THE TOLLY GROUP

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3Com Corp.

SuperStack 3 Switch 4300 versus Cisco Systems Inc. Catalyst 3548 XL

Layer 2 Fast Ethernet/Gigabit Ethernet Throughput Evaluation

Test Summary

Premise: *Network managers who deploy multi-layer switches need a product that not only delivers exceptional performance, but delivers economic value, as well. As is often the case, switch makers optimize their products to perform at certain frame sizes. The reality, though, is that user traffic often is a mix of standard and non-standard frame sizes. Network switches must process all legal Ethernet frame sizes without sacrificing performance. Moreover, buyers can benefit measurably just by considering a switch's packet-per-second transmission cost.*

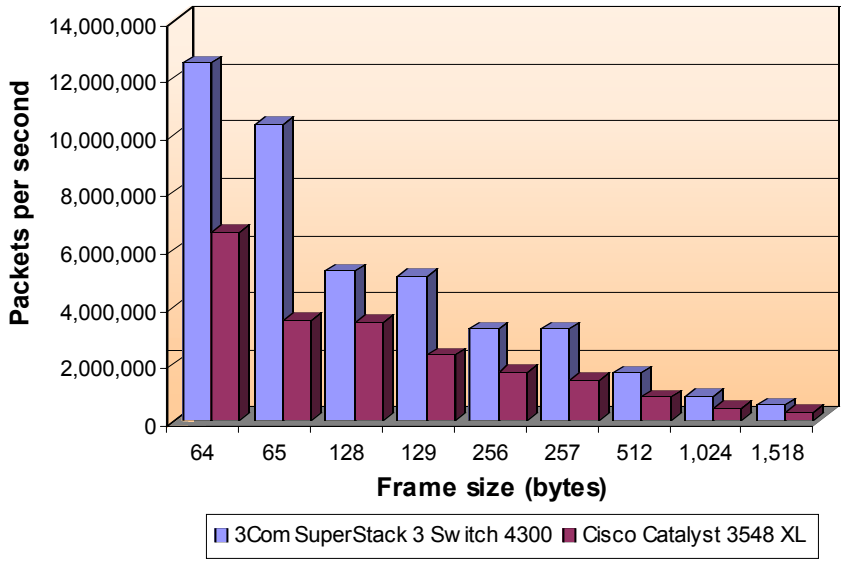
3Com Corp. commissioned The Tolly Group to benchmark its SuperStack 3 Switch 4300 versus the Cisco Systems, Inc. Catalyst 3548 XL switch in competitive Layer 2 Fast Ethernet/Gigabit Ethernet forwarding performance tests. The SuperStack 3 Switch 4300 is 3Com's high-density, high-performance Layer 2 hybrid Fast Ethernet/Gigabit Ethernet switch that provides 48 Fast Ethernet ports and up to four Gigabit Ethernet ports. The Catalyst 3548 XL switch offers 48 Fast Ethernet ports and two Gigabit Ethernet ports.

The Tolly Group evaluated the steady state, zero-loss (≤0.001%) bidirectional (full-duplex) frames per second (fps) throughput of both switches in a full-mesh configuration. In addition to the standard frame sizes of 64-, 128-, 256-512-, 1,024- and 1,518-byte frames, engineers benchmarked the throughput of both switches when handling "odd-sized" frames of 65, 129 and 257 bytes. Some switch makers optimize their boxes to

Test Highlights

- Delivers double the aggregate Layer 2 packet throughput of the Cisco Catalyst 3548 XL across a variety of frame sizes tested
- Maintains zero-loss throughput rates when handling 129- and 257-byte "odd-sized" frames, while Catalyst 3548 XL throughput drops 33% and 18% respectively in tests using same frame-sizes compared to 128-byte and 256-byte frame rates
- Offers price/performance that is 2.5 times better than the Catalyst 3548 XL

Layer 2 Full-Duplex Aggregate Throughput
Zero-Loss Fast Ethernet/Gigabit Ethernet Performance Using SmartWindows[1]



[1]The test occurred in a full-mesh environment with 48 Fast Ethernet ports on both devices: the 3Com SuperStack 3 Switch 4300 was outfitted with four Gigabit Ethernet ports, while the Cisco Catalyst 3548 XL was outfitted with two Gigabit Ethernet ports.

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

handle the commonly tested frame sizes, only to see performance fall off when other frame sizes come into play. 3Com wanted to prove its SuperStack 3 Switch 4300 handles the full spectrum of frame sizes better than the Catalyst 3548 XL. The 3Com SuperStack 3 Switch 4300 was tested with 48 Fast Ethernet ports (100Base-TX) and four Gigabit Ethernet ports (1000Base-SX). The Cisco Catalyst 3548 XL was tested with 48 Fast Ethernet ports (100Base-TX) and two Gigabit Ethernet ports (1000Base-SX). Both devices were configured in a full-mesh configuration with 10 Fast Ethernet ports meshed with each Gigabit Ethernet port, and the remainder of the Fast Ethernet ports meshed among each other. So the SuperStack 3 Switch 4300 supported 40 Fast Ethernet ports meshed with the four Gigabit Ethernet ports and the remaining eight Fast Ethernet ports meshed with each other. On the Cisco Catalyst 3548 XL, 20 Fast Ethernet ports were meshed with the two Gigabit Ethernet ports and 28 Fast Ethernet ports were meshed with each other.

Tests show the SuperStack 3 Switch 4300 outperformed the Catalyst 3548 XL convincingly in every packet test performed. Moreover, while the SuperStack 3 Switch 4300 generally handled odd-sized frames without significant impact on performance, the Catalyst 3548 XL throughput fluctuated significantly when tests substituted odd-sized frames in place of commonly tested frame sizes.

Results

Zero-Loss Bidirectional Throughput

Testing demonstrated that the 3Com SuperStack 3 Switch 4300 forwarded 12,500,000 64-byte packets versus 6,589,148 for the Catalyst 3548 XL. The 3Com SuperStack 3 Switch 4300 delivered 95% of wire-speed throughput in a full-mesh Layer 2 configuration with zero loss, when forwarding 64-byte frames. The maximum throughput at 64-byte frames with 95% offered load is equivalent to 16.7 Gbit/s. The Catalyst 3548 XL, by contrast, delivered zero-loss throughput at 65% of the theoretical maximum rate, or 8.8 Gbit/s – about half of the 64-byte frame throughput reported for the SuperStack 3 Switch 4300.

The frame size was then changed to 65 bytes and the same test was run. This time, the zero-loss throughput for the Catalyst 3548 XL dropped dramatically to just 35% of the maximum attainable throughput, which results in the maximum throughput equaling 4.8 Gbit/s, or nearly one-third the aggregate throughput offered by the SuperStack 3 Switch 4300. More importantly, when considering packet-forwarding rates, the Catalyst 3548 XL throughput plummeted 47% when comparing the throughput generated by using 65-byte frames instead of 64-byte frames. During this frame-size test, throughput decreased 15% on the SuperStack 3 Switch 4300, leveling off at 14 Gbit/s.

The second set of tests included 128- and 129-byte frames. Engineers noted that zero-loss throughput occurred at 70% of the theoretical maximum for the SuperStack 3 Switch 4300, with the device forwarding 5,213,270 pps. This was not the case with the Catalyst 3548 XL. At 128-byte frames, the Catalyst 3548 XL achieved throughput equal to 60% of the theoretical maximum (or 3,448,276 pps), but when the tests employed a 129-byte frame the Catalyst 3548 XL achieved throughput equal to just 40% of the theoretical maximum (2,281,879 pps). That means, for just a 1-byte increase in packet size, the Catalyst 3548 XL throughput dropped by 34%.

This trend continued with 256- and 257-byte frame tests. Again, engineers discovered no difference between the performance achieved on the SuperStack 3 Switch 4300 when 256 byte-frames and 257-byte frames were used. Both frame sizes were recorded having obtained a zero-loss rate of 80% of the theoretical maximum. With the Catalyst 3548 XL, engineers observed throughput equal to 55% of the theoretical maximum when tested with 256-byte frames, dropping to 45% of theoretical maximum when 257-byte frames were employed. From a packet-forwarding perspective, the SuperStack 3 Switch 4300 forwarded 3,188,406 64-byte packets versus 1,694,915 for the Catalyst 3548 XL. At 65-byte packets, the 3Com switch forwarded 3,179,191 pps, versus 1,380,991 pps for the Cisco device. For just a 1-byte increase in packet size, the Catalyst 3548 XL throughput dropped by 19%.

The remaining three frame sizes (512, 1,024, and 1,518 bytes) produced fairly high zero-loss throughput for the SuperStack 3 Switch 4300 equal to 80% of maximum wire-speed throughput for the 512-byte and 1,024-byte frames and 75% of maximum throughput for the 1,518-byte frames. By contrast, the Catalyst 3548 XL generated throughput equal to 50% of the theoretical max for each of the three large frame sizes tested.

Analysis

Customers who deploy Fast Ethernet/Gigabit Ethernet switching in high-performance networking environments need to ensure that the device chosen for implementation will forward traffic cost-effectively to its destination with high levels of throughput across a wide range of frame sizes.

An important factor to consider when implementing the best performing switch(es) would be when various frame sizes are being forwarded through the switching fabric. Real-world TCP/IP network traffic can include any legal Ethernet frame size (64 bytes on up through 1,518 bytes). In some cases, vendors optimize the performance of their switches to handle standard-size frames. But performance may suffer, in some cases markedly, when odd-size frames are used.

The Tolly Group tested each switch with frame sizes other than those typically used for performance benchmarks. In theory, the results of using a slightly larger frame should be consistent. When the SuperStack 3 Switch 4300 was introduced to the 65-byte frame size, engineers throttled back to 80% offered load to achieve zero loss. When changing the frame size between 128 bytes to 129 bytes and 256 bytes to 257 bytes, the 3Com switch maintained the same zero frame-loss threshold.

When performing these same tests on the Catalyst 3548 XL, throughput results wavered dramatically. Aside from much lower throughput with the standard frame sizes, the Cisco switch suffered severely from the 1-byte frame size augmentation losing in one test almost 50% of the throughput compared to the normal frame sizes.

Beyond performance, buyers also should consider the cost per million packets per second. At a U.S. list price of $4,295 for the 48-port SuperStack 3 Switch 4300 with the four Gigabit Ethernet (10/100/1,000 Mbit/s) ports, the device yields a price/performance of $344 per million pps (price divided by the 64-byte pps rate of 12.5 million pps). By contrast, the Cisco Catalyst 3548 XL carries a retail price of $5,785 for the 48-port switch plus a pair of 1000Base-T interface cards. Factoring in the switch's 64-byte packet performance of 6.6 million pps, the Catalyst 3548 XL yields a price/performance of $877 per million pps – or more than 2.5 times more than the SuperStack 3 Switch 4300.

Test Configuration and Methodology

For performance tests, The Tolly Group tested a 3Com Corp. SuperStack 3 Switch 4300 hybrid switch with 48 Fast Ethernet ports and four Gigabit Ethernet fiber-optic ports, with the switch running software version 4.0. Engineers pitted the 3Com device against a Cisco Systems Inc. Catalyst 3548 XL hybrid switch configured with 48 Fast Ethernet ports and two Gigabit Ethernet fiber-optic ports, running IOS software version 12.

Both devices under test were subjected to steady state, zero-loss (≤0.001%) bidirectional packets per second (PPS) throughput tests. Tests used the smallest (64 bytes) and largest (1,518 bytes) frame sizes at a load of 100% utilization, decreasing in 5% increments if greater than 0.001% loss should provide sufficient data for all traffic.

For each test, the device under test connected to the Spirent Communications SmartBits SMB-2000 via 48 Fast Ethernet connections and Gigabit Ethernet (four connections for the SuperStack 3 Switch 4300 and two for the Catalyst 3548 XL). An Acterna Corp. Domino Internetwork Analyzer also tapped into the SMB-2000 to verify packet content, but was removed before the performance tests commenced.

Engineers configured each port on the device under test for the link speed it would support and full-duplex operation. Engineers disabled spanning tree, flow control and other ancillary features that otherwise could have an impact on switch performance. Then, they configured the SmartBits for the tested frame size, network utilization, and test duration. Tests were run with the following configuration from the switch to the SmartBits: Fast Ethernet ports 1-10 to Gigabit Ethernet port 1, Fast Ethernet ports 11-20 to Gigabit Ethernet port 2, Fast Ethernet ports 21-30 to Gigabit Ethernet port 3 (3Com only), Fast Ethernet ports 31-40 to Gigabit Ethernet port 4 (3Com only), and the remaining Fast Ethernet ports in a full-mesh configuration. Engineers initiated the test and recorded the results. If frame loss occurred, they repeated the procedure and lowered the network utilization until no frame loss occurred.

The SmartWindows application recorded total transmitted frames,

3Com Corp.

SuperStack 3 Switch 4300

Competitive Layer 2 Zero-Loss Throughput Test

TOLLY Up to Spec CERTIFIED

3Com Corp. SuperStack 3 Switch 4300 Product Specifications*

Flexible connectivity

- 48 10BASE-T/100BASE-TX auto-negotiating ports
- Two module slots accommodating media modules
- Single- and dual-port expansion modules
- Advanced Redundant Power System connector

Advanced management

- Web-based GUI
- Command line interface
- RS-232 console port
- 3Com Network Supervisor (provided free of charge on CD)

Dimensions

- Height: 65mm (2.6 in)
- Width: 440mm (17.3 in)
- Depth: 300mm (12 in)
- Weight: 5.3Kg (12 lb)

High-quality manufacture and certification

- MTBF@40C: 141,000 hours
- Operating temperature: 0C to 40C (32F to 104F)
- Safety: UL1950, EN60950, CSA 22.1 No.950, IEC 60950
- Emissions: EN55022 Class A, FCC part 15 Subpart B Class A, ICES-003 Class A, VCCI Class A, AS/NZS 3548 Class A, CNS 13438 Class A
- Immunity: EN55024
- Heat dissipation: 90W max (307 BTU/hr)

Support Services

- Lifetime limited warranty
- Advanced hardware replacement
- Free software upgrades

For more information contact:

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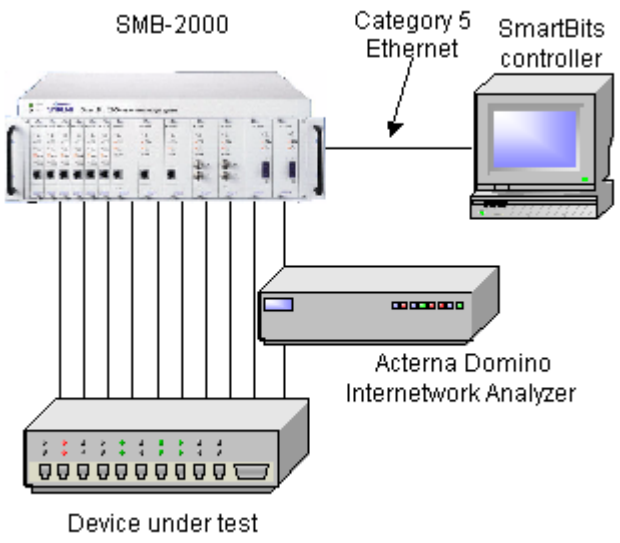
Santa Clara, CA 95052
Phone: (408) 326-5000
Fax: (408) 326-5001
URL: http://www.3Com.com/

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

Test Bed



Source: The Tolly Group, June 2001 *Figure 2*

and total received frames, plus frame loss, if any. Tests were run for 60 seconds for each of three test iterations.

Equipment Acquisition and Support

The Cisco Catalyst 3548 XL was acquired through normal distribution channels. The Tolly Group contacted Cisco and invited the company to provide a higher level of technical support than available through normal channels. Cisco declined to support the test. Tolly Group engineers used standard technical support instead. For a more complete understanding of the interaction between The Tolly Group and Cisco, refer to the Technical Support Diary for Competitive Products Tested posted on The Tolly Group's World Wide Web site at (see document 201117.)

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

Vendor	Product	Web address
Acterna Corp.	Domino Internetwork Analyzer	http://www.acterna.com
Spirent Communications	SmartBits SMB-2000	http://www.spirentcom.com
Spirent Communications	SmartWindows	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: 3Com Corp.
Document number: 201117
Product class:
- Layer 2/Layer 3 Fast Ethernet/Gigabit Ethernet switch

Products under test:
- 3Com Corp. SuperStack 3 Switch 4300
- Cisco Systems Inc. Catalyst 3548 XL

Testing window: April 2001 to June 2001
Software versions tested:
- SuperStack 3 Switch 4300 software Version 1.01
- Catalyst 3548 XL IOS Version 12.0

Software status:
- Generally available

Additional information available:
- Technical Support Diary
- Configuration files
- Data files

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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