THE TOLLY GROUP

No. 203116 September 2003

Dell Inc.

Dell PowerConnect 3348 vs. 3Com SuperStack 3 Switch 4400 and Cisco Systems Catalyst 2950 Layer 2 Fast Ethernet/Gigabit Ethernet Competitive Switch Evaluation

Test Summary

Premise: *Customers who deploy Fast Ethernet/Gigabit Ethernet switches have come to expect high throughput. In fact, while many customers design networks based upon such expectations, traffic flow rarely occurs in a way optimized for a given switch architecture. These devices must deliver high performance even when traffic flows across the device are maximizing the Gigabit uplinks of the switch. That is, when Fast Ethernet to Gigabit Ethernet uplink flows work "against" the design of the switch fabric.*

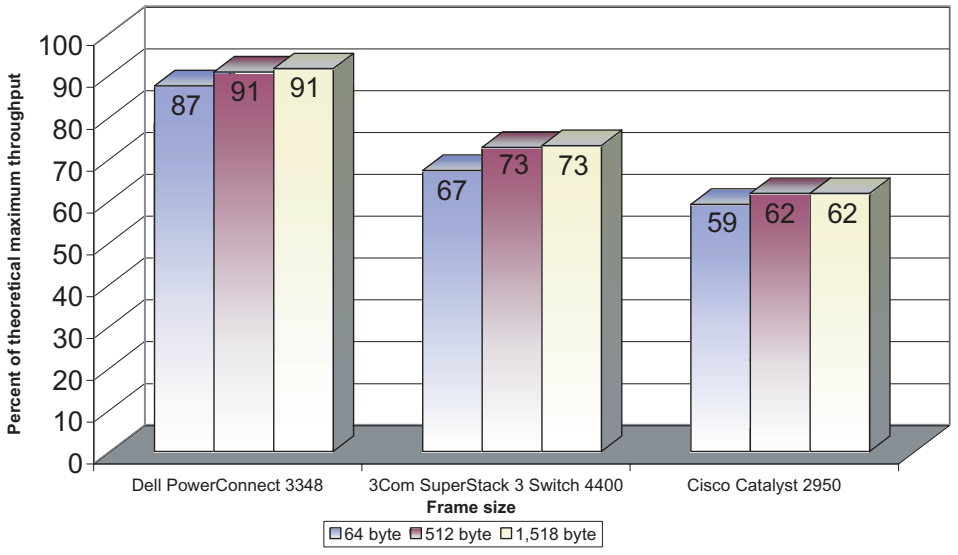
Dell Inc. commissioned The Tolly Group to benchmark the performance of its PowerConnect 3348, an enterprise edge switch. The PowerConnect 3348 provides 48 managed Fast Ethernet ports with two Gigabit Ethernet uplinks (built-in copper, optional fiber). Dell also requested that The Tolly Group test the performance of two other rival switches: 3Com Corp.'s SuperStack 3 Switch 4400 and Cisco System's Catalyst 2950. Each of the devices provides 48 Fast Ethernet ports with two GBIC slots.

The Tolly Group conducted zero-loss (≤ 0.001%) bi-directional throughput tests on all three switches, subjecting them to test scenarios in which traffic of 64-byte, 512-byte and 1,518-byte frames was utilized in a challenging port mapping configuration that forced traffic from the "low" Fast Ethernet ports to the "high" Gigabit Ethernet port and vice versa.

Test Highlights

- Outperforms 3Com and Cisco switches consistently in Layer 2 throughput tests using "uplink stress test" for Fast Ethernet to Gigabit Ethernet uplink traffic flow
- Exceeds throughput of SuperStack 3 Switch 4400 by 30% and Catalyst 2950 by 48% in Layer 2 throughput tests of 64-byte frames
- Forwards 87% of the maximum theoretical rate for 64-byte frames, plus 91% of the maximum theoretical rate for both 512-byte and 1,518-byte frames

Percent Of Theoretical Maximum Zero-Loss (≤ 0.001%) Throughput
48 Fast Ethernet + 2 Gigabit Ethernet ports as Reported by SmartFlow



Source: The Tolly Group, September 2003 *Figure 1*

(For details, see the Test Methodology & Configuration section.)

Testing was performed in August 2003.

Test results show that the Dell PowerConnect 3348 offers superior performance to the two rival switches in Layer 2 throughput tests for all frame sizes tested. The PowerConnect 3348 demonstrated near wire-speed performance in all Layer 2 tests of 64-, 512-, and 1,518-byte frames while competitors' devices were unable to sustain the same level of performance.

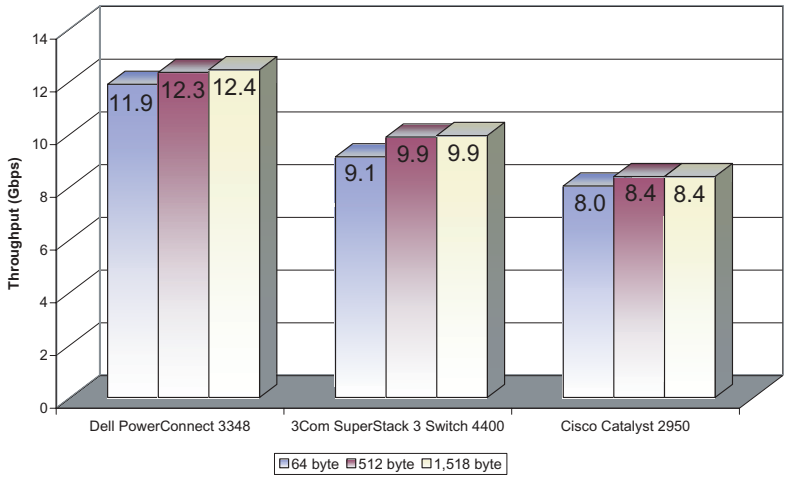
Results

Zero-Loss Bi-directional Throughput Using 64-byte Frames

Engineers tested the Layer 2 throughput of the devices under test in a complex port-mapping scheme. (See Test Methodology and Configuration section for details.) In tests using 64-byte frames, the PowerConnect 3348 delivered 87% of the theoretical maximum, zero-loss throughput or an aggregate of 17,679,464 frames-per-second (fps). By contrast, the Cisco Catalyst 2950 managed only 59% of zero-loss throughput and the 3Com SuperStack 3 Switch 4400 managed just 67% of zero-loss throughput for the same test. (See Figures 1, 3, 4.)

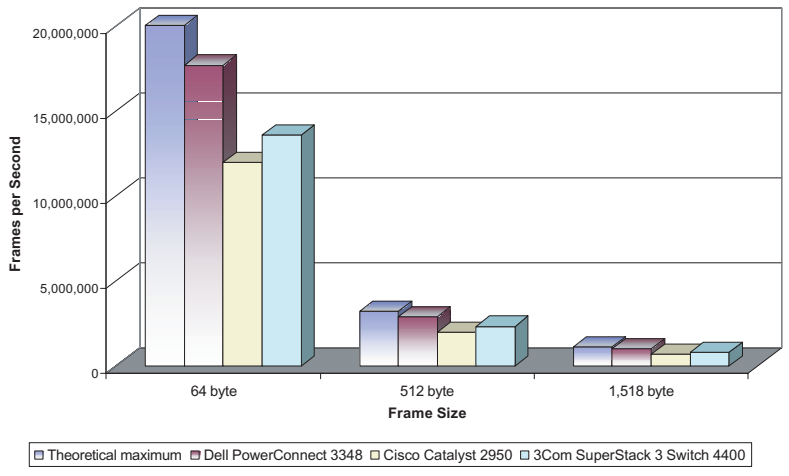
Engineers also calculated the aggregate throughput of the combined switch ports (i.e. 13.6 Gbps in a full-duplex environment). Results show that the Dell PowerConnect 3348 delivered an aggregate throughput of 11.9 Gbps. In comparison, the Cisco Catalyst 2950 delivered 8.0 Gbps and the 3Com SuperStack 3 Switch 4400 managed 9.1 Gbps. (See Figures 2, 4.)

Percent of Theoretical Maximum Zero-Loss (≤ 0.001%) Throughput
48 Fast Ethernet + 2 Gigabit Ethernet Ports
As Reported By SmartFlow



Source: The Tolly Group, 2003 *Figure 2*

Layer 2 Zero-Loss (≤ 0.001%) Aggregate Frames Per Second Rate
48 Fast Ethernet + 2 Gigabit Ethernet ports
as Reported by SmartFlow



Source: The Tolly Group, 2003 *Figure 3*

Zero-Loss Bi-directional Throughput Using 512-byte Frames

Engineers also measured the throughput of the switches under test using 512-byte frames in the same configuration. Tests results show that the PowerConnect 3348 delivered 91% of the theoretical maximum throughput, or an aggregate throughput of 12.3 Gbps. By contrast, the 3Com SuperStack 3 Switch 4400 delivered just 73% of the theoretical maximum throughput, or 9.9 Gbps, while the Cisco Catalyst 2950 managed to deliver only 62% of the theoretical maximum throughput, or 8.4 Gbps. (See Figures 1, 2, 4.)

Zero-Loss Bi-directional Throughput Using 1,518-byte Frames

Finally, engineers tested each device while using 1,518-byte frames in the same test configuration. Results show that the PowerConnect 3348 delivered 91% of the theoretical maximum throughput, or 12.4 Gbps. The 3Com SuperStack 3 Switch 4400 delivered 73% of the theoretical maximum throughput, or 9.9 Gbps and the Cisco Catalyst 2950 managed to deliver just 62% of theoretical maximum throughput, or 8.4 Gbps. (See Figures 1, 2, 4.)

Dell Inc.. PowerConnect 3348 Layer 2 Throughput Competitive Switch Evaluation

Dell Computer Corp.
PowerConnect 3348

Port attributes:
- 48 10/100BASE-T auto-sensing Fast Ethernet switching ports
- Four SFP slots for fiber media support (Note: SFP slots are used instead of the built-in 10/100BaseT ports)
- Auto-negotiation for speed, duplex mode and flow control
- Port mirroring
- Broadcast storm control

VLAN
- Up to 256 VLANs supported
- Dynamic VLAN with GVRP support

Availability
- Spanning Tree (IEEE 802.1D) and Rapid Spanning Tree (IEEE 802.1w) with Fast Link support

Quality of Service
- IEEE 802.1p tagging
- Port-based prioritization
- Layer 2/Layer 3-aware prioritization
- Four priority queues per port
- Adjustable Weighted-Round-Robin queue scheduling (WRR)

Multicast
- IGMP snooping for IP Multicast Support
- Static IP multicast

Security
- IP Address filtering for management access via Telnet, HTTP, HTTPS/SSL, SSH and SNMP
- User-definable settings for enabling or disabling Web, SSH, Telnet, SSL management access
- Port-based MAC Address alert and lock-down
- RADIUS support for switch management access
- SSL/SSH encryption for switch management traffic
- Access Control Lists (ACLs) supported; up to 248 Access Control Entries (ACEs) per Fast Ethernet ACL and up to 120 ACEs per Gigabit Ethernet ACL; up to 2,000 total ACEs per switch
- ACLs can identify flows based upon protocol (TCP/UDP port), source/destination IP address, source/destination port, DSCP values, IP precedence values, source/destination MAC address, and VLAN ID
- ACLs can be bound to ports, link aggregation groups and VLANs

Other Switching
- Link Aggregation with support for up to six aggregated links per switch and up to eight ports per aggregated link (IEEE 802.3ad)
- LACP support

Management
- Web-based management interface
- Industry-standard CLI accessible via Telnet or console
- SNMPv1 and SNMP v2c supported
- Four RMON groups supported (history, statistics, alarms and events)
- TFTP transfers of firmware
- Dual firmware images supported
- Configuration file upload/download supported
- Statistics for error monitoring and performance optimization including port summary tables
- BootP/DHCP IP address management supported
- Syslog remote logging capabilities

Chassis
- 1U, rack-mounting kit included

For more product information on the PowerConnect 3348 contact:
Dell Computer Corp., One Dell Way, Round Rock, TX 78682
Phone: 1-800-BUY-DELL (1-800-289-3355) URL: http://www.dell.com
**Vendor-supplied information not verified by The Tolly Group*

Analysis

Users that deploy Fast Ethernet/ Gigabit Ethernet switches in their networks need to wring every bit of performance from the devices they deploy, even when traffic flows challenge switch fabrics. In the test for this Test Summary, engineers created a traffic flow in which 10 Fast Ethernet ports transmitted traffic to one Gigabit Ethernet port, another set of 10 Fast Ethernet ports transmitted data to the second available Gigabit Ethernet port and the remaining Fast Ethernet ports exchanged data in a full mesh. Under this uplink stress traffic scenario, we witnessed the ability of the various switches to respond to the traffic flows.

Fast Ethernet/Gigabit Ethernet Full Duplex Layer 2 Performance Summary

	Maximum theoretical throughput (full duplex, Gbps)	Frame size (bytes)	Maximum theoretical throughput (frames-per-second)	Actual throughput (full duplex, Gbps)	Actual throughput (frames-per-second)	Percent of theoretical maximum throughput
Dell PowerConnect 3348 Layer 2 Switch - 48 Fast Ethernet & 2 Gigabit Ethernet ports	13.6	64	20,238,095	11.9	17,679,464	87%
		512	3,195,489	12.3	2,897,978	91%
		1,518	1,105,332	12.4	1,010,780	91%
3Com SuperStack 3 Switch 4400 - 48 Fast Ethernet & 2 Gigabit Ethernet ports	13.6	64	20,238,095	9.1	13,589,698	67%
		512	3,195,489	9.9	2,321,476	73%
		1,518	1,105,332	9.9	807,812	73%
Cisco Catalyst 2950 - 48 Fast Ethernet & 2 Gigabit Ethernet ports	13.6	64	20,238,095	8.0	11,944,734	59%
		512	3,195,489	8.4	1,969,588	62%
		1,518	1,105,332	8.4	681,308	62%

Source: The Tolly Group, September 2003 *Figure 4*

The PowerConnect 3348 distinguished itself as the fastest switch tested, providing up to 48% more throughput than rival switches tested when measured across the three frame sizes tested.

In the 64-byte frame test, the PowerConnect 3348 delivered 48% greater throughput than the Cisco Catalyst 2950 and 30% greater throughput than the 3Com SuperStack 3 Switch 4400.

In the 512-byte frame test the PowerConnect 3348 maintained its performance lead, delivering 47% greater throughput than the Cisco Catalyst 2950 and 25% greater throughput than the 3Com SuperStack 3 Switch 4400.

In the 1,518-byte test, the PowerConnect 3348 delivered 48% throughput than the Cisco Catalyst 2950 and 25% greater throughput than the 3Com SuperStack 3 Switch.

Test results revealed that the PowerConnect 3348 delivered consistent advantage over rival products in frame processing rates. The PowerConnect 3348 delivered a maximum frame per second rate of 17,679,464 for the Dell PowerConnect 3348 in the 64-byte frame test, 2,897,978 fps when tested with 512-byte frames and 1,010,780 when tested with 1518-byte frames. By contrast, the 3Com SuperStack 3 Switch 400 delivered 13,589,698 fps, 2,321,476 fps and 807,812 fps for the three frame sizes tested. And the Cisco Catalyst 2950 processed 11,944,734 fps, 1,069,734 fps and 681,308 fps for the three frame sizes.

The message is clear; the PowerConnect 3348 delivers consistent performance gains over the Cisco and 3Com switches, regardless of frame sizes tested.

Related Tests

In The Tolly Group's Test Summary 202149, engineers benchmarked the Dell PowerConnect 3248 against the Cisco Catalyst 2950G-48 and 3Com SuperStack 3 Switch 4400 with a

port-pairing scheme that was designed to provide the maximum difficulty for all systems due to internal hardware configurations. The testing proved that the Dell PowerConnect 3248 outperformed both the Cisco 2950 and 3Com 4400 in like tests. For this round of testing, Dell decided to benchmark the PowerConnect 3348 against the previously tested Cisco and 3Com. This latest round of testing utilized the same test methodology utilized in Test Summary 202149.

Test Configuration and Methodology

For this series of performance tests, The Tolly Group benchmarked a Dell PowerConnect 3348 Version 1.0.0.52 against a pair of competitive offerings: a 3Com Corp. SuperStack 3 Switch 4400 Version 3.0 and a Cisco Systems Catalyst 2950 running IOS 12.1 (13)EA1.

Tolly Group engineers subjected the switches to zero-loss (≤ 0.001%) bi-directional throughput tests using frame sizes of 64, 512 and 1,518 bytes. Engineers recorded measures in Gbps throughput, frames per second rate, and percentage of maximum theoretical throughput.

For the test, each switch was connected to a Spirent Communications SmartBits 6000 Advanced Multiport Performance Tester/ Analyzer/Simulator equipped with four LAN-6101A 10/100 SmartModules, which provide a total of 48 Fast Ethernet connections to the switch under test.

A generic 500-MHz Pentium III PC running Spirent Communications' SmartFlow version 2.2 was used as the SmartBits console.

For throughput tests, engineers configured a test bed in which the first 10 Fast Ethernet ports forwarded traffic to the second Gigabit Ethernet port, Fast Ethernet ports 25-34 forwarded traffic to the first Gigabit Ethernet port, and the remaining Fast Ethernet ports were destined for each other in a full-mesh configuration. (see Figure 5.) This was the same as the port pairing that was used for Test Summary 202149.

This port-pairing configuration is designed to provide the maximum difficulty for all systems under test to tax their internal hardware configurations. Switch hardware architects generally design Layer 2 Fast Ethernet switches with GbE uplink ports in a manner that the first 24 Fast Ethernet ports (1-24) fully connect with the GbE port (port 49) and the second group of Fast Ethernet ports (25-48) connect directly with the second of the two GbE ports (port 50). As a result, the connection between the first Fast Ethernet port group and the second GbE port is not designed to fully accommodate an uplink stress traffic scenario. This creates unexpected performance degradation and in turn limits the flexibility of the port usage scheme in the real-life environment.

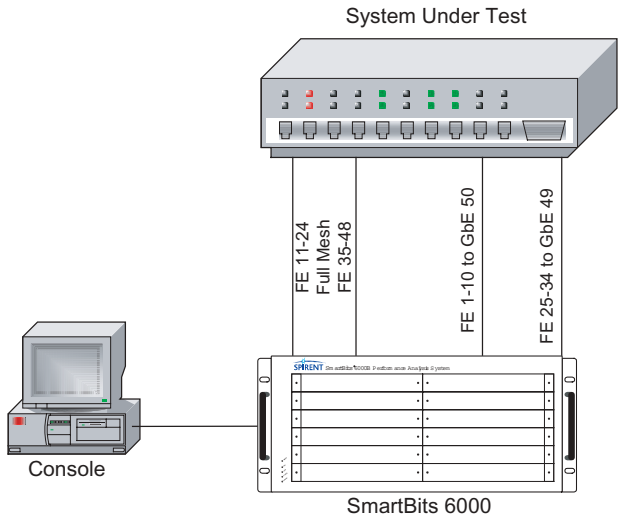
Each switch under test was configured for maximum speed (100 Mbps for Fast Ethernet ports and 1 Gbps for Gigabit Ethernet ports) and full-duplex operation while Spanning Tree, Flow Control and all other ancillary functions were disabled.

For bi-directional steady state, zero-loss (≤ 0.001%) throughput tests of 64-, 512, and 1,518-byte frames, engineers used SmartBits to generate Layer 2 traffic in the configuration described above at an initial load of 50%. Tolly Group engineers initiated each test and recorded results. If frame loss exceeding the test threshold occurred, the offered load was adjusted accordingly by a SmartFlow binary search algorithm with 1% of resolution. The SmartFlow application recorded the total transmitted frames and total received frames, plus frame loss, if any. Tests were run for 60 seconds for each of three test iterations and results were averaged.

Equipment Acquisition and Support

The 3Com and Cisco switches were acquired through normal distribution channels. In accordance with The Tolly Group's Fair Testing Charter, The Tolly Group contacted executives at each of these companies and invited them to provide a higher level of support than available through normal channels. Cisco and 3Com did not respond to the offer. Individual results were sent to representatives of each vendor who neither confirmed nor disputed their accuracy.

Test Bed



Source: The Tolly Group, September 2003

Figure 5

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

Vendor	Product	Web address
Spirent Communications	SmartBits 6000	http://www.spirentcom.com
Spirent Communications	SmartFlow V. 2.2	http://www.spirentcom.com

Tolly Group Services

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Project Profile

Sponsor: Dell Inc.
Document number: 203116
Product Class: Layer 2 Fast Ethernet/Gigabit Ethernet switches

Products under test:

- Dell PowerConnect 3348 Version 1.0.0.52
- 3Com Corp. SuperStack 3 Switch 4400 Version 3.0
- Cisco Systems Catalyst 2950, IOS 12.1 (13)EA1

Testing window: August 2003

Software status:

- Generally 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 (561) 391-5610.

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