

# Dell, Inc.

## Dell PowerConnect 5324 and Dell PowerConnect 3324



### Test Summary

### Functionality Certification and Competitive Interoperability Evaluation

**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 5324, a 24-port Gigabit Ethernet switch, and the PowerConnect 3324, a 24-port Fast Ethernet switch. Tolly Group engineers put the PowerConnect switches through a battery of tests along with seven other switches from five vendors to reveal the depth of interoperability each switch provides. Tests were conducted in November 2004 at The Tolly Group's Boca Raton, FL., test facilities.

Tolly Group engineers validated five advanced LAN services/functions under The Tolly Group's Tolly Verified certification program that are essential to enterprise networks. Engineers evaluated the PowerConnect 5324 and PowerConnect 3324 for their support for auto-negotiation, 802.1 p/Q VLAN tag propagation, 802.3ad Link Aggregation, Accelerated Convergence Spanning Tree 802.1w, and Jumbo Frames. In every instance, the PowerConnect switches proved their interoperability with other switches tested.

### RESULTS

#### INTEROPERABILITY

These tests demonstrate that the Dell PowerConnect 5324 and PowerConnect 3324 offer interoperability with third-party switches for a number of advanced network services. Moreover, the Dell PowerConnect 5324 and PowerConnect 3324 switches proved their interoperability with popular switches from a veritable Who's Who of switch vendors and products: 3Com SuperStack

### Test Highlights

- Earns five Tolly Verified certifications for advanced LAN switch functions
- Achieves interoperability with 3Com, Cisco, Extreme, Foundry and HP switches when supporting advanced functions such as 802.1p/Q VLAN tag propagation, Link Aggregation and Rapid Reconfiguration of Spanning Tree
- Demonstrates support for Jumbo Frames on the PowerConnect 5324 with other devices tested

#### Tolly Verified Interoperability Certifications Earned - PowerConnect 5324

		3Com Super-Stack 3 Switch 3870	HP ProCurve Switch 2848	HP ProCurve Switch 5308xl-48G	Foundry FastIron Edge Switch FES-X424-PREM	Foundry BigIron M8	Dell PowerConnect 3324	Extreme BlackDiamond 10k	Cisco Catalyst 6509 Switch
TV Number	TV Name	Result							
10600	10/100/1000 Auto-Negotiation	✓	✓	✓	✓	✓	✓	✓	✓
10601	802.1p/Q VLAN Tag Propagation	✓	✓	✓	✓	✓	✓	✓	✓
10602	Link Aggregation (IEEE 802.3ad)	✓	✓	See <sup>1</sup> Note	✓	✓	✓	✓	✓
10603	Accelerated Convergence Spanning Tree 802.1w	✓	✓	✓	✓	✓	✓	✓	✓
10614	Jumbo Frame Support - 9K	✓	✓	See <sup>2</sup> Note	✓	✓	✓	✓	✓

<sup>1</sup> HP did not submit the ProCurve 5308xl for the Link Aggregation test.  
<sup>2</sup> Not tested. HP does not offer Jumbo Frames Support on this model.

Source: The Tolly Group, November 2004

Figure 1

3, Cisco Systems Catalyst, Extreme Networks BlackDiamond, Foundry Networks FastIron and BigIron MG8, and HP ProCurve models.

**AUTO-NEGOTIATION**

The Dell PowerConnect 5324 and PowerConnect 3324 interoperated with all eight other switches tested. Devices earning this certification have demonstrated the ability to establish the highest available speed and duplex settings in all possible vendor combinations.

**802.1P/Q VLAN TAG PROPAGATION**

The Dell PowerConnect 5324 and PowerConnect 3324 interoperated with all eight other switches tested. Devices earning this certification have demonstrated the ability to maintain and recognize 802.1p/Q tags across all vendor combinations tested.

**LINK AGGREGATION 802.3AD**

The Dell PowerConnect 5324 and PowerConnect 3324 interoperated with seven

**Tolly Verified Interoperability Certifications Earned - PowerConnect 3324**

TV Number	TV Name	Result							
		3Com SuperStack 3 Switch 3870	HP ProCurve Switch 2848	HP ProCurve Switch 5308xl-48G	Foundry FastIron Edge Switch FES-X424-PREIM	Foundry BigIron MG8	Dell PowerConnect 5324	Extreme BlackDiamond 10k	Cisco Catalyst 6509 Switch
10600	10/100/1000 Auto-Negotiation	✓	✓	✓	✓	✓	✓	✓	✓
10601	802.1p/Q VLAN Tag Propagation	✓	✓	✓	✓	✓	✓	✓	✓
10602	Link Aggregation (IEEE 802.3ad)	✓	✓	See <sup>1</sup> Note	✓	✓	✓	✓	✓
10603	Accelerated Convergence Spanning Tree 802.1w	✓	✓	✓	✓	✓	✓	✓	✓

<sup>1</sup> HP did not submit the ProCurve 5308xl for the Link Aggregation test.

Source: The Tolly Group, November 2004

Figure 2

**Dell, Inc.  
PowerConnect 3324  
Product Specifications\***

**Port attributes**

- 24 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 perswitch 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

**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

## Tolly Verified Interoperability Certifications Earned - Dell PowerConnect 5324 and PowerConnect 3324

Certification ID	Certification	Category
10600	Auto-Negotiation	Switch Interoperability 2003/2004
10601	802.1 p/Q VLAN Tag Propagation	Switch Interoperability 2003/2004
10602	Link Aggregation 802.3ad	Switch Interoperability 2003/2004
10603	Accelerated Convergence Spanning Tree 802.1w	Switch Interoperability 2003/2004
10614	Jumbo Frame Support <sup>1</sup>	Switch Interoperability 2003/2004

<sup>1</sup> Dell switches only applicable to PowerConnect 5324

Source: The Tolly Group, November 2004

Figure 3

other switches tested. Devices earning this certification have demonstrated the ability to trunk ports and appropriately forward traffic across all possible vendor combinations.

### ACCELERATED CONVERGENCE SPANNING TREE 802.1W

The Dell PowerConnect 5324 and PowerConnect 3324 interoperated with all eight other switches tested. Devices earning this certification have demonstrated the ability to converge and recover failed links using the 802.1w protocol with all possible vendor combinations.

### JUMBO FRAMES SUPPORT

The Dell PowerConnect 5324 interoperated with all of the devices tested. The Dell PowerConnect 3324 and the HP ProCurve 5308xl were not subjected to the Jumbo Frames test. Devices earning this certification have demonstrated interoperability transmitting Jumbo Frames across all possible vendor combinations.

### ANALYSIS

The Dell PowerConnect 5324 and PowerConnect 3324 address the growing market momentum of Gigabit Ethernet-to-the-desktop for workgroup switching.

The Dell switches tested proved that they are interoperable with popular third-party router brands for a diverse set of router

functions that include advanced services such as Rapid Reconfiguration Spanning Tree support, Jumbo Frames and 802.1p/Q VLAN tag propagation. This demonstration of versatile interoperability should put prospective users at ease regarding the decision to deploy PowerConnect switches in a multivendor network.

Moreover, interoperability with a diverse set of routers means the Dell PowerConnect 5324 and PowerConnect 3324 can be relied upon for inter-switch communications, or for acting upon as an aggregator of other switches. Interoperability support for advanced LAN services tested makes the PowerConnect 5324 and PowerConnect 3324 ideal for Gigabit Ethernet server or workstation connectivity, network traffic aggregation and datacenter connectivity.

### TEST CONFIGURATION AND METHODOLOGY

For tests, The Tolly Group tested a 24-port (10/100/1000BaseT auto-sensing Gigabit Ethernet switching ports) PowerConnect 5324, software version 1.1.0.45, configured with 64 Mbytes of RAM and 16 Mbytes of flash memory. The PowerConnect 5324 came with four combo SFP slots for fiber media support.

Engineers also tested a 24-port (10/100-BASE-T auto-sensing Fast Ethernet switching ports) Dell PowerConnect 3324, software version 1.1.0.42, configured with 32 Mbytes of SDRAM. The PowerConnect 3324 also came configured with two 10/100/

Dell, Inc.

**PowerConnect  
5324 and  
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3324**



**Interoperability and Functionality**

**Dell, Inc.  
PowerConnect 5324  
Product Specifications\***

#### Port attributes

- 24 10/100/1000BaseT auto-sensing Gigabit Ethernet switching ports
- Four combo SFP slots for fiber media support
- Advanced cable and fiber diagnostics for troubleshooting

#### VLAN

- Up to 256 VLANs
- Protocol-based VLANs
- Dynamic VLAN with GVRP

#### Availability

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

#### Quality of Service

- IEEE 802.1p tagging (L2/L3-aware)
- Adjustable Weighted-Round-Robin (WRR) and strict queue scheduling

#### Multicast

- IGMP snooping for IP Multicast Support
- Static IP multicast

#### Security

- Port-based security via IEEE 802.1x
- Port-based MAC Address alert and lock-down
- RADIUS and TACACS+ support for switch management access
- SSL/SSH encryption for switch management traffic

#### Other switching

- Link Aggregation with support for up to eight aggregated links per switch and up to eight ports per aggregated link (IEEE 802.3ad)
- Jumbo frame support for frames up to 10k bytes

#### Management

- Web-based management interface and industry standard CLI
- Statistics for error monitoring and performance optimization
- BootP/DHCP IP address management
- Syslog remote logging
- SNMP, Traceroute, Telnet client and DNS

#### For more information contact:

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1000BASE-T auto-sensing Gigabit Ethernet switching ports and two 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 the second SFP slot.)

For interoperability tests, Tolly Group engineers tested the Dell PowerConnect 5324 and PowerConnect 3324 against seven other switches: 3Com SuperStack 3 Switch 3870 (SW version 2.01.00.19), Cisco Catalyst 6509 (software version 12.2(17d)SXB1), Extreme networks BlackDiamond 10808 (software version 11.1.0.24), Foundry Networks BigIron MG8 (software version 2.0.2T117), Foundry Networks FastIron Edge Switch FESX424-PREM (software version 02.0.00Te3), and Hewlett-Packard ProCurve 2848 (software version I.08.54) and ProCurve Switch 5308xl-48G (software version E.08.52).

Each test had a dedicated test-bed setup. For instance, for testing TV#10603 – Accelerated Convergence Spanning Tree 802.1w, the two ports each on the participating switches were configured for Accelerated Convergence Spanning Tree 802.1w support. The two pairs of ports on the two switches were connected through 10/100/1000 Ethernet links. An end-station was connected to each switch. Each end-station initiated a train of ICMP PING requests to the end-station connected to the other switch. The engineers made sure that the two switches could successfully PING each other. One of the links configured between the two switches was removed, and it was verified if the switches failed-over the ICMP PING traffic to the second link within less than three to five seconds.

Full details of the various interoperability tests conducted can be found at [http://www.tolly.com/TV/TV\\_home.aspx](http://www.tolly.com/TV/TV_home.aspx).

## RELATED TESTS

In July 2004, The Tolly Group published Test Summary Document 204140, a Layer 2 Gigabit Ethernet switch evaluation of the Dell PowerConnect 5324. In that document, The Tolly Group chronicled the Layer 2, zero-loss, wire-speed throughput of the switch, and documented more than a dozen Tolly Verified certifications earned by the PowerConnect 5324. Engineers also validated the Quality of Service attributes of the switch and its beneficial impact on voice quality during periods of congestion. That document is available online for viewing at <http://www.tolly.com/TVDetail.aspx?ProductID=147>.



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

Vendor	Product	Web address
Spirent Communications	SmartWindow ver 8.0.162	<a href="http://www.spirentcom.com">http://www.spirentcom.com</a>

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## PROJECT PROFILE

**Sponsor:** Dell, Inc.

**Document number:** 204156

**Product class:** LAN switch

**Products under test:**

- 3Com SuperStack 3 Switch 3870 (SW version 2.01.00.19)
- Cisco Catalyst 6509(SW version 12.2(17d)SXB1)
- Dell PowerConnect 3324 (SW version 1.1.0.42)
- Dell PowerConnect 5324 (SW version 1.1.0.45)
- Extreme Networks BlackDiamond 10808 (SW version 11.1.0.24)
- Foundry Networks BigIron MG8 (SW version 2.0.2T117)
- Foundry Networks FastIron Edge Switch FES-X424-PREM (SW version 02.0.00Te3)
- Hewlett-Packard ProCurve 2848 (SW version I.08.54)
- HP ProCurve Switch 5308xl-48G (SW version E.08.52)

**Testing window:** November 2004

**Software status:** Generally available

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