

3Com Corp.

3Com Switch 7700R

Layer 2 Gigabit Ethernet Competitive Benchmark versus Cisco Systems Catalyst 4507R/Catalyst 6509

Test Summary

Premise: Network managers at medium- and large-sized businesses require high switching performance from core network switching products. 3Com's Switch 7700R provides non-blocking, wire-speed throughput when compared with Cisco Catalyst switch alternatives that introduce various levels of blocking, ultimately inhibiting aggregate device throughput.

3Com Corp. commissioned The Tolly Group to evaluate its 3Com Switch 7700R, a modular, eight-slot chassis-based Layer 2/3/4 high-capacity Gigabit Ethernet switch designed for the network core of large enterprise and campus networks. 3Com directed The Tolly Group to benchmark the Layer 2 performance of the 3Com Switch 7700R against two switches from Cisco Systems, Inc. – the Catalyst 4507R and the Catalyst 6509.

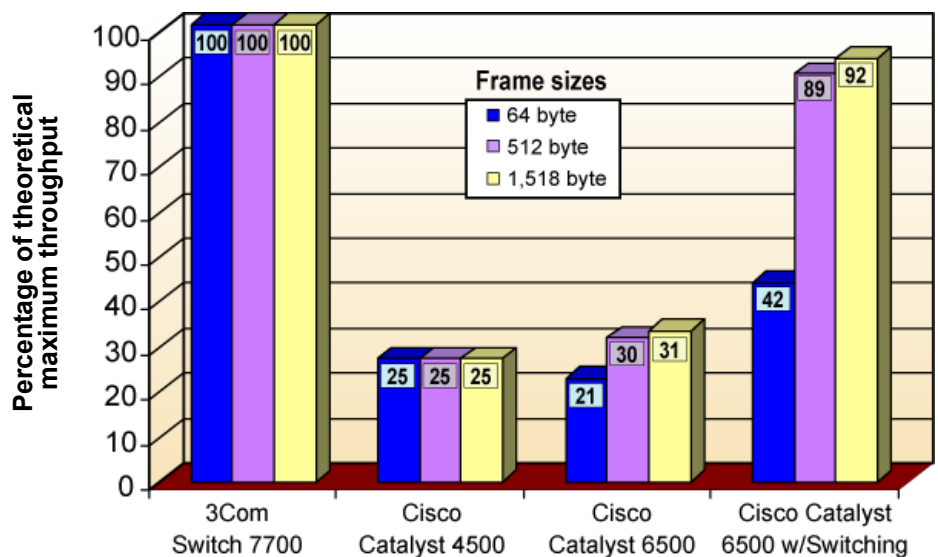
Engineers subjected each of the devices to Layer 2 throughput tests using packet sizes of 64, 512 and 1,518 bytes.

Tolly Group engineers attempted to create an apples-to-apples price/performance comparison of the devices under test, although this proved to be challenging with the Catalyst 6500. Of particular note, the Catalyst 6500 configuration did not include Cisco Distributed Fabric Cards (DFCs), which offload packet processing from traversing the switch backplane to be handled by the Switching Fabric Module (SFM) or the Supervisor Engine. At a price of \$7,495 per switching module, the DFCs would have pushed the Catalyst 6500 well into another pricing realm, further exacerbating the

Test Highlights

- Delivers 100% of theoretical maximum zero-loss throughput at all frame sizes tested while Cisco Catalyst switches deliver considerably less throughput for the majority of tests
- Generates 96 Gbps aggregate throughput consistently across 48 ports in full-duplex mode for all packet sizes tested, versus Cisco Catalyst switches that achieved from 20 Gbps to 89 Gbps
- Provides up to four times the performance of the Catalyst 4500 and Catalyst 6500

Percent of Theoretical Maximum Zero-Loss ($\leq 0.001\%$) Throughput
 48 Gigabit Ethernet Ports Using an Adjacent Port-Pairing Scheme as Reported by SmartFlow



Source: The Tolly Group, December 2003

Figure 1

price/performance gap with the 3Com Switch 7700R – the 3Com switch 7700R cost \$42,965 as tested, versus \$86,960 for the Catalyst 6500 with the SFM. For testing purposes, the Catalyst 6500 was tested with, and without, the Switching Fabric Module. Tests were conducted in December 2003.

Tests show that the 3Com Switch 7700R was the only device tested that achieved zero-loss wire-speed performance across all packet sizes tested when handling Layer 2 traffic in an adjacent port-pairing scheme.

RESULTS

LAYER 2 THROUGHPUT

The 3Com Switch 7700R demonstrated that it achieves wire-speed performance when outfitted with 48 Gigabit Ethernet ports processing intra-module Layer 2 traffic via an adjacent port-pairing scheme. With no frame loss and regardless of the packet sizes tested, the 3Com Switch 7700R’s throughput was equal to that of the theoretical maximum at 96 Gbps.

For all packet sizes tested, the Cisco Catalyst 4500 produced a zero-loss throughput equal to 25% of the theoretical maximum Gbps – or 24 Gbps. Since the results were the same regardless of the packet-forwarding rate, the results suggest there is 4:1 blocking in the switch modules and/or the backplane.

Cisco Catalyst 6500 results varied widely among the frame sizes tested, and also depending upon whether the SFM was utilized or not.

A Catalyst 6500 with just a Supervisor II engine generated 21% of the theoretical maximum throughput when tested with 64-byte packets. (Test plans originally called for use of a Supervisor 720 module, but such an upgrade would have required a fan upgrade and a power supply upgrade as well which would

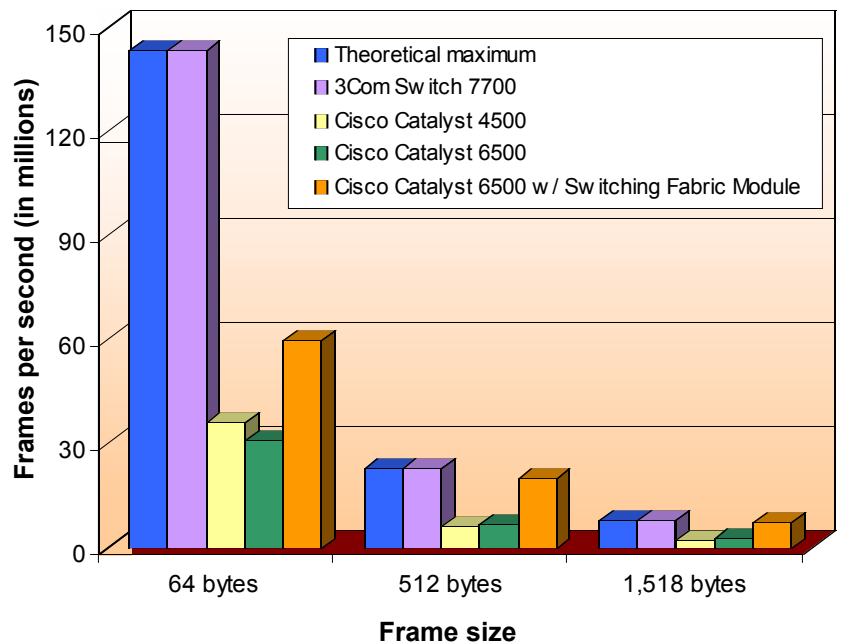
**Layer 2 Performance Summary
Full-Duplex Gigabit Ethernet with Adjacent Port-Pairing Scheme
as Reported by SmartFlow**

	Maximum theoretical throughput (full duplex, Gbps)	Packet size (bytes)	Maximum theoretical throughput packets-per-second)	Actual throughput (full duplex, Gbps)	Actual throughput packets-per-second)	Percent of theoretical maximum throughput
3Com Switch 7700 - 48 Gigabit Ethernet ports (six 8-port modules)	96	64	142,857,143	96.0	142,857,140	100%
		512	22,556,391	96.0	22,556,390	100%
		1,518	7,802,341	96.0	7,802,340	100%
Cisco Catalyst 4500 - 48 Gigabit Ethernet ports (two 24-port modules)	96	64	142,857,143	24.0	35,714,250	25%
		512	22,556,391	24.0	5,639,098	25%
		1,518	7,802,341	24.0	1,950,584	25%
Cisco Catalyst 6500 - 48 Gigabit Ethernet ports (three 16-port modules)	96	64	142,857,143	20.4	30,357,142	21%
		512	22,556,391	28.5	6,696,428	30%
		1,518	7,802,341	29.8	2,426,040	31%
Cisco Catalyst 6500 - 48 Gigabit Ethernet ports (three 16-port modules) with Switching Fabric Module	96	64	142,857,143	40.6	60,491,068	42%
		512	22,556,391	85.2	20,018,796	89%
		1,518	7,802,341	88.6	7,198,874	92%

Source: The Tolly Group, December 2003

Figure 2

**Layer 2 Zero-Loss ($\leq 0.001\%$) Aggregate
Frames per Second Rate
48 Gigabit Ethernet Ports Using an Adjacent Port-Pairing Scheme
as Reported by SmartFlow**



Source: The Tolly Group, December 2003

Figure 3

have further burdened the Catalyst pricing so the Supervisor II module was used instead.) Tests show that the Catalyst 6500 throughput was constrained by the switch's forwarding rate of about 15 Mpps, which is documented by Cisco (our results show the full-duplex external packet rate of 30.4 Mpps). The results for the 512- and 1,518-byte packet sizes yielded about 30% of theoretical maximum throughput, and in both cases, the forwarding rates were well below the switch's maximum.

Throughput tests on the Catalyst 6500 outfitted with the SFM resulted in aggregate throughput ranging from 42% to 92% of the theoretical maximum. With the 64-byte packet size, the switch's throughput doubled from the addition of the SFM to 42% of the theoretical maximum Gbps. The throughput was constrained by the switch's forwarding rate, which also doubled from adding the SFM to about 30 Mpps for Layer 2. This forwarding rate is also documented by Cisco (again, our results show the full-duplex external packet rate of 60.5 Mpps). The results for the 512- and the 1,518-byte packet sizes improved approximately threefold with the addition of the SFM with performance reaching approximately 90% of the theoretical maximum throughput.

TEST CONFIGURATION AND METHODOLOGY

For performance tests, The Tolly Group tested a 3Com Switch 7700R containing six, 8-port 10/100/1000 1000BASE-T modules for a total of 48 ports. The 3Com Switch 7700R chassis included eight slots and a 460-watt power supply.

Tolly Group engineers also tested a Cisco Systems Catalyst 4500, outfitted with a 4507R seven-slot chassis, Supervisor IV module, 1000-watt power supply and two 24-port 1000Base-T modules. The Catalyst 4500 tested was running

hardware version 2.1, firmware version 12.1(12r)EW and software version 12.1(12r)EW.

Engineers also tested two configurations of the Catalyst 6500. The first employed a 6509 nine-slot chassis with a Supervisor II module and Policy Feature Card 2. The switch also came configured with a Cat 6K MSFC2 daughterboard, a 1,000-watt power supply and three 16-port SFM-capable 10/100/1000 RJ-45 port modules. The Catalyst 6500 tested was running hardware version 3.11, firmware version 7.1(1) and software version 12.1(19)E.

The second of the two Catalyst 6500 configurations largely was a copy of the first, with the sole exception of an additional Switching Fabric Module.

To measure the throughput for each of the tested switches, engineers employed a pair of Spirent Communications SmartBits with SmartFlow to generate bidirectional Layer 2 traffic into the 48 GbE ports in a simple adjacent port-pairing configuration (e.g. port 1 to port 2, port 3 to port 4...). Each switch was tested in three throughput iterations for each of the following packet sizes: 64, 512, and 1,518 bytes. Engineers recorded the maximum throughput that can be sustained for each packet size with zero frame loss ($\leq 0.001\%$).

The purpose of this validation strategy is to perform a simple throughput test by using only Layer 2 traffic with a basic adjacent port-pairing scheme. This straightforward methodology will show how the switches perform under these simple conditions and where (if any) the performance constraints are located.

The two SmartBits chassis were linked to each other via their expansion interfaces, and each chassis was fully populated with SmartBits TeraMetric modules (each having two

3Com Corp.

3Com Switch 7700R

Layer 2 Gigabit Ethernet Throughput



3Com Corp. 3Com Switch 7700R Product Specifications*

Performance

- 96 Gbps backplane capacity
- 96 Gbps maximum bandwidth
- 71 Mpps maximum throughput

Layer 2 Switching

- 32K MAC addresses
- 10K static MAC addresses
- All interface modules support line-speed forwarding (forward delay <math><10\mu\text{s}</math>)
- Jumbo Frames support

Layer 3 Switching

- OSPF, RIP and RIP2 protocols
- PIM DM/SM (Multicast)
- 64k routes
- VRRP

VLANs

- 4,096 VLANs (IEEE 802.1Q)
- GVRP (GARP VLAN Registration Protocol)

Link aggregation

- Supports a maximum of 64 port aggregation groups
- Up to 16 Fast Ethernet ports per aggregation group
- Up to 8 Gigabit Ethernet ports per aggregation group

Traffic control

- IEEE 802.3x full-duplex flow control
- Eight hardware-based QoS queues per port
- Bandwidth management

Security

- Access Control Lists
- IEEE 802.1x network login
- Radius Authentication

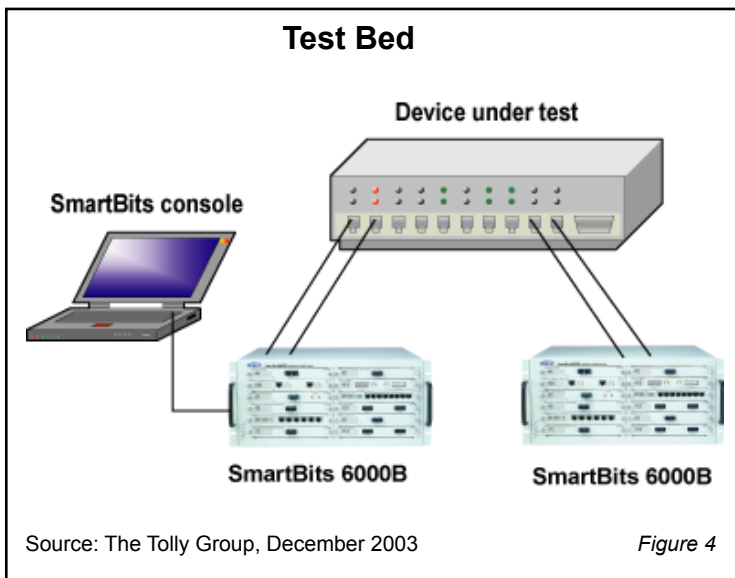
Management

- SNMP
- Telnet
- RMON
- Syslog
- Configuration back-up and restore

For more information contact:

3Com Corp.
350 Campus Drive
Marlborough, MA 01752-3064, USA.
Phone: (508) 323-5000
Fax: (508) 323-1111
URL: <http://www.3Com.com>

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



GbE ports). The switch under test was connected to the SmartBits using an adjacent port-pairing scheme, creating intra-module traffic. Additionally, a console is connected to the SmartBits for management purposes.

EQUIPMENT ACQUISITION AND SUPPORT

The Cisco Catalyst switches used in testing were acquired by 3Com through standard product distribution channels.

In compliance with The Tolly Group's Fair Testing Charter, executives at Cisco Systems were contacted and invited to participate in the testing process to ensure that the results were accurate, and to provide a higher level of support than that available via standard channels. Cisco agreed to participate, and The Tolly Group subsequently shared the testing methodology prior to the test, and also delivered the Catalyst results after the evaluation for Cisco to comment. Cisco elected not to comment on the methodology or the test results.

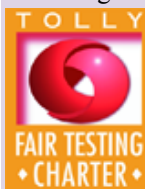
The Tolly Group gratefully acknowledges the providers of test equipment used in this project.

Vendor	Product	Web address
Spirent Communications	SmartBits 6000B	http://www.spirentcom.com
Spirent Communications	SmartFlow 3.0	http://www.spirentcom.com



TOLLY GROUP SERVICES

With more than 15 years of testing experience of leading-edge network technologies, The Tolly Group employs time-proven test methodologies and fair testing principles to benchmark products and services with the highest degree of accuracy. Plus, unlike narrowly focused testing shops, The Tolly Group combines its vast technology knowledge with focused marketing services to help clients better position product benchmarks for maximum exposure. The company offers an unparalleled array of reports and services including: Test Summaries, Tolly Verifieds, performance certification programs, educational Webcasts, white paper production, proof-of-concept testing, network planning, industry studies, end-user services, strategic consulting and integrated marketing services. Learn more



about The Tolly Group services by calling (561) 391-5610, or send E-mail to sales@tolly.com.

For info on the Fair Testing Charter, visit: <http://www.tolly.com/Corporate/FTC.aspx>

PROJECT PROFILE

Sponsor: 3Com Corp.

Document number: 203130

Product class: Gigabit Ethernet switch

Products under test:

- 3Com Switch 7700R, HW Ver. 2.1/SW Ver. 1.0
- Cisco Catalyst 4507R, HW Ver. 7700R-001/FW Ver. 12.1(12r)EW/SW Ver. 12.1(19)EW1
- Cisco Catalyst 6509, HW Ver. 3.11/FW Ver. 7.1(1)/SW Ver. 12.1(19)E
- Cisco Catalyst 6509 with Switching Fabric Module, HW Ver. 3.11/FW Ver. 7.1(1)/SW Ver. 12.1(19)E

Testing window: December 2003

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 sales@tolly.com, call (561) 391-5610.

Information technology is an area of rapid growth and constant change. The Tolly Group conducts engineering-caliber testing in an effort to provide the internetworking industry with valuable information on current products and technology. While great care is taken to assure utmost accuracy, mistakes can occur. In no event shall The Tolly Group be liable for damages of any kind including direct, indirect, special, incidental, and consequential damages which may result from the use of information contained in this document. All trademarks are the property of their respective owners.

The Tolly Group doc. 203130 rev. clk 14 Jan 04