THE TOLLY GROUP

No. 204123 April 2004

Extreme Networks, Inc.

Summit 400

Layer 2/Layer 3 Switch Performance Testing and "Tolly Verified" Functionality Evaluation

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Test Summary

Premise: *High-density Gigabit Ethernet edge switches must exhibit wire-speed performance as well as offer 10-Gigabit Ethernet uplinks to assure high performance interaction with the network core. Furthermore, such devices should offer a rich suite of traffic management, security and system management features.*

Extreme Networks Inc. commissioned The Tolly Group to evaluate its Summit 400-48t, a 48-port Gigabit Ethernet Layer 2 and Layer 3 switch designed for use as an enterprise-class edge switch to connect Gigabit Ethernet-attached desktops. The Summit 400-48t is a fixed-port model that supports two optional 10-Gigabit Ethernet uplinks, an optional redundant power supply, and an array of software features that make it suitable as an intelligent edge switch.

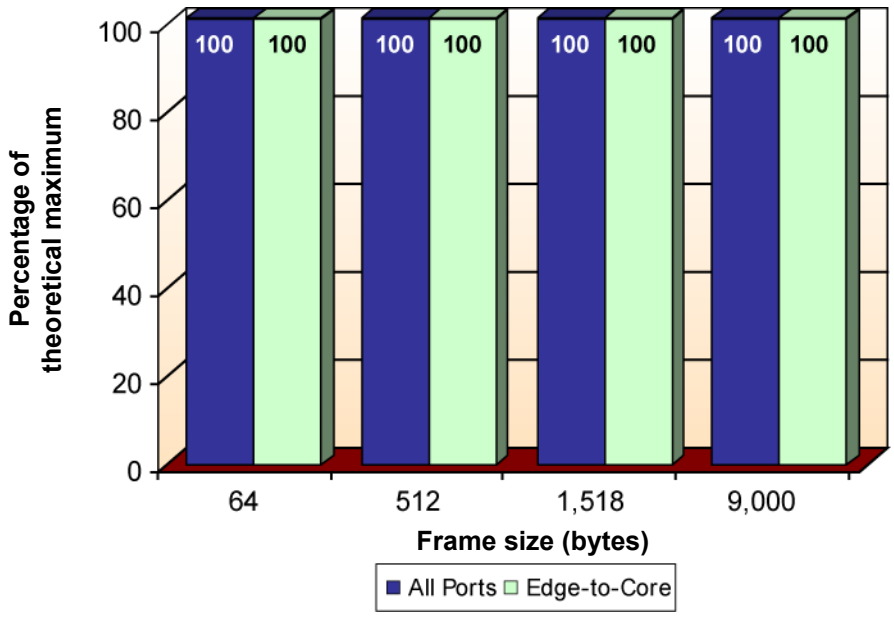
The Tolly Group tested the Layer 2/Layer 3 throughput capability of the Summit 400 in two different port-pairing configurations, while it was subjected to standard fixed packet sizes. Additionally, engineers certified nearly 30 separate features defined by The Tolly Group's "Tolly Verified" vendor-neutral certification program. Tests were conducted in March 2004.

Tests show that the Summit 400 delivers wire-speed throughput at Layer 2/Layer 3 and can process in excess of 100 million 64-byte packets per second at Layer 2/Layer 3. In an "Edge-to-Core" scenario that exercised the switches two 10-Gigabit Ethernet uplinks, the switch performed at wire speed delivering 40 Gbps of throughput across the 10-Gigabit Ethernet uplinks. Tolly Verified tests, detailed below, illustrated substantial capabilities in the areas of QoS, security, and user management/system management.

Test Highlights

- Delivers system throughput of 101 million pps and 68 Gbps
- Achieves wire-speed, 40 Gbps in "Edge-to-Core" test using 10-Gigabit Ethernet uplinks
- Offers advanced QoS features such as eight traffic queues and per-port rate limiting
- Provides sophisticated user management and security features
- Provides robust hardware and software redundancy features, including RSTP, link aggregation and redundant power supply

Layer 2/Layer 3 Gigabit-10 GbE Ethernet Throughput:
All Ports Paired and Edge-to-Core Tests[1]



[1] Results are for two test scenarios: In the first scenario, all ports transmitted data at Layer 2/Layer 3 for an aggregate of 68 Gbps, while the second scenario represented Layer 2/Layer 3 uplink throughput from the network edge to the core switch, with 40 Gbps traversing the links.

Source: The Tolly Group, March 2004 *Figure 1*

Results

Layer 2/Layer 3 Gigabit Ethernet/10-Gigabit Ethernet Aggregate Throughput

Two sets of performance tests were executed. The first consisted of "paired-port[1]" bidirectional traffic among all 48 Gigabit Ethernet ports and between the two 10-Gigabit Ethernet ports. Layer 2/Layer 3, zero-loss throughput tests were run using streams of 64-, 128-, 256-, 512-. 1,024, 1,518-byte and 9,000-byte frames. The Summit 400 exhibited Layer 2/Layer 3 wire-speed performance at all frame sizes. Aggregate frame throughput for 64-byte frames was 101,190,474 packets per second – or 101 Mpps.

To illustrate that the 10-Gigabit Ethernet uplinks could deliver full bandwidth in an edge-to-core configuration, 10 (ten) Gigabit Ethernet ports were paired with each 10-Gigabit Ethernet port to illustrate a full flow of traffic to and from the core of the network via the uplinks. Using the same frame sizes as the previous test, the Summit 400 once again delivered wire-speed throughput at all frame sizes tested. In this case wire-speed was 40 Gbps (i.e.,the maximum rate for two, full-duplex 10-Gigabit Ethernet connections). Figure 1 summarizes the results of the tests using three frame sizes across the range from smallest to largest.

Tolly Verified Certifications

Close to 30 certifications were awarded to the Summit 400 during this test together with at least five "firsts," including per-port rate limiting, as well as several related to 802.1X and user authentication. Figures 2 and 3 list the specific certifications for which additional information is available on the Web, and the following analysis points out key attributes of the tests.

[1] Port 1 to port 2, port 3 to port 4, etc.

Tolly Verified Certifications Earned

Certification ID	Certification	Category
10501	Voice Capable Infrastructure (QoS)	LAN Switch Core
10587	QoS - Eight Traffic Queues	LAN Switch Core
10534	Rate Limiting Per Port	LAN Switch Core
10533	Quality-of-Service Feature Verification	LAN Switch Core
10532	VLAN Feature Verification (802.1Q)	LAN Switch Core
10503	Jumbo Frames Support - 9K	LAN Switch Core
10583	User Authentication via Layer 3 (IP) based Access Control List	LAN Switch Core
10584	User authentication via Layer 4 (TCP/UDP) based Access Control List	LAN Switch Core
10529	Access Control List (ACL) Functionality Bound to Specified VLAN	LAN Switch Core
10507	Rapid Reconfiguration Spanning Tree Support (802.1w)	LAN Switch Core
10511	Link Aggregation (IEEE 802.3ad)	LAN Switch Core
10515	Port Mirroring	LAN Switch Core
10514	Auto MDI/MDIX	LAN Switch Core
10516	Redundant Power Supply	High-Availability Core
10572	Embedded Web Management	System Management
10502	Non-Destructive Code Upgrade	System Management
10518	Dual Firmware Images	System Management
10519	Dual Configuration Images	System Management
10555	System Upgrade via Trivial File Transfer Program	System Management
10513	10/100/1000 Mbps Auto Negotiation	LAN Connectivity

For detailed descriptions of any of these certifications, visit www.tolly.com

Source: The Tolly Group, March 2004 *Figure 2*

Tolly Verified Certifications Earned For System Security and User Management

Certification ID	Certification
10535	**Management Access Authentication via IP Access Control Lists**
10536	**Management Access Authentication via RADIUS**
10575	**Secure Shell (SSH) remote access**
10559	**User Authentication via IEEE 802.1X**
10746	**802.1X - Single port, "Per-MAC" Authentication**
10747	**Dynamic VLAN Assignment after Authentication**
10748	**Web Browser-based Authentication**
10749	**URL "Hijacking"**
10750	**URL Automatic Redirect after Authentication**

For detailed descriptions of any of these certifications, visit www.tolly.com

Source: The Tolly Group, March 2004 *Figure 3*

VoIP, VLAN and QoS-related Certifications

The Summit 400 not only demonstrated core support for both VLANs and QoS, but advanced traffic shaping as well. (See Figure 2.) Passing TV 10501, the Summit 400 illustrates that even in the face of massive oversubscription, that voice quality can be maintained. The Summit 400 is able to provision eight traffic queues (TV 10587) to provide for very granular control over multiple types of traffic. With per-port rate limiting (TV 10534), the Summit 400 illustrates that traffic flows can be tuned further by creating "logical pipes" of bandwidth per traffic classification rather than being able to provision only at the 10/100/1000 port level. With Jumbo Frames support (TV 10503), the Summit 400 shows that it can provide more efficient file throughput, a QoS of sorts, for high-volume data streams found in the high-performance cluster computing networks (HPCC).

Availability & System Management

The Summit 400 is equipped with key availability hardware and software. The Summit 400's Rapid Reconfiguration Spanning Tree (TV 10507) provides for rapid network recovery should the primary link path fail. In addition, its support for Link Aggregation (TV 10511) provides not only additional, incremental capacity between switches, but also an active-active redundant link. This feature, thus, aids in both performance and availability. The Summit 400's Auto MDI/MDIX (TV 10514) covers the device's ability to change the polarity on the copper connection automatically thus making the choice of straight-through or cross-over cables for connections irrelevant (as either will work for any copper port). The Summit 400's port mirroring (TV 10515) is essential for low level, "sniffer" troubleshooting of the network and its optional redundant power supply (TV 10516) can eliminate the power supply as a possible cause of downtime.

System Security and User Management

Figure 3 lists the Tolly Verified certifications for the Summit 400 specific to this area. While several security and user management certifications are self-explanatory, it is important to note the granular level of support for user authentication. Not only can the Summit 400 support new clients, like Windows XP that contain the client-side code for IEEE 802.1X authentication (TV 10559), but it's integrated Web browser-based support (TV 10748) allows it to deliver advanced authentication services to back-level and non-Microsoft clients as well.

With 802.1X – single port, "per MAC" authentication (TV 10746), the Summit 400 can maintain per-station authentication on a single port, effectively allowing its authentication process to function with "N" downstream clients. (Note: The current TV certification only requires proof of handling two separate MACs per port.)

The Summit 400's Dynamic VLAN assignment (TV 10747) provides a useful level of flexibility that allows a given port to be re-assigned dynamically to a particular VLAN as part of the authentication process.

Finally, URL "hijacking" (TV 10749) and URL automatic redirect (TV 10750) where the Summit 400 can first capture and redirect the browser stream (usually to a login or to an acceptable-use agreement page) and then, after authentication, send the user to a previously configured URL are functions likely to be very useful especially to quasi-public networks like those in hotels, libraries or universities.

Test Configuration and Methodology

For Layer 2/Layer 3 performance tests, The Tolly Group tested an Extreme Networks Summit 400-48t, which is a 48-port 10/100/1000 Gigabit Ethernet edge switch with two 10-Gigabit XENPACK uplinks

Extreme Networks, Inc.

Summit 400-48t

Layer 2/Layer 3 Performance & 'Tolly Verified' Functionality

Extreme Networks Inc.
Summit 400-48t
Product Specifications*

Feature

- Dual 10 Gigabit Ethernet uplinks
- 802.3ad Link Aggregation/Load Sharing
- 802.1D, 802.1W, EMISTP (MISTP + Extreme Extensions), PVSTP+
- 8 QoS Queues, 802.1P, and DiffServ Code Points
- Bandwidth Rate Limiting - 63 rate limiters per port
- 5520 ACLs (Layer 2/3/4 Access Control Lists)
- 4096 VLANs,
- 16,000 MAC Address Table
- RIP v1/v2
- ESRP-aware
- OSPF-edge
- OSPF Equal Cost Multipath Routing (ECMP)
- IGMP v1/v2
- IGMP Snooping
- PIM-SM-edge
- EAPS-edge
- Network Address Translation
- Extensive Security Features
  - Layer 2/3/4 Access Control Points
  - RADIUS Support
  - TACACS+ Support
  - Access-List Support
  - Network Login
  - 802.1X
  - SSH2 Server/Client
  - SCP
  - SNMPv3
  - CPU DOS Protection
- Jumbo Frames (9KB)
- Cable Diagnostics

For more information contact:
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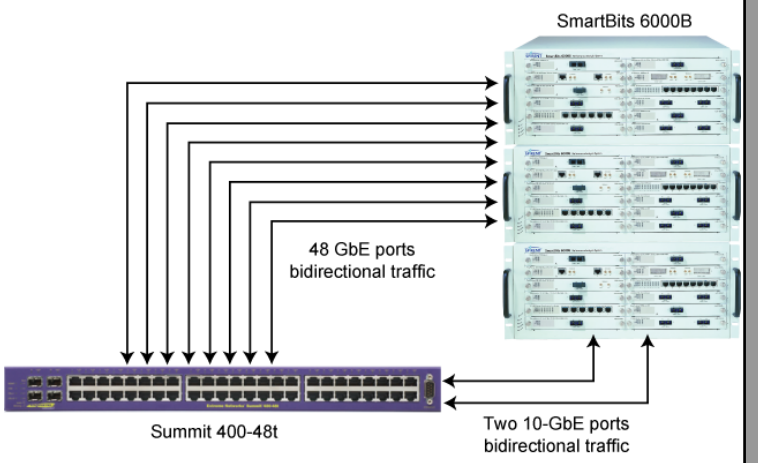
**Vendor-supplied information not verified by The Tolly Group*

Switch Throughput Test Bed (Port-Pair)



Source: The Tolly Group, March 2004 *Figure 4*

and optional EPS-160 redundant AC power supply. The device ran Extremeware version 7.2e.1b4.

For the full-system test, engineers configured a test bed in which all 48 Gigabit Ethernet ports were destined for the adjacent port (1-2, 3-4, etc) and the two 10-Gigabit Ethernet ports sent traffic between them. For the "edge-to-core" scenario, 10 (ten) Gigabit Ethernet ports were paired with each of the two 10-Gigabit Ethernet ports. For bidirectional steady state, zero-loss (≤ 0.001%) throughput tests of 64-, 128-, 256-, 512-, 1024-, 1,518- and 9,000-byte frames, engineers used SmartBits to generate Layer 2/Layer 3 traffic in the configuration described above.

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

Vendor	Product	Web address
Spirent Communications	SmartBits 6000B	http://www.spirentcom.com
Spirent Communications	SmartFlow Ver 3.00	http://www.spirentcom.com
Spirent Communications	SmartWindow Ver 7.70	http://www.spirentcom.com

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Project Profile

Sponsor: Extreme Networks, Inc.

Document number: 204123

Product class: Gigabit Ethernet Switch

Products under test:

- Extreme Networks Summit 400-48t

Testing window: March 2004

Software versions tested:

- Extremeware 7.2e.1b4

Software status: Generally available

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The Tolly Group doc. 204123 rev. clk 13 April 04