

# Force10 Networks, Inc. TeraScale E-Series E1200 Resilient Switch/Router



## Test Summary

### 10-Gigabit Ethernet and Gigabit Ethernet Zero-Loss Throughput Evaluation

***Premise:** Enterprises and service providers are faced with supporting network infrastructures in which core network or aggregation devices must act as workhorses and cannot become a bottleneck to network performance. It is imperative that such devices exhibit low latency and line-rate throughput – or as close to it as possible. Moreover, such switches or routers must be able to maintain performance even as the number of clients it supports scales significantly. And, the presence of active services, such as access control lists (ACLs) and other advanced features cannot have a deleterious effect on device performance.*

Force10 Networks, Inc. commissioned The Tolly Group to evaluate its TeraScale E-Series E1200 Resilient Switch/Router, a chassis-based system with 14 line-card slots, plus built-in redundancy and resiliency features.

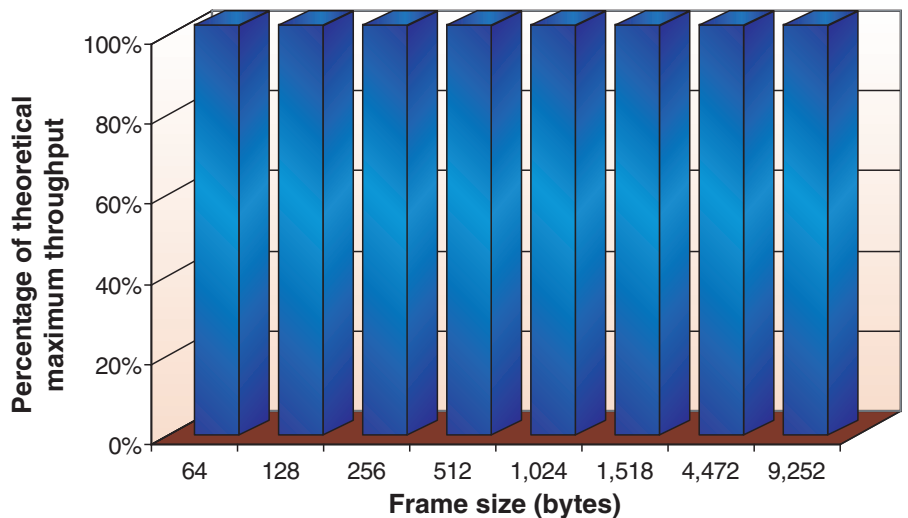
Engineers measured the zero-loss Gigabit Ethernet (GbE) and 10-Gigabit Ethernet (10-GbE) throughput of the E-Series E1200 to determine the capability of the device to scale zero-loss throughput across a large number of users. Engineers measured the zero-loss throughput using various-sized packets on an E1200 with both “snake” and full-mesh configurations. Throughput tests were conducted while the E1200 was handling over one million access control lists (ACLs). Engineers also demonstrated zero packet loss hitless failover of key system components such as the Route Processor Modules (RPM) and Switch Fabric Modules (SFM). Tests were conducted in August 2004.

Tests demonstrate that the E-Series E1200 is capable of offering zero-loss line-rate

### Test Highlights

- Achieves 100% of line-rate zero-loss throughput when tested across 672 Gigabit Ethernet ports, equating to over 1.34 Terabits per second throughput, processing traffic at 1 billion 64-byte packets per second (pps)
- Supports 100% of line-rate zero-loss throughput when tested across 56 10-Gigabit Ethernet ports, equating to over 1 Terabits per second throughput
- Offers 100% of line-rate zero-loss throughput while handling over 1 million Access Control Lists (ACLs) tested across 56 10-Gigabit Ethernet ports
- Sustains 100% of line-rate zero-loss throughput when forwarding IPv6 packets at Gigabit Ethernet and 10-Gigabit Ethernet data rates

**Layer 3 Gigabit Ethernet Line Card Throughput  
 Across 48 Ports in a Full-Mesh Configuration**



Source: The Tolly Group, August 2004

Figure 1

throughput under a variety of Gigabit Ethernet and 10-GbE configurations.

**RESULTS**

**LAYER 2 GBE SCALABLE ZERO-LOSS THROUGHPUT**

Engineers measured the zero-loss Gigabit Ethernet throughput across 672 ports with 64-byte packets. During the test, bidirectional traffic from an Ixia 1600T traffic generator flowed across 14 48-port Gigabit Ethernet line cards populated in the E1200. The E1200 delivered line-rate bidirectional throughput of 1.34 Tbps and processing 1 billion packets per second.

**LAYER 3 GBE LINE CARD ZERO-LOSS THROUGHPUT**

Engineers measured the zero-loss throughput of a single 48-port GbE line card slotted in the E1200, hammering the switch/router with various packet sizes across a full-mesh port configuration. The Force10 Networks E1200 responded with 100% of line-rate throughput without any packet loss. (See Figure 1.)

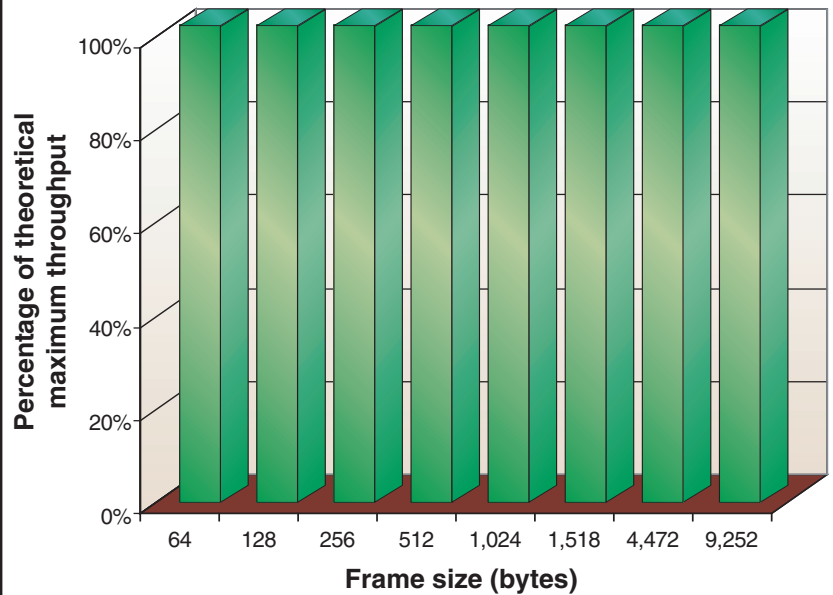
**LAYER 2 10-GbE ZERO-LOSS THROUGHPUT**

Engineers measured the bidirectional zero-loss 10-Gigabit Ethernet throughput across 56 10-GbE ports (14 four-port 10-GbE line cards) with over one million ACLs active. Throughput tests were recorded with various packet sizes transmitted across the device. Results show that the E1200 achieved full-line rate throughput, equating to 1.12 Tbps of bidirectional throughput.

**LAYER 3 10-GbE LINE CARD ZERO-LOSS THROUGHPUT**

Engineers measured the zero-loss throughput of a pair of four-port 10-GbE line cards slotted in the E1200, hammering the switch/router with various packet sizes across a full-mesh port configuration. The E1200 responded

**Layer 2, IPv4, IPv6 10-Gigabit Ethernet Throughput Across Eight 10-GbE Ports in a Full-Mesh Configuration**



Source: The Tolly Group, August 2004

Figure 2

with 100% of line-rate throughput without any packet loss. (See Figure 2.) Engineers also measured the latency introduced by the E1200 during packet processing and recorded low latency of 16 microseconds for a 64-byte packet size and up to 18.3 microseconds for 1,518-byte packets. (See Figure 3.)

**LAYER 3 GIGABIT ETHERNET TO 10-GbE AGGREGATION**

Engineers measured the zero-loss throughput of the E1200 as data was transmitted from 40 GbE ports to four 10-GbE line cards. Engineers recorded

**Two-port Line-rate Bidirectional 10-Gigabit Ethernet Latency and Jitter**

Packet size	Latency (Microseconds)	Jitter (Microseconds)
64	15.99	0.144
128	16.22	0.215
256	16.62	0.178
512	16.9	0.267
1,024	17.78	0.312
1,280	18.3	0.269
1,518	18.32	0.274
4,470	23.9	0.713
8,000	31.08	1.086
9,252	33.48	1.182

Source: The Tolly Group, August 2004

Figure 3

throughput rates by subjecting the E1200 to random packet sizes and millions of data flows. Tests show the E1200 achieved line-rate throughput for all packet sizes tested.

#### NATIVE IPV6 FORWARDING

Engineers measured the zero-loss throughput of the E1200 as data was transmitted in a full-mesh configuration. Tests were conducted on eight 10-GbE ports with packet sizes ranging from 64 bytes to 9,252 bytes; in every instance the E1200 returned line-rate zero-loss throughput.

#### ANALYSIS

Network architects of service provider and large-scale enterprise networks realize that scalability, line-rate performance, and full Layer 2 switching and Layer 3 routing functionality are essential for today's most demanding network applications.

Performance tests show that the E1200 delivers the type of scalable throughput, at full line rate, even when advanced features such as ACLs are turned on. Moreover, the E1200 delivers full line-rate GbE over 672 ports, marking the first time The Tolly Group has benchmarked a Layer 2/Layer 3 switch/router that scales to such heights.

Even the E1200's line cards for both GbE and 10-GbE deliver line-rate performance. The E1200's switch fabric provides a 1.68 Tbps non-blocking switching capacity along with support for advanced queuing, multicast and Jumbo Frames. *(Advanced queuing and multicast support were tested but not part of this report.)*

Force10 Networks E-Series E1200 has many of the features/functions that make it an ideal candidate for a core network switch and an aggregation point for Layer 3 subnets.

#### TEST CONFIGURATION AND METHODOLOGY

For performance tests, The Tolly Group tested a Force10 Networks Inc. E-Series

E1200 Resilient Switch/Router Software Version 4.4.2.107. According to Force10 Networks this Beta release was replaced by Version 6.1.1.0.

For the GbE throughput scalability test, engineers configured two GbE ports for the Optixia test tool and configured 14 48-port 10-GbE cards for the E1200. Engineers configured the test suite for "snake" traffic (that is, data exiting on a given port was redirected into an adjacent port) and configured the test suite to transmit traffic at 64 bytes. During the grueling "snake test" a single packet was amplified 672 times as it traversed every single interface in the E1200 chassis.

For the 10-GbE throughput test, engineers configured a pair of 10-GbE ports for the IXIA 1600T chassis and configured 14 four-port 10-GbE cards for the E1200. Engineers generated over one million ACLs and configured the test suite for "snake" traffic. Engineers also configured the test suite to transmit traffic at 64, 128, 256, 512, 1,024, 1,518 and 9,252 bytes. Engineers ran the test for 60 seconds and recorded the throughput; tests were run three times and the results averaged.

For the 48-port GbE line card throughput test, engineers configured 48 GbE ports for the Optixia chassis and configured a 48-port GbE card for the E1200. Engineers configured the test suite for bidirectional full-mesh traffic and configured the test suite to transmit traffic at 64, 128, 256, 512, 1,024, 1,518, 4,472 and 9,252 bytes. Engineers ran the RFC2544 test for 60 seconds and recorded the throughput; tests were run three times and the results averaged.

For the eight-port (2x4-port) 10-GbE line card throughput test, engineers configured eight 10-GbE ports for the IXIA 1600T chassis and configured 2 four-port 10-GbE cards for the E1200. Engineers configured the test suite for bidirectional full-mesh traffic and configured the test suite to transmit traffic at 64, 128, 256, 512, 1,024, 1,518, 4,472 and 9,252 bytes. Engineers ran the test for 60 seconds and recorded the throughput; tests were run three times and the results averaged.

**Force10 Networks,  
Inc.**

**TeraScale  
E-Series E1200**

**Throughput and  
Functionality Evaluation**



**Force10 Networks, Inc.  
E-Series E1200  
Product Specifications\***

#### Resilient architecture

- Distributed control plane with separate processors and memory for Layer 2 switching, Layer 3 routing and system management
- Robust Force10 FTOS™ modular software delivers full functionality Layer 2 switching and Layer 3 routing while also supporting zero packet loss hitless restarts and software upgrades
- Redundant route processor modules (RPMs), switch fabric modules (SFMs) and power supplies
- Zero packet loss hitless failover of all components for non-stop applications
- Live insertion/removal of interface cards
- Virtual Router Redundancy Protocol (VRRP)

#### Scalable performance and port density

- Up to 672 Gigabit Ethernet line rate ports or 56 10-Gigabit Ethernet line rate ports per chassis
- Innovative Force10 ASICs deliver non-blocking, line-rate forwarding throughput of 1 billion packets per second with access control lists (ACLs) and QoS enabled for all packet sizes from 64 byte to 9,252 byte frames
- Large packet buffers on ingress 10 GbE LAN and WAN ports capable of buffering from 55 to 200 milliseconds of line-rate traffic
- Patented 5 Tbps fully passive copper backplane enables seamless migration to 100 Gigabit Ethernet without a forklift upgrade
- Dual-stack IPv4/IPv6 support with hardware-based forwarding

#### Embedded Security

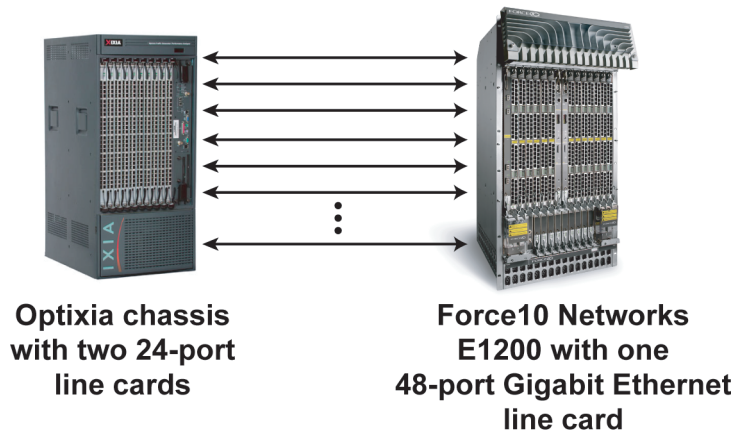
- Denial-of-Service protection through filtering and rate limiting control traffic
- Up to 1.4 million ACLs per system with real time insertion capability without creating a security issue
- RADIUS/TACACS+ for strong authentication, authorization and accounting
- Authentication and encryption of data transfers to and from the switch/router

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*\*Vendor-supplied information not verified by The Tolly Group*

### Layer 3 Gigabit Ethernet Line Card Throughput Test Bed



Source: The Tolly Group, August 2004

Figure 4

For the Gigabit Ethernet to 10-GbE aggregation test, engineers configured 40 GbE and four 10-GbE ports on the IXIA 1600T chassis. Engineers also configured one GbE card and one 10-GbE card on the E1200. Engineers configured the test suite for bidirectional partial-mesh traffic and configured the test suite to transmit random frame sizes from 64 byte to 9,252 byte frames. Engineers ran the test for 60 seconds and recorded the throughput; tests were run three times and the results averaged.

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

Vendor	Product	Web address
Ixia	IXIA 1600T	<a href="http://www.ixiacom.com">http://www.ixiacom.com</a>
Ixia	IxChariot Console 5.1	<a href="http://www.ixiacom.com">http://www.ixiacom.com</a>
Ixia	IxExplorer 3.70.24.46.SP3A	<a href="http://www.ixiacom.com">http://www.ixiacom.com</a>
Ixia	Performance Endpoint 5.1	<a href="http://www.ixiacom.com">http://www.ixiacom.com</a>
Ixia	IxScriptMate 4.10.5.9	<a href="http://www.ixiacom.com">http://www.ixiacom.com</a>
Ixia	Optixia	<a href="http://www.ixiacom.com">http://www.ixiacom.com</a>



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## PROJECT PROFILE

**Sponsor:** Force10 Networks, Inc.

**Document number:** 204147

**Product class:** Carrier-class switch/router

**Products under test:**

- TeraScale E-Series E1200 Resilient Switch/Router

**Testing window:** August 2004

**Software version tested:**

- Version 4.4.2.107 (Ver. 6.1.1.0 now shipping)

**Software status:**

- Beta release

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