THE TOLLY GROUP

No. 199111 May 1999

Foundry Networks, Inc.

BigIron 8000 Gigabit Ethernet Switching Router

Layer 2 & Layer 3 Performance Evaluation

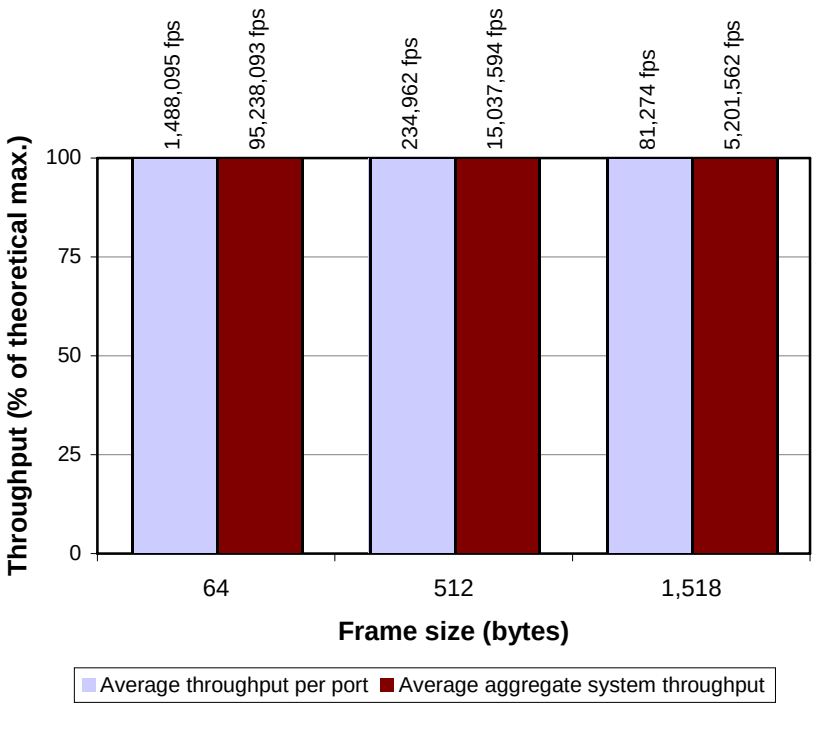
Test Summary

Premise: *To ensure optimal performance in demanding carrier or enterprise networks, a backbone switch should deliver high, non-blocking throughput when handling both layer 2 and layer 3 IP/IPX traffic. Furthermore, a backbone switch should have the capability to maintain wire-speed throughput at a reasonable cost-per-gigabit of throughput.*

Foundry Networks Inc. commissioned The Tolly Group to benchmark the layer 2 and layer 3 IP/IPX throughput of the BigIron 8000 with 64 ports of Gigabit Ethernet in two 32-port full-mesh configurations. Testing demonstrated that the eight-slot, chassis-based switch achieved wire-speed throughput with no loss, utilizing three different packet sizes. Testing was performed in April 1999.

Test Highlights

- Delivers zero-loss wire-speed throughput across 64 Gigabit Ethernet ports carrying layer 2 and layer 3 IP/IPX traffic
- Utilizes a non-blocking switch design to deliver effective scalability up to 64 Gigabit Ethernet ports
- Achieves wire-speed performance at 64-byte frames with 95 million packets per second of aggregate throughput



Source: The Tolly Group, May 1999

Figure 1

Results

The Tolly Group verified the throughput performance of the BigIron 8000 at layer 2, layer 3 IP and layer 3 IPX at the following three packet sizes: 64 bytes, 512 bytes and 1,518 bytes. Each test ran three times, for a duration of 60 seconds and the results were averaged. All tests resulted in wire-speed throughput.

For 64-byte packets, the BigIron 8000 handled an average of 95.2 million packets per second (pps) for the duration of the test. When testing with 512-byte packets, the BigIron 8000 achieved an average of 15 million pps and at 1,518-byte packets, the BigIron 8000 processed an average of 5.2 million pps.

At all layers, the BigIron 8000 was tested at 100% of the theoretical maximum of throughput. See figures 1, 2 and 3.

Analysis

Scalability and Throughput

In order to be effective in a demanding carrier-class or large enterprise environment, certain switch characteristics are highly desirable. Scalability and high throughput are key. These tests illustrate that the BigIron 8000 is capable of delivering wire-speed throughput even when handling full-duplex loads on 64 Gigabit Ethernet ports. The results remained the same regardless of traffic type: layer 2 switching, layer 3 IP or layer 3 IPX.

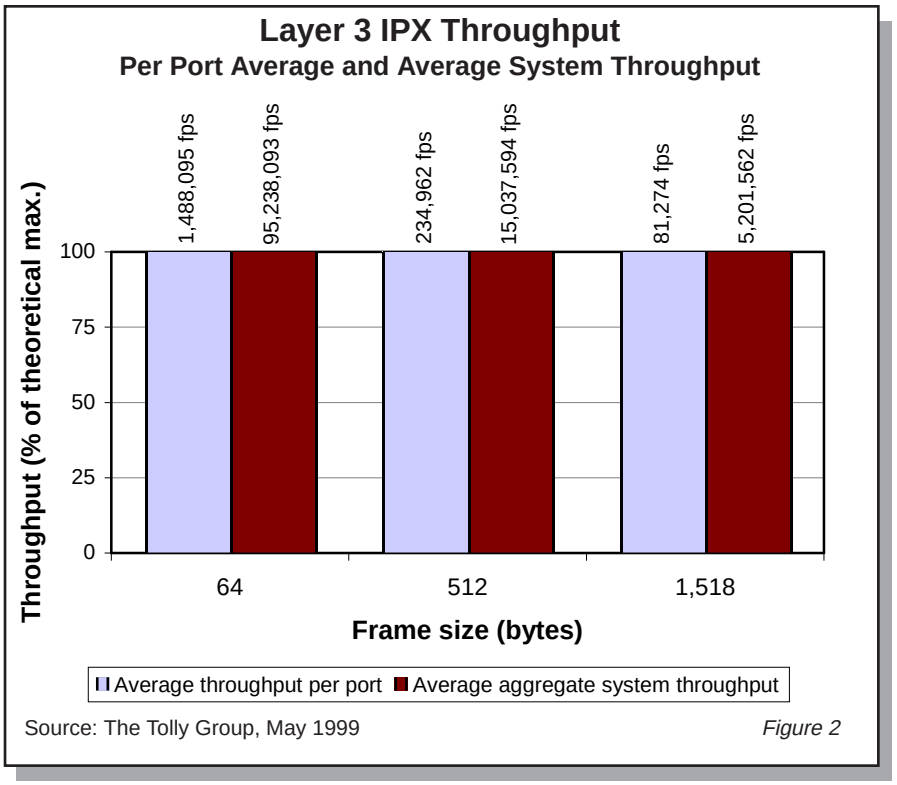
Using 64 ports in two, 32-port full-mesh configurations, The Tolly Group subjected the BigIron 8000 to the most demanding throughput test where ports within each 32-port mesh transmit data to and receive data from every other port within the group at wire speed. While this is an impractical, "worst case" scenario that will not occur in the real world, it demonstrates that BigIron 8000 performance does not degrade when traffic is being moved across all ports in a complex manner.

Due to test gear limitations, The Tolly Group was unable to configure the SmartBits to conduct a 64-port full-mesh test (see configuration in methodology section). Instead, The Tolly Group conducted testing using two 32-port full-mesh configurations. There is no indication that the test results would differ when running the 64-port test in a mesh configuration.

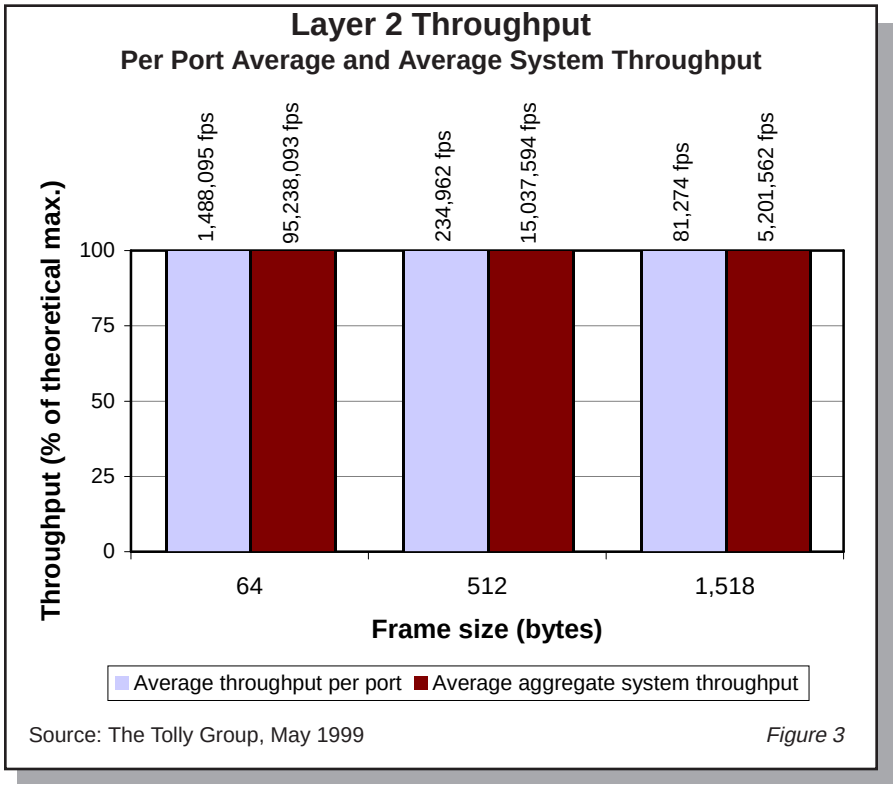
Multiprotocol Support

Given the position of such a switch at the center of a carrier's network or as the focal point of a large campus, support for layer 3 IP is essential. It is unlikely that a network big enough to require 32 or 64 Gigabit Ethernet connections would require only layer 2 switching/transparent-bridging services.

Furthermore, given the significant presence of Novell's NetWare in corporate accounts, support for IPX is an important attribute. Although NetWare Version 5 offers support for NetWare client-server interaction via TCP/IP, that software is relatively new, use of TCP/IP is not mandatory and the installed base of legacy NetWare servers is quite large.



Source: The Tolly Group, May 1999 *Figure 2*



Source: The Tolly Group, May 1999 *Figure 3*

Small Footprint

For both carriers and enterprise customers, space in communications closets and data centers is always at a premium. While not an official part of the evaluation, The Tolly Group noted that a fully-configured BigIron 8000 outfitted with 64 ports of Gigabit Ethernet and four power supplies for redundancy could be contained in a standard 19-inch rack enclosure only 12 rack units high.

Cost-per-Gigabit Throughput

Historically, switch pricing has been quoted as "price per port." While somewhat useful, this fails to take into account the actual throughput of a product and, as a result, can be quite misleading. To create a more meaningful measure of value, The Tolly Group developed its "cost-per-gigabit/throughput" metric. In brief, when the cost of the switch is divided by the aggregate throughput (measured in Gbit/s), the result is cost-per-gigabit of throughput.

This number compensates for the fact that a less expensive device may also deliver lower throughput — something that the price-per-port metric completely ignores. The cost-per-gigabit/throughput provides for a meaningful price/performance comparison among different switches. The BigIron 8000 offers a cost-per-gigabit/throughput of $2,413 for all traffic types tested. This is based on the manufacturer's U.S. list price as of 15 April 1999.

Test Configuration and Methodology

The system under test was the BigIron 8000 switch (B8000), a chassis with eight switch modules and eight ports per module (software version BIR05000C8, serial number 1050). One of the switch modules also served as the management module (part number 30101-010, serial number IU0001117). The remaining seven switch modules (part number: 30101-108; serial numbers: 145807092, 145807294, 145807294, 145807271, 145807080, 145807280) simply provided additional Gigabit Ethernet ports via SC fiber interface connectors. Four power supplies were installed (part number: VA-VF0033-08194-5; serial numbers: 852073, 852239, 842164, 851751).

The BigIron 8000 was configured with Spanning Tree disabled, Gigabit Ethernet auto-negotiation disabled and the MAC address aging timer set to its maximum value. All other parameters were set to device defaults.

The BigIron 8000 connected directly to the SmartBits equipment via standard multimode fiber-optic cables using SC connectors. The SmartBits equipment consisted of two SMB-2000 chassis, six SMB-10 chassis, 64 GX1405B SmartCards and SmartWindow software version 6.26. See figure 4.

The Tolly Group conducted standard zero-loss performance throughput tests on the BigIron 8000 across 64 Gigabit Ethernet ports. Traffic was configured to flow through the device under test in two 32-port full-mesh traffic patterns. Due to limitations in the test equipment, specifically the 2K buffer limitation of the Netcom Systems GX-1405B SmartCards, and, the scripting required to create the desired layer 3 traffic profiles, The Tolly Group was unable to configure a 64-port full-mesh configuration.

Theoretical maximum fps rates for Gigabit Ethernet were calculated by adding 20 bytes to each frame size to account for the 0.096 microsecond interframe gap (equivalent to 12 bytes) and the preamble (eight bytes). Thus, the theoretical maximum Gigabit Ethernet frame rate in fps for a frame of X bytes is defined by the following formula: (1,000,000,000bits/s)/((eight bits/byte)* (X+20)).

Foundry Networks

BigIron 8000

Layer 2 and Layer 3 IP/IPX Throughput

TOLLY Up to Spec CERTIFIED

Foundry Networks, Inc.
BigIron 8000
Product Specifications*

Features

- Modular, chassis-based switching routers for campus, MAN and LAN/WAN environments
- Delivers up to 64 Gigabit Ethernet ports and 96,000,000 packets per second performance
- Provides hardware-based Layer 2 / 3 / 4 switching, multiprotocol routing, 256,000 BGP4 routes and Packet over SONET
- Switch or route on a per-port basis for increased flexibility and lower overall equipment costs
- Advanced features include policy-based VLANs, four levels of QoS, server multi-homing, inter-switch trunk groups, hardware-based access control lists, DHCP assist and industry leading multicast support
- IronView network management includes a comprehensive set of tools for simplified configuration and management
- Command Line Interface (CLI) provides a familiar configuration command structure and format
- 70 km Gigabit Ethernet for high-performance metropolitan area networks

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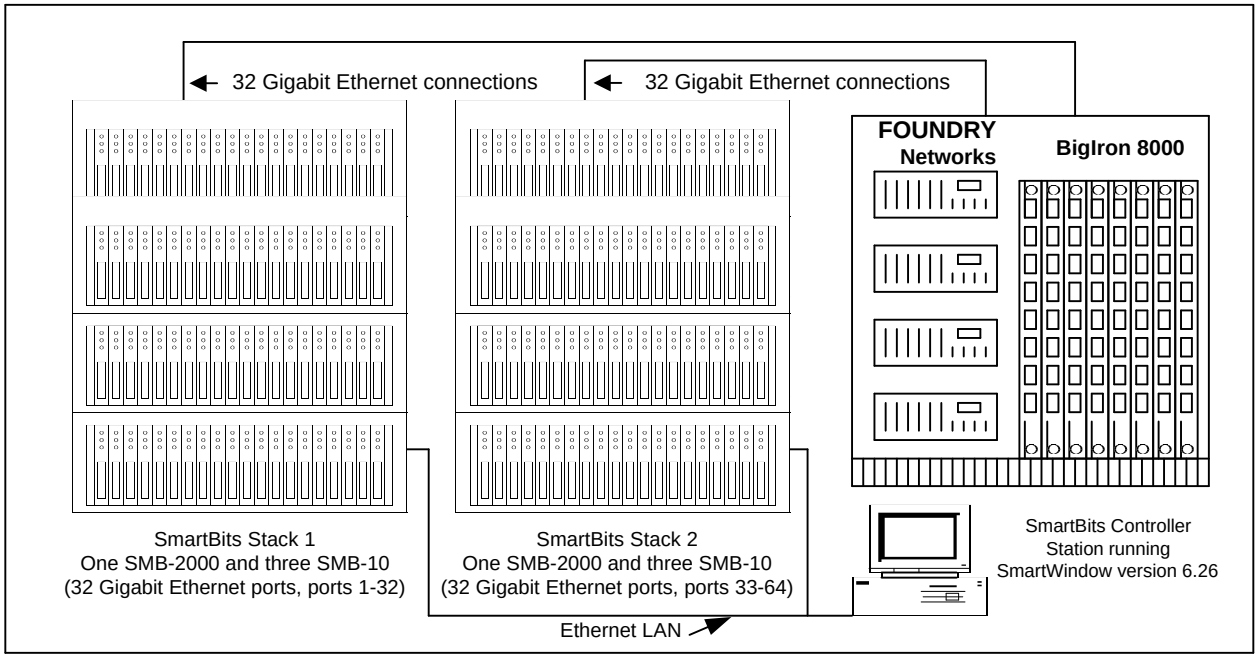
**Vendor-supplied information not verified by The Tolly Group*

BigIron 8000 Test Bed



Source: The Tolly Group, May 1999

Figure 4

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

Vendor	Product	Web address
Netcom Systems, Inc.	SmartBits 2000	http://www.netcomsystems.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: Foundry Networks, Inc.
Document number: 199111
Product class: Backbone switching router
Product under test: BigIron 8000
Testing window: April 1999
Software versions tested:

- BIR05000C8

Software status:

- BigIron 8000 software version BIR05000C8 is readily available

For more information on this document, or other services offered by The Tolly Group, visit our World Wide Web site at http://www.tolly.com, send E-mail to info@tolly.com, call (800) 933-1699 or (732) 528-3300.

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