THE TOLLY GROUP

No. 203134 October 2003

Dell, Inc.

PowerConnect 3348

Layer 2 IP Interoperability Evaluation

Test Summary

Premise: *Heterogeneous, multivendor networks are the rule rather than the exception. IT managers who deploy a variety of Fast Ethernet and Gigabit Ethernet switching devices in their networks need guaranteed interoperability of these switches in order to maintain a functional network.*

Dell, Inc. commissioned The Tolly Group to evaluate the Layer 2 interoperability of the PowerConnect 3348, a 48-port Fast Ethernet switch with two Gigabit uplink ports for enterprise networks. The Tolly Group engineers put the PowerConnect 3348 through a battery of tests along with eight other products to reveal the depth of interoperability each switch provides.

Vendors were invited to participate in any of 19 interoperability tests, including Layer 2 and Layer 3 tests. Dell elected to test the PowerConnect 3348 in six of the Layer 2 tests. Testing was performed in July and August 2003.

Test Results

Auto-negotiation of Ethernet Port Characteristics (Tolly Verified 10600)

Each pair of switches must properly negotiate the highest speed and duplex settings common to both devices. The Tolly Group tested the PowerConnect 3348's auto-negotiation with all other switches. Results show that the PowerConnect 3348 interoperates with all of the switches in the test. (See Figure 1.)

Test Highlights

- Delivers multivendor interoperability in six tests with eight other switches from six vendors in Layer 2 tests of auto-negotiation, Link Aggregation, Gigabit Ethernet uplinks and 802.1p/Q, among others
- Achieves IEEE 802.1p/Q interoperability with all eight other switches tested
- Supports Gigabit Ethernet uplink to eight other switch models

Dell PowerConnect 3348

Layer 2 Interoperability Test Results

Third-party devices tested	Tests conducted					
	Auto-negotiation	Link aggregation (Dynamic)	IEEE 802.1 p/Q	Rapid Spanning Tree 802.1w	Gigabit Uplink	Split Multi-Link Trunking (Nortel)
3Com SuperStack 3 Switch 4400	✓	✓	✓	✓	✓	N/A
3Com 4060 Switch	✓	✓	✓	✓	✓	N/A
Cisco Catalyst 6500	✓	✓	✓	✓	✓	N/A
Dell PowerConnect 5224	✓	✓	✓	✓	✓	N/A
Enterasys Matrix N3	✓	✓	✓	✓	✓	N/A
Foundry FastIron Edge 9604	✓	✓	✓	✓	✓	N/A
Nortel Passport 1424T	✓	✓	✓	N/A	✓	N/A
Nortel Passport 8600	✓	✓	✓	N/A	✓	✓

Key: ✓ = Pass N/A = Not applicable [1]

[1] N/A represents that feature was not supported

Source: The Tolly Group, October 2003

Figure 1

Link Aggregation (802.3ad) (Tolly Verified 10602)

Link Aggregation allows two or more physical ports to function as a single logical port between a pair of switches. Each switch pair must communicate over an aggregated link consisting of two full duplex, Fast Ethernet links. The PowerConnect 3348 passed the Link Aggregation interoperability test with all of the other switches tested. (See Figure 1.)

The PowerConnect 3348's successful interoperability in the Link Aggregation test means that the switch can form a trunk link with different brand switches by combining smaller channels into a larger link and transmitting data over it.

802.1p/Q (Tolly Verified 10601)

Each switch pair must demonstrate that when a virtual LAN (VLAN) tag and priority frame is introduced, the switch forwards the packet without modification to the frame. The Tolly Group tested the PowerConnect 3348 and determined that the switch can exchange VLAN tagged and priority packets successfully without modification with all other switches tested. (See Figure 1.)

Rapid Spanning Tree (802.1w) (Tolly Verified 10507)

In tests of Rapid Spanning Tree, switches must demonstrate the capability to recover from a device failure in less than 10 seconds using Bridge Protocol Data Units (BPDUs). The Tolly Group determined that the PowerConnect 3348 interoperates with all six of the other switches tested which support 802.1w. (See Figure 1.)

Gigabit Ethernet Uplink (Tolly Verified 10604)

As workgroup switched networks converge with backbone campus networks, it is not uncommon to need a Gigabit Ethernet link between switches from different vendors. Each pair of switches must interoperate across a single, full-duplex Gigabit Ethernet (1000Base-SX) uplink. The Tolly Group determined that the PowerConnect 3348 interoperates with all other switches tested when supporting a Gigabit Ethernet uplink to another switch. (See Figure 1.)

Split Multi-Link Trunking (Tolly Verified 10617)

This certification verifies that the device under test supports the aggregation of multiple ports and the fail-over using Nortel's "Split-MLT" protocol. Tests show the PowerConnect 3348 demonstrated interoperability with the Passport 8600 to support Split-MLT aggregated links and fail-over supporting the Split-MLT protocol.

Analysis

In a world of ever-evolving standards and tight budgets, network managers searching for new equipment need to know that the switches they purchase are interoperable with their current infrastructure. It is important for managers to know which devices can work together and which devices can maintain their interoperability with different standardized and non-standardized functions.

Results from this series of tests provide guidance only on basic functionality of the device under test in a switch-to-switch relationship, without consideration of feature trade-offs or the requirement to incorporate multiple devices within a network system. Network managers who need more complex feature support or have a high diversity of vendor equipment in their existing infrastructure will need to evaluate and determine the specific needs and capabilities of their individual network environments.

Test Configuration and Methodology

For interoperability tests, The Tolly Group engineers connected the PowerConnect 3348 SW ver. 1.0.0.52 to the following switches (one at a time) in a variety of configurations: a 3Com Corp. SuperStack 3 4400 SW ver. 3.12, a 3Com SuperStack 3 4060 SW ver. 3.0, a Cisco Systems, Inc. Catalyst 6500 SW ver. 12.1(13)E6, a Dell PowerConnect 5224 SW ver. 2.0.0.27, an Enterasys Networks Matrix N3 SW ver. 2.0.13, a Foundry Networks FastIron Edge 9604 SW ver. 3.0.01Tc3, a Nortel Networks Passport 1424T Routing Switch SW ver. 2.1.0, and a Nortel Networks Passport 8600.

For Layer 2 auto-negotiation tests, the DUT connected via Category 5 UTP cable. A Spirent Communications SMB-2000 chassis outfitted with ML-7710 cards also connected to both switches under test to generate traffic. Engineers recorded the speed and the duplex setting reported by each device in the test and then verified that the reported speed and duplex type were correct by generating a 1,518-byte bidirectional stream of traffic in excess of 10 Mbps between the two devices and verified that no data was lost.

Testers measured Dynamic Link Aggregation mainly using LACP protocol, which supports the IEEE 802.3ad specification. For this round of testing, two Fast Ethernet SmartBits ports were connected to one switch under test (Switch 'A') and the other two Fast Ethernet ports connected to a second switch under test (Switch 'B'). A pair of Fast Ethernet links connected the two switches under test. Testers configured each SmartBits port to generate multiple streams with random source and destination MAC and IP addresses at the rate of 70 Mbps. Two ports of traffic from the SmartBits were directed to Switch A and two ports of the SmartBits traffic was directed to Switch B. Both switches passed the traffic across the aggregated links. As a result, 140 Mbps of traffic was transmitted from Switch A to Switch B, and 140 Mbps was

transmitted from Switch B to Switch A. (So, the total aggregate traffic was 280 Mbps. Note: the maximum aggregate full-duplex link capacity using two Fast Ethernet links is 400 Mbps). Testers considered the switches would 'pass' the test when bi-directional traffic went through the aggregated link with frame loss of ≤ 1%. Also, the aggregate link had to share traffic evenly. Otherwise, there is no true meaning of load balancing and increasing carrying capacity.

Note: The scope of the Link Aggregation test was to prove the switch capable of Link Aggregation of more than 200 Mbps of full duplex; it was not a performance test.

The Gigabit Uplink test was configured in a similar manner as link aggregation, however that test utilized a single Gigabit Ethernet link for uplink testing instead of a pair of Fast Ethernet connections.

For tests of 802.1p/Q, each switch pair under test was configured for 802.1p/Q. Engineers then generated a stream of 1,518-byte, VLAN tags (VLAN ID: 100; priority 7) destined for the remote switch's private network via a Spirent Communications SmartBits. An Acterna DominoFastEthernet Internetwork in-line analyzer validated the state of the packet upon exiting the first switch for the destined remote network. The SmartBits counted all frames

Dell, Inc.

PowerConnect 3348

Layer 2/Layer 3 Interoperability

Dell, Inc. PowerConnect3348 Product Specifications

Port Attributes
- 48 10/100BASE-T auto-sensing Fast Ethernet switching ports
- 2 10/100/1000BASE-T auto-sensing Gigabit Ethernet switching ports
- 2 SFP slots for fiber media support (Note: SFP slots are used instead of the built-in 10/100/1000BaseT ports) or 1 SFP slot with stacking support in second SFP slot
- Stacking capabilities can support up to 192 Fast Ethernet ports or up to six switches per stack
- Interchangeable stacking with PowerConnect 3324
- Auto-negotiation for speed, duplex mode and flow control
- Auto MDI/MDIX
- Port mirroring (many-to-one)
- Broadcast storm control with separate enable/disable for Unknown Unicast, Unknown Multicast and Broadcast traffic

Performance
- Switch fabric capacity: 13.6 Gbps
- Forwarding rate: 10.1 Mpps
- Up to 8,000 MAC addresses
- Store-and-forward forwarding mode

Availability
- Spanning Tree (IEEE 802.1D) and Rapid Spanning Tree (IEEE 802.1w) with Fast Link support
- External redundant power support with PowerConnect RPS-600 (sold separately)
- Three cooling fans for redundancy

VLAN
- VLAN support for tagging and port-based as per IEEE 802.1Q
- Up to 256 VLANs supported
- Dynamic VLAN with GVRP support

Quality of Service
- IEEE 802.1p tagging
- Port-based prioritization
- Four priority queues per port
- Layer 2/Layer 3/Layer 4-aware prioritization
- Adjustable Weighted-Round-Robin and strict 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 ACE's 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
- 4 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
- 1.7 in H x 17.3 in W x 13.9 in D
- 1U, rack-mounting kit included

For more information contact:
Dell, Inc.
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*

received maintaining the 802.1p/Q VLAN tags. The test was then repeated running in the reverse direction, initiating traffic from the original receiving network.

For interoperability tests of Rapid Spanning Tree, engineers configured the devices under test to have two links interconnecting the two switches (one link configured as the primary and the other as the secondary) and one workstation on each of the two vendor switches. The engineers initiated a sequence of PINGs at one-second intervals and verified both the request and the response across the same path. The active path was then failed and then the end station was monitored for the number of sequential PINGs lost before the network reconverges and the PINGs achieve success.

For Split-MLT tests, engineers configured two ports on each Nortel Passport 8600 switch for the Inter-switch Trunk between the PowerConnect 3348 and configured two other ports on each switch tested to provide the "gold standard" termination of the MLT. The PowerConnect 5224 was configured for the general Link Aggregation support and two links from the DUT cross-connected to the two Nortel Passport 8600 and the same applies to the other PowerConnect 3348. Testers verified that traffic flows across both ports to/from the DUT. The DUT must illustrate that when the single link between two switches were oversubscribed that additional traffic overflows on to one or more of the aggregated links.

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

Vendor	Product	Web address
Acterna Corp.	DominoFastEthernet	http://www.acterna.com
Acterna Corp.	DominoNAS 2.0	http://www.acterna.com
Agilent	Software Advisor	http://www.agilent.com
Spirent Communications	SMB-2000	http://www.spirentcom.com
Spirent Communications	SmartFlow 1.5	http://www.spirentcom.com
Spirent Communications	SmartWindows 7.3	http://www.spirentcom.com

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TOLLY FAIR TESTING CHARTER

For info on the Fair Testing Charter, visit: www.tolly.com/About/ftc.asp

Project Profile

Sponsor: Dell, Inc.
Document number: 203134
Product class: Layer 2/Layer 3 switches
Products under test:

- 3Com SuperStack 3 4400 SW ver. 3.12
- 3Com 4060 Switch SW ver. 3.0
- Cisco Systems Catalyst 6500 Series switch SW IOS ver. 12.1(13)E6
- Dell PowerConnect 3348 SW ver. 1.0.0.52
- Dell PowerConnect 5224 SW ver. 2.0.0.27
- Enterasys Networks Matrix N3 SW ver. 2.0.13
- Foundry Networks FastIron Edge 9604 SW ver. 3.0.01Tc3
- Nortel Networks Passport 8600 Routing Switch SW version 3.22
- Nortel Networks Passport 1424T Routing Switch SW ver. 2.1.0

Testing window: July/August 2003

For more information on this document, visit our Web site at http://www.tolly.com, send E-mail to sales@tolly.com, or call (732) 528-3300.

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