Extreme Networks, Inc.

BlackDiamond 10808

Network Resiliency and High Availability

1989 - 2004 **15** Years TOLLY

Test Summary

Premise: Next-generation networks and core switches in particular are required to support a large and continually growing number of edge devices and mission-critical applications. Users require a network infrastructure that is reliable, resilient, and one that provides the highest network availability and uptime.

Extreme Networks, Inc. commissioned The Tolly Group to evaluate its BlackDiamond 10808, a scalable chassis-based switch outfitted with Gigabit Ethernet and 10-Gigabit Ethernet blades and designed to serve in the network core of service provider and enterprise-class networks.

The Tolly Group tested the Black-Diamond 10808 (hereafter Black-Diamond 10K) to determine the device's resiliency to induced failures, as well as its stability in delivering toll-quality VoIP traffic even under the duress of induced failures or excessive processing loads. Additionally, engineers certified more than 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 BlackDiamond 10K's built-in resiliency capabilities enable the device to rebound from induced failures in just milliseconds, and in some cases with zero measurable impact. Tests also show that the Black-Diamond 10K carries VoIP traffic, even under conditions of duress, while still

Test Highlights

❍ Demonstrates network scalability, resiliency, security and extensibility to meet the demands of next-generation core networks

❍ Delivers toll-quality VoIP call performance under various induced system and network outages, even under the most resource-intensive control task operations

❍ Demonstrates non-stop operation and VoIP traffic delivery even during Denial of Service attacks while provisioning 30,000 ACL rules, or while processing one million BGP routes

❍ Achieves hitless failover of system components, including management and switch fabric modules, power management modules, fan trays and network-level protocols
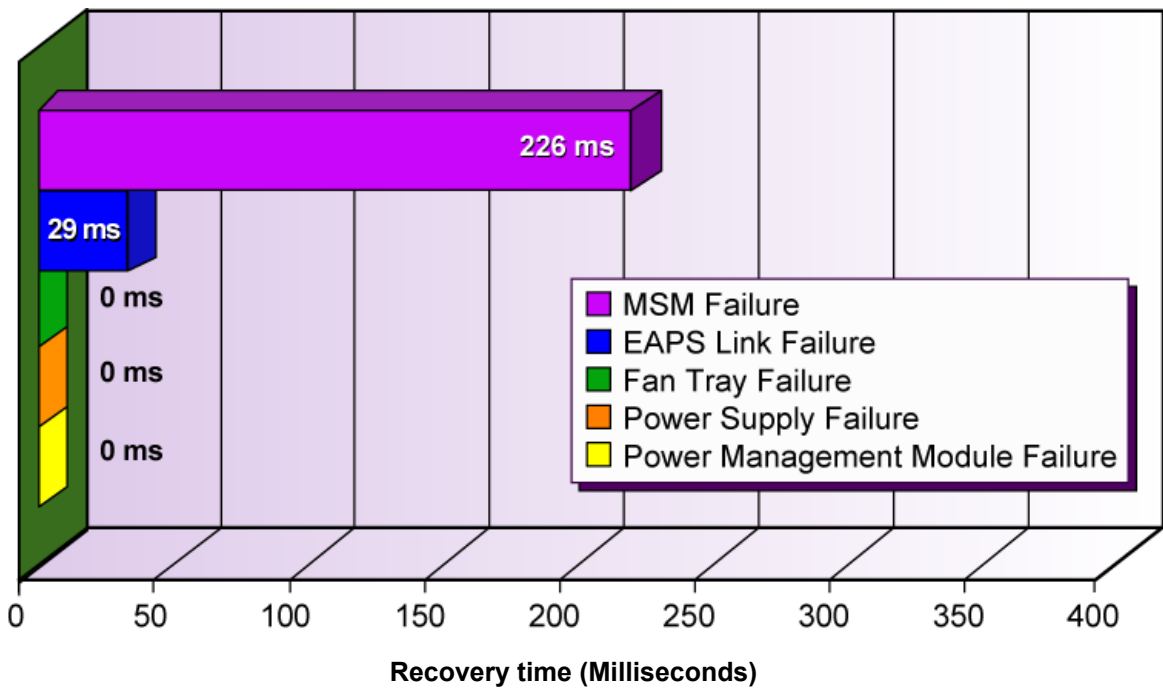
Maintained VoIP Quality (PSQM) During Induced Failures
(Lower is Better Quality)
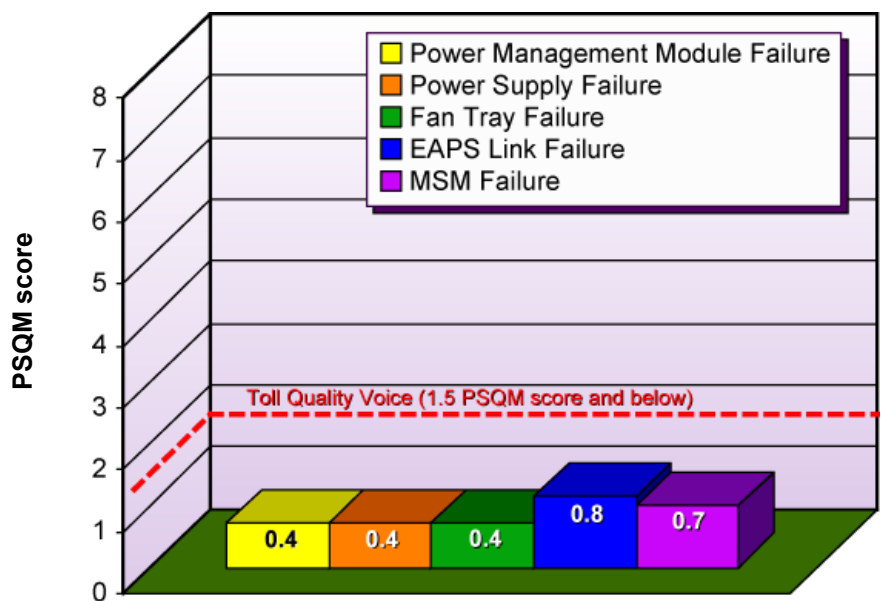
Source: The Tolly Group, March 2004

Figure 1

Network Recovery Time
from Induced Failures

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

maintaining 'excellent' toll quality. Tolly Verified tests, detailed below, illustrated substantial capabilities in the areas of QoS, security, and user management/system management.

Results

VoIP Quality during Induced Failures

Tolly Group engineers subjected the BlackDiamond 10K to five induced failures and recorded the impact of those events on the toll quality of VoIP traffic traversing the switch. Engineers subjected the Black-Diamond 10K to the following induced failures: Power supply hotswap, power module hotswap, fan tray hotswap, management and switch fabric module hotswap, and an Ethernet Automatic Protection Switching (EAPS) ring link failure.

Engineers used the Perceptual Speech Quality Measurement (PSQM) metric, as implemented by Spirent, to benchmark VoIP quality scores; PSQM measures the distortion of speech signals, while also taking into account human speech perception. PSQM uses a rating system of 0 to 6.5, whereby a score of 1.5 or lower represents toll quality. In every induced failure scenario, the BlackDiamond 10K responded by delivering excellent quality VoIP. (See Figure 1.) In three of the scenarios – Power supply hotswap, power module hotswap and fan tray hotswap the PSQM score was 0.4, equating to excellent toll quality by a wide margin.

VoIP Quality during Resource-Intensive Operations

Another area of concern when evaluating core network devices

is the effect of resource-intensive CPU control plane tasks or memory-related operations that may have an impact on overall system performance. Engineers subjected the BlackDiamond 10K to four resource-intensive events designed to tax the switch processor and determine what impact, if any, would be passed on to VoIP traffic traversing the switch.

The four resource-intensive events were: processing of 30,000 Access Control List entries, processing of one million BGP routes, a SYN Flood denial of service (DoS) attack and a Ping Flood DoS attack. In each instance, the average PSQM score was 0.4, equating to excellent toll quality.

Recovery Time during System and Network Failures

Engineers measured the reconvergence time for the switch function to rebound from an induced failure. In the case of the power supply hotswap, power module hotswap and fan tray hotswap the reconvergence time was 0 seconds. For the management and switch module hotswap, reconvergence consumed 225.7 milliseconds and for the EAPS ring link failure, reconvergence took 28.6 ms. (See Figure 2.)

Tolly Verified Certifications

More than 30 certifications were awarded to the BlackDiamond 10K during this test together with at least 10 "firsts," including SONET-Class Protection Ring, as well several related to In-service Operation and DoS attack resistance. (*This was the first time any device had been awarded these Tolly Verified certifications*.) Figures 3 and 4 list the specific certifications for which additional information is available on the Web.

Analysis

Users require a network infrastructure that is reliable, resilient, and one that provides the highest network availability and uptime. Whether these services are implemented within an Enterprise network or within a Service Provider network, core switches

must be available regardless of system or link failures, security breaches, virus outbreaks, system or software maintenance, and day-to-day operational configuration events. As core networks scale to 10-Gigabit Ethernet and carry massive amounts of data, network outages become more costly to businesses.

Extreme Networks, Inc.

BlackDiamond 10808

Network Resiliency and High Availability

Extreme Networks Inc.
BlackDiamond 10808
Product Specifications*

BlackDiamond 10K Series Switch

Industry-leading port capacity:
- 48 ports of 10-Gigabit Ethernet
- 480 ports of 1000BASE-X (SFP)
- 480 ports of 10/100/1000
- Future support for the emerging 40- and 100-Gigabit Ethernet standards

Features:
4th Generation ASICs (4GNSS)
- Industry's first programmable ASIC set
- Hardware support for:
  - Longest Prefix Match (LPM) Routing
  - MPLS: Layer 2 VPNs (Martini and Lasserre), Layer 3 VPNs (RFC 2547)
  - IPv6 (including 6-to-4 and other tunneling mechanisms)
  - GRE
  - NAT
  - Virtual Switching/Virtual Routing
  - CLEAR-Flow:
    - ❖ Adaptive statistics and control for enhanced security, network baselining, etc.

Resiliency:
- Redundant Control, Switching, PSUs
- Hitless failover and hitless upgrades
- Self-healing ECC memory throughout the system
- Advanced Power Management

Security:
- Up to 128,000 ACLs
- Denial of Service (DoS) attack protection
- Centralized management of administrator rights via RADIUS and TACACS+

Scalability:
- Up to 1,200,000 IPv4 / IPv6 routes
- Up to 256,000 LPM forwarding entries
- Up to 256,000 MAC addresses
- Up to 128,000 ingress and egress ACLs
- Symmetric Multi-Processing (SMP) control plane

Extensibility:
- Hardware line-rate support for IPv4, IPv6, MPLS, NAT, and GRE tunneling

- T-Flex ASIC programmability:
  - Programmable packet parser supporting multiple lookups on each packet to decode tunneled and encapsulated traffic
  - Programmable packet editor, enabling line-rate packet translation and/or reformatting, including stacked encapsulations
  - CLEAR-Flow programmable statistics
- ExtremeWare XOS software:
  - Fully modular, self-healing operating system
  - Extensible support for TCL scripting and XML APIs
  - Native virtual routing and virtual switching support

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Vendor-supplied information not verified by The Tolly Group

Tolly Verified Certifications Earned

Certification ID	Certification	Category
10501	Voice Capable Infrastructure (QoS)	LAN Switch Core
10503	Jumbo Frames Support - 9K	LAN Switch Core
10507	Rapid Reconfiguration Spanning Tree Support (802.1w)	LAN Switch Core
10511	Link Aggregation (IEEE 802.3ad)	LAN Switch Core
10513	10/100/1000 Auto Negotiation	LAN Connectivity
10514	Auto MDI/MDIX	LAN Switch Core
10515	Port Mirroring	LAN Switch Core
10516	Redundant Power Supply	High-Availability Core
10529	Access Control List (ACL) Functionality Bound to Specified VLAN	LAN Switch Core
10532	VLAN Feature Verification (802.1Q)	LAN Switch Core
10533	Quality-of-Service Feature Verification	LAN Switch Core
10534	Rate Limiting Per Port	LAN Switch Core
10564	Virtual Router Redundancy Protocol (VRRP)	LAN Switch Core
10568	Redundant Fabric Module	LAN Switch - High-Availability
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
10587	QoS – Eight Traffic Queues	LAN Switch Core
10594	Redundant Power Supply – Hot Swappable	High-Availability Core (Product-type Independent)
10595	Hot-Swappable Fan	High-Availability Core (Product-type Independent)
10717	Redundant Power Management Module	High-Availability Core (Product-type Independent)
10718	Redundant System Management Module	High-Availability Core (Product-type Independent)
10719	Dynamic, Variable-Speed Fan	High-Availability Core (Product-type Independent)
10739	"SONET-class" Protection Ring	LAN Switch – High Availability
10740	Zero-impact "In-service" ACL Update	LAN Switch – High Availability
10741	Zero-impact "In-service" BGP Route Update	LAN Switch – High Availability
10742	Zero-impact "Resistance" to DoS Attack: SYN Flood	LAN Switch – High Availability
10743	Zero-impact "Resistance" to DoS Attack: PING Flood	LAN Switch – High Availability
10744	Link Aggregation (IEEE 802.3ad) – Cross Blade	LAN Switch – High Availability
10745	Port Mirroring – Cross Blade	LAN Switch Core

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

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

Understanding the effects of various critical network outages is essential to deploying high-performance networked applications and services such as VoIP. The cause for such events can be network failures, route flaps, configuration of new features and services, or device misconfiguration. In addi-

tion, network security threats such as virus/worm propagation, network reconnaissance scans, and Denial of Service attacks can also negatively impact network performance and availability.

Tests of the BlackDiamond 10K, while handling sensitive VoIP

traffic, show that call-quality remains in the 'excellent' range even when the switch is subjected to a variety of induced outages. This means that network managers can confidently deploy toll-quality VoIP services with non-stop operation regardless of network failures, system component

Tolly Verified Certifications Earned for System Security and User Management	
Certification ID	**Certification**
10502	Non-Destructive Code Upgrade
10518	Dual Firmware Images
10519	Dual Configuration Images
10535	Management Access Authentication via IP Access Control Lists
10536	Management Access Authentication via RADIUS
10555	System Upgrade via Trivial File Transfer Program

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

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

failures, or field maintenance replacements.

The BlackDiamond 10K allows for in-service maintenance without single points of failure as demonstrated by hot-swappable Management and Switch Fabric Modules, Power Management Modules, Power Supplies and Fan trays. Failure or replacement of these components does not result in costly outages and it will not impact network performance. Additional system enhancements such as error-correction code memory and symmetric multi-processing also improve the Black-Diamond 10K's ability to handle unforeseen problems without impacting the network.

Advanced resiliency features are also built into the BlackDiamond's modular ExtremeWare XOS operating system, such as hitless software upgrades, and memory protection of individual application tasks. Extreme Networks' Ethernet

Automatic Protection Switching (EAPS) provides loop prevention and sub-50 ms convergence times. These features allow network managers to guarantee network uptime for both planned operational events and unexpected events such as system or link failures.

Test Configuration and Methodology

The Tolly Group tested an Extreme Networks BlackDiamond 10808, outfitted with a G60T module, G60X module, one 10G6X module and a pair of MSM1-XL Management and Switching Fabric Modules. The BlackDiamond 10K was running ExtremeWare XOS version 10.2.0.4 BETA.

Engineers built a test network to simulate various network and system outages. The test network consisted of two BlackDiamond 10K switches that were attached via 10-Gigabit Ethernet trunk

ports. (See Figure 5.) Each switch was connected to an Ixia Communications 1600T chassis for traffic generation.

For the VoIP Call Quality during Induced Failures test, engineers used the Spirent SmartBits 6000B test tool to transmit simulated VoIP traffic and attain a PSQM VoIP quality score.

The test network consisted of two BlackDiamond 10K switches that were attached via 10-Gigabit Ethernet trunk ports. Engineers attached 30 Gigabit Ethernet test ports to each BlackDiamond 10K. Each SmartBits test port simulated 100 VoIP sessions to another SmartBits test port that was attached to the second Black-Diamond 10K switch. Consequently, engineers simulated 3,000 unique VoIP sessions and measured the average VoIP quality for each induced failure condition.

For the Recovery Time during System and Network Failure test, engineers generated bidirectional IP traffic across the test network at a constant rate and then calculated the network recovery time based on the amount of packet loss during the induced network failures.
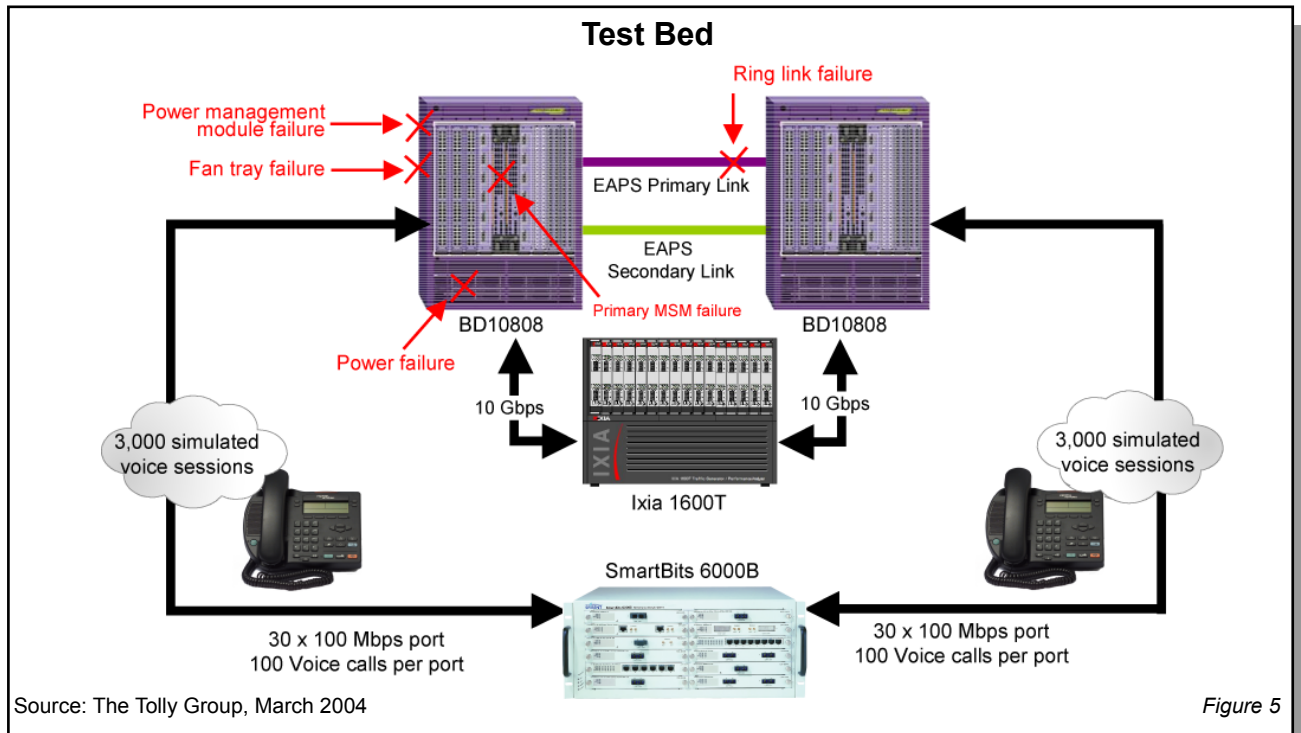
PERFORMANCE VERIFIED
By IXIA

TESTED with **SPIRENT**

Test Bed

Source: The Tolly Group, March 2004

Figure 5

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

Vendor	Product	Web address
IXIA Communications	Ixia 1600T	http://www.ixiacom.com
Spirent Communications	SmartBits 6000B	http://www.spirentcom.com
Spirent Communications	SmartVoIPQoS 1.13.003	http://www.spirentcom.com

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For info on the Fair Testing Charter, visit:
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Project Profile

Sponsor: Extreme Networks, Inc.

Document number: 204124

Product class: 10-Gigabit Ethernet Switch

Products under test:

- Extreme Networks BlackDiamond 10808

Testing window: March 2004

Software versions tested:

- ExtremeWare XOS 10.2.0.4 BETA

Software status: Generally available

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