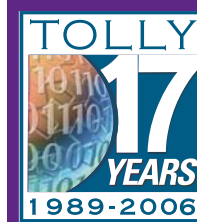


Dell Inc. PowerConnect 3424P

"Tolly Verified" Layer 2 Fast Ethernet Switch Evaluation



Test
Summary

Premise: Layer 2 switches used in network infrastructures must possess wire-speed performance to handle a variety of 'real-world' traffic scenarios, offer a secure platform, high-availability features, and possess the capability to support real-time and non-real-time traffic to be truly effective in passing traffic into the network core. When considering the purchase of such devices, network architects and managers would want verification of key features.

Dell Inc. commissioned The Tolly Group to evaluate its PowerConnect 3424P, a 24-port Fast Ethernet switch designed for use in a wide array of network infrastructure environments. The PowerConnect 3424P is equipped with a variety of switching features with two copper GbE ports and two optional fiber GbE ports via SFP transceivers. It also supports the IEEE 802.3af standard for Power over Ethernet.

Tolly Group engineers subjected the PowerConnect 3424P to a battery of tests designed to verify the key features of this device. Tests were conducted in February 2006.

Tests show that the PowerConnect 3424P performs at wire-speed at Layer 2 with its 24 Fast Ethernet ports and four GbE ports in a full-mesh port configuration for all frame sizes tested, which varied from 64 bytes through 1,518 bytes. Tolly Group engineers also validated more than a dozen key switch functions essential to LAN switches under The Tolly Group's Tolly Verified certification program. These features include support for the IEEE 802.3af standard, as well as legacy mode Power over Ethernet (PoE), link aggregation (802.3ad), VLAN support (802.1Q), prioritization tagging (802.1p), Rapid Reconfiguration of Spanning Tree support (802.1w), IGMP snooping, and support for IEEE 802.1x and RADIUS protocols for advanced user authentication mechanisms – to name just a few. (A complete assortment of the Tolly Verified certifications earned can be found below in the Results section.)

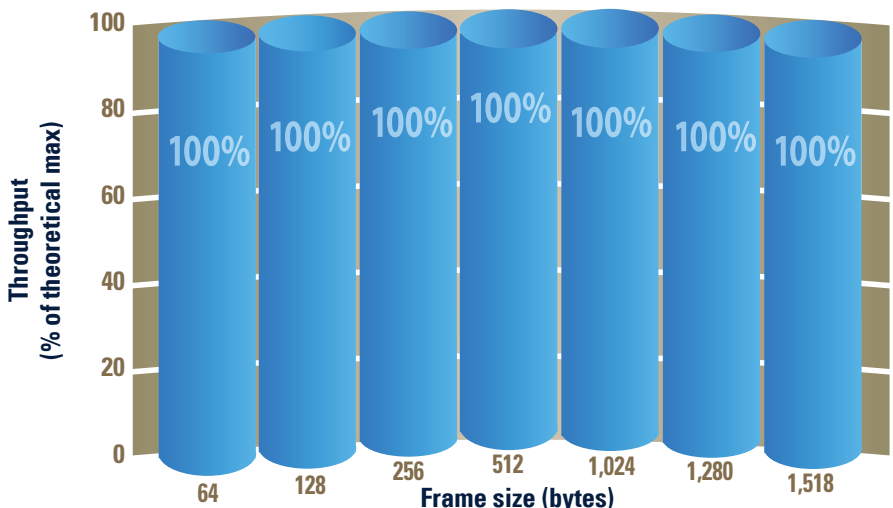
RESULTS

LAYER 2 WIRE-SPEED FAST
ETHERNET THROUGHPUT – ALL
PORTS, TOLLY VERIFIED 10528

Test Highlights

- Delivers wire-speed Layer 2 throughput for all frames sizes tested
- Provides Power over Ethernet (PoE) to powered devices such as wireless access points, IP telephones, etc.
- Supports advanced authentication methods using RADIUS and IEEE 802.1x protocols
- Supports high-quality voice transport
- Supports IEEE 802.3ad standard for forwarding traffic across multiple aggregated links
- Reconfigures Layer 2 Spanning Tree using "Rapid" Spanning Tree protocol
- Distinguishes and prioritizes traffic correctly based on IEEE 802.1p standard
- Appropriately tags and distinguishes traffic between multiple VLANs

Dell PowerConnect 3424P
Layer 2 Aggregate Zero-Loss Throughput ($\leq 0.001\%$ Frame Loss)
across 24 Fast Ethernet Ports and 4 GbE ports
as Reported by Spirent SmartFlow 4.6



Source: The Tolly Group, February 2006

Figure 1

This certification verifies the backplane capacity of the switch. Specifically, that it can deliver wire-speed throughput or 100% of the theoretical maximum throughput for a standard set of frame sizes including the minimum and maximum allowable frame sizes with the 24 Fast Ethernet ports and the four GbE ports active (See Test Methodology section for more details on port configuration). Tolly Group engineers measured the Layer 2 throughput of the PowerConnect 3424P using standard frame sizes ranging from 64 bytes to 1,518 bytes. (See Figure 1.)

**VOIP CAPABLE
INFRASTRUCTURE (QoS), TOLLY
VERIFIED 10501**

This certification verifies that the DUT's QoS mechanisms can adequately support latency-sensitive applications such as voice in a congested environment by providing sufficiently low latency, as well as produce voice quality scores that are deemed toll quality.

Tests using the Perceptual Evaluation of Speech Quality (PESQ) metric indicate that the DUT offered toll quality voice (any PESQ score greater than 3.8 is considered toll quality). With no QoS active and congestion taxing the switch the score dropped well below toll quality, but bounced right back to toll quality once QoS was activated.

**RAPID RECONFIGURATION
SPANNING TREE SUPPORT
(802.1W), TOLLY VERIFIED 10507**

This certification verifies that the DUT detects endpoints and forwards traffic utilizing the Rapid Spanning Tree protocol. This feature of the switch provides rapid network recovery should the primary link path fail, thus providing high-availability.

**LINK AGGREGATION (IEEE
802.3AD), TOLLY VERIFIED 10511**

This certification verifies that the DUT implements standards-based link aggregation, thus providing the ability to increase the switch-to-switch throughput by aggregating multiple physical links into one logical interface.

**PORT MIRRORING, TOLLY
VERIFIED 10515**

This certification verifies that the DUT can duplicate the traffic associated with a given port to another port on the DUT.

**VLAN SUPPORT (IEEE 802.1Q),
TOLLY VERIFIED 10532**

This certification verifies that the DUT segments traffic into Virtual LANs

Dell PowerConnect 3424P Tolly Verified Certifications Earned		
Certification ID	Certification	Category
10832	Tolly Power over Ethernet (Hybrid) 2006	Power over Ethernet
10501	VoIP Capable Infrastructure	LAN Switch Core
10507	Rapid Reconfiguration Spanning Tree Support (IEEE 802.1w)	LAN Switch Core
10511	Link Aggregation (IEEE 802.3ad)	LAN Switch Core
10515	Port Mirroring	LAN Switch Core
10528	Layer 2 Wire Speed Fast Ethernet – All Ports (Fixed Configuration Switch)	LAN Switch Core
10532	VLAN Support (IEEE 802.1Q)	LAN Switch Core
10533	QoS (IEEE 802.1p)	LAN Switch Core
10537	Port Access Authorization via MAC Address	LAN Switch Core
10786	IGMP Snooping	LAN Switch Core
10636	Embedded Web Management via Secure Sockets Layer (SSL) or Transport Layer Security (TLS)	System Management
10536	Management Access Authentication via RADIUS	System Security and User Management
10559	User Authentication via IEEE 802.1x	System Security and User Management
10575	Secure Shell (SSH) Remote Access	System Security and User Management

Source: The Tolly Group, February 2006 Figure 2

(VLANs) appropriately according to the IEEE 802.1Q protocol.

**QoS RECOGNITION (IEEE 802.1P)
TOLLY VERIFIED 10533**

The PowerConnect 3424P passed this certification that verifies a device's ability to distinguish and prioritize traffic based on the 802.1p Quality of Service standard. For verification purposes a given DUT must be able to differentiate between two streams that are "tagged" with different priorities according to this standard. Traffic is forwarded exercising both queues. During over subscription traffic tagged as "high" priority should receive preferential treatment (i.e. more bandwidth).

**PORT ACCESS AUTHORIZATION
VIA MAC ADDRESS, TOLLY
VERIFIED 10537**

This certification verifies that the DUT provides functionality that allows net-

work managers to limit client port access to stations that have specific Layer 2 MAC addresses.

**IGMP SNOOPING, TOLLY
VERIFIED 10786**

This certification verifies that the DUT operating at Layer 2 can successfully "listen in" on IGMP conversations between hosts and routers and can make intelligent multicast forwarding decisions by examining the contents of each frame's Layer 3 IP header.

**EMBEDDED WEB MANAGEMENT
VIA SSL OR TLS, TOLLY
VERIFIED 10636**

This certification verifies that the DUT provides comprehensive Web-based management features via Secure Sockets Layer (SSL) and/or Transport Layer Security (TLS) encryption.

MANAGEMENT ACCESS AUTHENTICATION VIA RADIUS, TOLLY VERIFIED 10536

This certification verifies that the DUT provides functionality that allows network managers to limit management access to users that complete authentication with a backend RADIUS server with which the device under test communicates.

USER AUTHENTICATION VIA IEEE 802.1x, TOLLY VERIFIED 10559

This certification verifies that the DUT is capable of implementing 802.1x protocol to authenticate a client station. Tolly Group engineers used a RADIUS server for authentication process as per the IEEE 802.1x specification.

SECURE SHELL (SSH) REMOTE ACCESS, TOLLY VERIFIED 10575

This certification verifies that the DUT demonstrates support for Secure Shell connections, thus offering the ability to encrypt management traffic from remote locations.

(For a complete list of Tolly Verified certifications, see Figure 2.)

TOLLY POWER OVER ETHERNET (HYBRID) 2006, TOLLY VERIFIED 10832

The certification establishes that the DUT, acting as a Power Sourcing Equipment (PSE), supports both IEEE 802.3af and Power over Ethernet legacy mode standards. The PSE complies with all the mandatory parameters set forth in the IEEE 802.3af standard, except for the output voltage and current specifications at short circuit condition¹ and two timer parameters (T_{lim} and T_{ovia}) which are affected by the legacy mode for some implementations. These timer parameters do not affect interoperability.

TEST CONFIGURATION AND METHODOLOGY

For performance tests, The Tolly Group tested a Dell Inc. PowerConnect 3424P, hardware version 0.0.2 running software version 1.0.0.45. The PowerConnect 3424P was configured with 24 Fast Ethernet ports, two Copper GbE ports and two optional 'Fiber GbE via SFP' transceivers.

For testing the Power over Ethernet support by the DUT acting as a Power Sourcing Equipment (PSE), engineers

¹ See <http://www.tolly.com/TVProgDetail.aspx?ProgID=10832> for more details on this certification.

employed a Sifos Technologies PowerSync Analyzer PoE test tool connected to one of the ports on the DUT, and ran an 802.3af conformance test to validate compliance with the IEEE 802.3af parameters. Engineers tested the PowerConnect 3424P for 40 of the most important parameters specified in the standard. For detailed information of the parameters tested, please contact The Tolly Group.

For Layer 2 testing, engineers configured a test bed in which all 24 Fast Ethernet ports, two copper GbE ports and two fiber SFP-based GbE ports were used. In addition, 20 Fast Ethernet ports were connected to the two copper GbE ports such that a set of 10 Fast Ethernet ports were destined to each copper GbE port, and the remaining four Fast Ethernet ports were destined for each other in a full-mesh configuration. The two SFP-based fiber GbE ports were configured in a port-to-port connection. The traffic flows were configured to be bidirectional so that each port sent and received traffic at the same time. For bidirectional steady state, zero-loss ($\leq 0.001\%$) throughput tests of 64, 128, 256, 512, 1,024, 1,280 and 1,518-byte frames, engineers used SmartBits to generate Layer 2 traffic in the configuration described above with an initial load of 100%. (See Figure 3.)

For the VoIP Quality Infrastructure support (TV # 10501) test, the DUT was connected to an Agilent Voice Quality Tester (VQT) and two VoIP phones that communicated across the DUT with the VQT measuring the voice quality in terms of the PESQ metric. Engineers measured the baseline voice quality and one-way delay using an Agilent Voice Quality Tester connected to VoIP phone handsets and communicating across the device under test with no other traffic present. With QoS on the DUT disabled, they re-ran the baseline while simultaneously generating line-rate traffic destined for the same output port. Engineers verified whether the voice quality suffered and/or the call was dropped. The test was repeated with QoS enabled on the DUT, with line-rate traffic destined to the same output port. The PESQ score was measured to verify if the voice quality improved in presence of QoS when the communication link was oversubscribed.

Full test methodology details of the various Tolly Verified certifications earned by the PowerConnect 3424P can be found at http://www.tolly.com/TV/TV_home.aspx.

Dell Inc.

PowerConnect 3424P

'Tolly Verified' Layer 2

Performance & Functionality



Dell Inc. PowerConnect 3424P Product Specifications*

Port Attributes

- 24 10/100BASE-T auto-sensing Fast Ethernet switching ports
- 2 copper GbE ports
- 2 fiber GbE SFP slots
- Integrated resilient stacking
- Port mirroring
- Broadcast storm control
- Power-Over-Ethernet supported across all 24 ports without additional hardware

Availability

- Spanning Tree (IEEE 802.1D) and Rapid Spanning Tree (IEEE 802.1w)
- Multiple Spanning Trees (IEEE 802.1s)
- Virtual Cable Tester provided by Marvell™ for cable diagnostics
- Optical transceiver diagnostics

VLAN

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

Quality of Service

- Layer 2/3 QoS
- 4 priority queues per port
- IGMP snooping for IP Multicast Support

Security

- IEEE 802.1x based edge authentication
- IP Address filtering for management access
- RADIUS and TACACS+ remote authentication for switch management access
- SSLv3 and SSHv2 encryption for switch management traffic
- Private VLANs

Other Switching

- Link aggregation
- LACP support (IEEE 802.3ad)

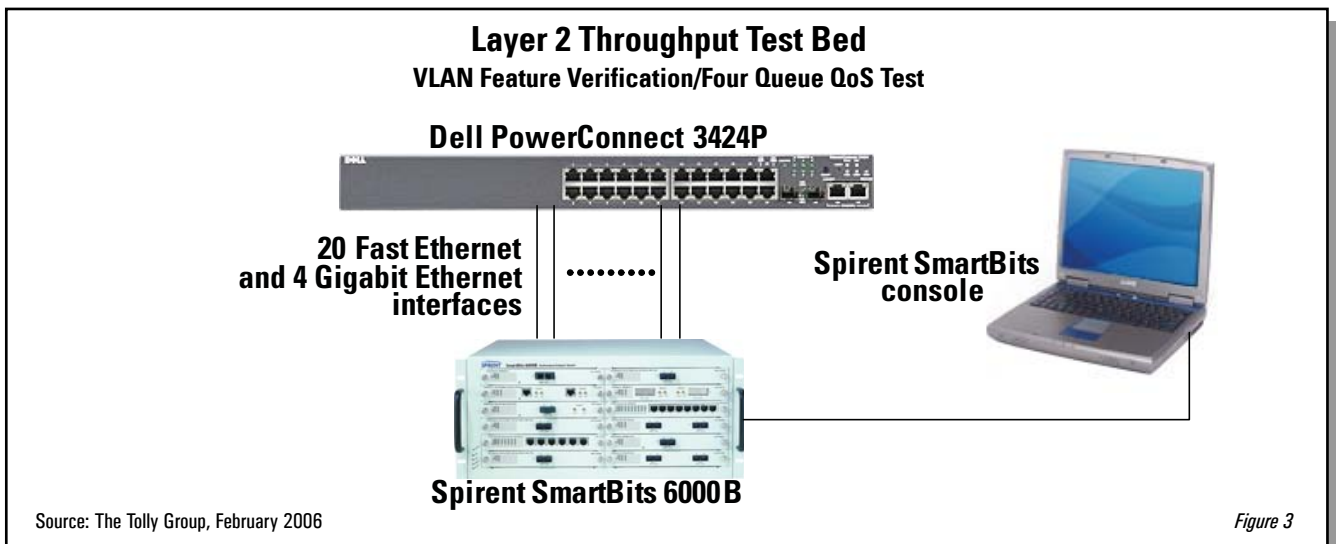
Management

- Web-based management interface
- Industry-standard CLI
- SNMPv1, SNMPv2c and SNMPv3
- 4 RMON groups
- Statistics
- BootP/DHCP IP address management
- Syslog remote logging
- Temperature sensors

For more information contact:

Dell Inc.
Round Rock, TX 78682
Phone: 1-800-BUY-DELL (1-800-289-3355)
URL: <http://www.dell.com/powerconnect>

* Vendor-supplied information not verified by
The Tolly Group



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

Vendor	Product	Web address
Agilent Technologies	Voice Quality Tester	http://www.agilent.com
Sifos Technologies, Inc.	PSE 802.3af Conformance Test Suite	http://www.sifos.com
Sifos Technologies, Inc.	PowerSync Analyzer (PSA-1200)	http://www.sifos.com
Spirent Communications	SmartBits 6000B	http://www.spirentcom.com
Spirent Communications	SmartFlow Version 4.6	http://www.spirentcom.com
Spirent Communications	SmartWindow Version 8.0	http://www.spirentcom.com



TERMS OF USAGE

USE THIS DOCUMENT ONLY IF YOU AGREE TO THE TERMS LISTED HEREIN.

This document is provided, free-of-charge, to help you understand whether a given product, technology or service merits additional investigation for your particular needs. Any decision to purchase must be based on your own assessment of suitability.

This evaluation was focused on illustrating specific features and/or performance of the product(s) and was conducted under controlled, laboratory conditions and certain tests may have been tailored to reflect performance under ideal conditions; performance may vary under real-world conditions. Users should run tests based on their own real-world scenarios to validate performance for their own networks.

Commercially reasonable efforts were made to ensure the accuracy of the data contained herein but errors and/or oversights can occur.

The test/audit documented herein may also rely on various test tools the accuracy of which is beyond our control. Furthermore, the document relies on certain representations by the sponsor that are beyond our control to verify. Among these is that the software/hardware tested is production or production track and is, or will be, available in equivalent or better form to commercial customers.

The Tolly Group provides a fee-based service to assist users in understanding the applicability of a given test scenario to their specific needs. Contact us for information.

When foreign translations exist, the English document is considered authoritative. To assure accuracy, only use documents downloaded directly from The Tolly Group's Web site.

PROJECT PROFILE

Sponsor: Dell Inc.

Document number: 206135

Product class: Fast Ethernet Switch

Products under test:

- PowerConnect 3424P HW Version 0.0.2

Testing window: February 2006

Software versions tested:

- SW 1.0.0.45

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 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 networking 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. 206135 rev. clk 08 May 06