280- or 1,518-byte packets unidirectionally for three iterations of one-minute each and averaged the results as reported by SmartBits.

Tests were conducted with both the 1-GHz Pentium platform and the 500-MHz Celeron platform.

To test the throughput of application traffic in baseline, IP routing and IPSec configurations, engineers configured the NetIQ Chariot to simulate bidirectional file transfers in all testing scenarios. Tests were again conducted for three iterations of one-minute each and results were averaged as reported by Chariot. The Acterna DominoPLUS DA-360 was used to capture and monitor traffic.

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

Vendor	Product	Web address
Acterna Corp.	DominoPLUS DA-360	http://www.acterna.com
NetIQ Corp.	Chariot 4.0	http://www.netiq.com
Spirent Communications, Inc.	SmartBits	http://www.spirentcom.com

Since its inception, The Tolly Group has produced high-quality tests that meet three overarching criteria: All tests are objective, fully documented and repeatable.

We endeavor to provide complete disclosure of information concerning individual product tests, and multiparty competitive product evaluations.

As an independent organization, The Tolly Group does not accept retainer contracts from vendors, nor does it endorse products or suppliers. This open and honest environment assures vendors they are treated fairly, and with the necessary care to guarantee all parties that the results of these tests are accurate and valid. The Tolly Group has codified this into the Fair Testing Charter, which may be viewed at http://www.tolly.com.

Project Profile

Sponsor: OpenReach, Inc.

Document number: 200236

Product Class: IP Routing and IPSec gateway software

Products under test:
- OpenReach Gateway Software v. 2.2

Testing window:
- December 2000 through January 2001

Software status:
- Readily available

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